

Transparency

Transmission of Visible Light

Transparency (or transmission of visible light) is characterized by light transmittance, i.e. the measured percentage of incident light transmitted through a standardized plastic specimen.

The higher the transmittance %, the higher the transparency

Transparency has no specific unit. Transmittance value is generally reported in the percentage of light transmitted.

The transparency or translucency of plastics depends on the type and structure of the polymer/crystallinity and types of additives, fillers, colors, etc. used.

- Generally, amorphous plastics are transparent – e.g. **acrylics, PC,** and **PS, ABS, PEI,** etc.
- Semi-crystalline or crystalline polymers are translucent or opaque as there are differences in refractive indices between the crystalline regions and amorphous regions – e.g. **PE, PP, PBT, PET, nylon**

Although PET and PP are crystalline, films of these materials are transparent (this because these films are bi-axially oriented – stretched in two directions – which orientates the polymer molecules in the plane of the film. Hence, when light passes through the film, there is no refraction because of this orientation)

View All Commercially Available Polymer Grades with Good Transparency

Check out more on Transparency:

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Factors Affecting the Transparency of Polymer

As the percentage crystallinity increases the polymer becomes progressively less clear due to the increase in **density** (which in turn decreases the speed of light passing through it). However, the clarity of crystalline plastics can be improved by quenching or random polymerization.

Further, the transparency of polymers (e.g. PP) can be considerably improved by using additives that act upon the growth and size of the crystal structure. These additives are known as nucleators and clarifiers.

Transmittance of light is also dependent on thickness – hence **many polymers transmit light** as thin films. Among thermosets such as unsaturated polyester, reinforcements interfere in transmittance.

Any chemical change in polymer-like degradation or oxidation or diffusion may impact transparency. The appearance of scratches or surface flaws as a result of exposure impact light transmittance.

Apart from the factors mentioned above, steps such as coloration, heat treatment, and mechanical processing during production can affect optical properties.

A material with good transparency will have high transmittance and low haze

Haze is measured as the percentage of incident light scattered by more than 2.5° through the plastic specimen.

Common Standard to Measure Transparency

How easily light can penetrate a substance is usually determined by **ASTM D1003** - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.

This test method covers the evaluation of specific light-transmitting and wide-angle-light-scattering properties of planar sections of materials such as essentially transparent plastic. Two procedures are provided for the measurement of luminous transmittance and haze.

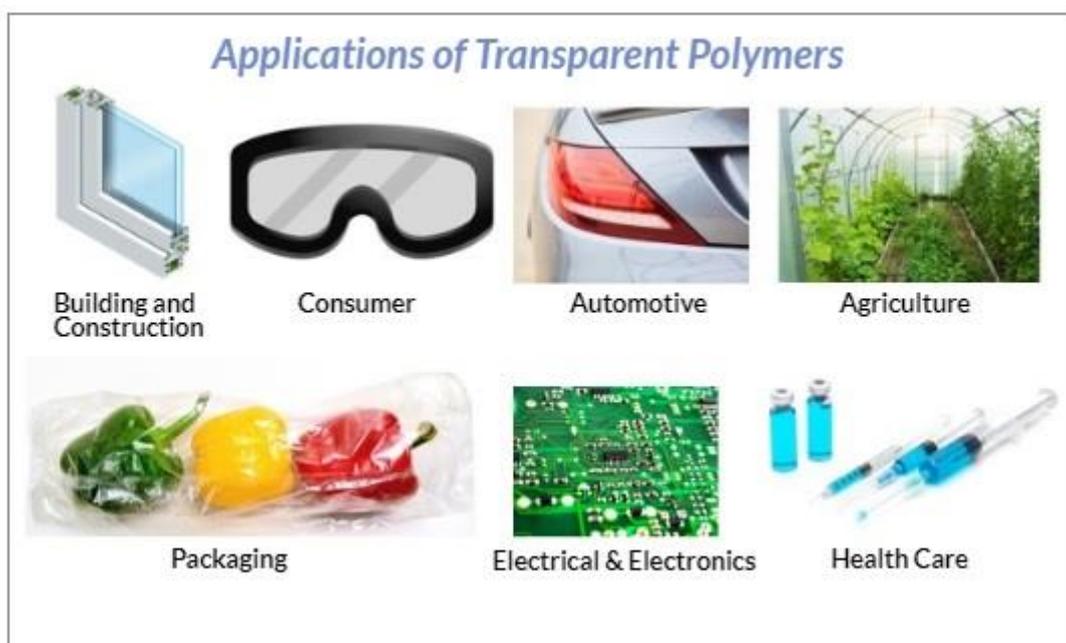
- Procedure A uses a hazemeter, and
- Procedure B uses a spectrophotometer

Material having a haze value greater than 30% is considered diffusing and should be tested in accordance with Practice **E2387**.

Haze and luminous-transmittance data are especially useful for quality control and specification purposes.

Applications of Transparent Polymers

Some of the successful applications of transparent include automotive taillight lenses, safety glasses, window glazing, display cases, food packaging films, agriculture greenhouses, optical instruments, etc. Since plastics have superior impact resistance than glass, transparent plastics such as polycarbonate, PMMA, etc. have replaced glass in many other applications.



Light Transmittance Percentage Values of Several Plastics

| Polymer Name | Min Value (%) | Max Value (%) |
|-------------------------------------------------------------------|---------------|---------------|
| Amorphous TPI, Moderate Heat, Transparent | 58.0 | 58.0 |
| Amorphous TPI, Moderate Heat, Transparent (Food Contact Approved) | 58.0 | 58.0 |
| Amorphous TPI, Moderate Heat, Transparent (Powder form) | 58.0 | 58.0 |

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|-------------------------------------------------------------------|-------|-------|
| ASA - Acrylonitrile Styrene Acrylate | 1.050 | 1.070 |
| ASA/PC Blend - Acrylonitrile Styrene Acrylate/Polycarbonate Blend | 1.150 | 1.150 |
| CA - Cellulose Acetate | 90.00 | 90.00 |
| CAB - Cellulose Acetate Butyrate | 90.00 | 90.00 |
| Cellulose Diacetate-Gloss Film | 92.70 | 92.70 |
| Cellulose Diacetate-Integuard Films | 90.26 | 90.26 |
| Cellulose Diacetate-Matt Film | 16.80 | 16.80 |
| Cellulose Diacetate-High Slip Film | 92.70 | 92.70 |
| Cellulose Diacetate-Semitone Films | 54.00 | 54.00 |
| CP - Cellulose Propionate | 90.00 | 90.00 |
| COC - Cyclic Olefin Copolymer | 91.00 | 91.00 |
| ETFE - Ethylene Tetrafluoroethylene | 95.00 | 95.00 |
| EVA - Ethylene Vinyl Acetate | 80.00 | 80.00 |
| FEP - Fluorinated Ethylene Propylene | 96.00 | 96.00 |
| HDPE - High Density Polyethylene | 80.00 | 80.00 |
| LDPE - Low Density Polyethylene | 80.00 | 80.00 |
| MABS - Transparent Acrylonitrile Butadiene Styrene | 88.00 | 88.00 |
| PA 11 - (Polyamide 11) 30% Glass fiber reinforced | 80.00 | 80.00 |
| PA 11, Conductive | 80.00 | 80.00 |
| PA 11, Flexible | 80.00 | 80.00 |
| PA 11, Rigid | 80.00 | 80.00 |
| PA 12, Flexible | 80.00 | 80.00 |
| PA 12, Rigid | 80.00 | 80.00 |
| Polyamide semi-aromatic | 80.00 | 80.00 |

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|--------------------------------------------------------|-------|-------|
| PC (Polycarbonate) 20-40% Glass Fiber Flame Retardant | 80.00 | 80.00 |
| PC - Polycarbonate, high heat | 88.00 | 89.00 |
| PET - Polyethylene Terephthalate | 70.00 | 90.00 |
| PETG - Polyethylene Terephthalate Glycol | 88.00 | 91.0 |
| PFA - Perfluoroalkoxy | 93.00 | 93.00 |
| PMMA - Polymethylmethacrylate/Acrylic | 80.00 | 93.00 |
| PMMA (Acrylic) High Heat | 80.00 | 93.00 |
| PMMA (Acrylic) Impact Modified | 80.00 | 92.00 |
| PP (Polypropylene) Copolymer | 85.00 | 90.00 |
| PP (Polypropylene) Homopolymer | 85.00 | 90.00 |
| PP Homopolymer, Long Glass Fiber, 30% Filler by Weight | 1.100 | 1.100 |
| PP Homopolymer, Long Glass Fiber, 40% Filler by Weight | 1.200 | 1.200 |
| PP Homopolymer, Long Glass Fiber, 50% Filler by Weight | 1.300 | 1.300 |
| PP, Impact Modified | 0.880 | 0.910 |
| PPA - Polyphthalamide 30% Mineral | 0.00 | 0.00 |
| PPA, 33% Glass Fiber-reinforced | 0.00 | 0.00 |
| PPA, 33% Glass Fiber-reinforced High Flow | 0.00 | 0.00 |
| PPA, 45% Glass Fiber-reinforced | 0.00 | 0.00 |
| PS (Polystyrene) Crystal | 88.00 | 88.00 |
| PS, High Heat | 80.00 | 90.00 |
| PVC, Plasticized | 75.00 | 85.00 |
| PVC, Plasticized Filled | 1.150 | 1.350 |

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|------------------------------------|-------|-------|
| PVC Rigid | 80.00 | 80.00 |
| SAN - Styrene Acrylonitrile | 86.50 | 91.00 |
| SAN, 20% Glass Fiber-reinforced | 1.200 | 1.400 |
| SMA - Styrene Maleic Anhydride | 1.050 | 1.080 |
| SMMA - Styrene Methyl Methacrylate | 80.00 | 91.40 |