

THINK TRANSLUCENT!

ULTRAMID® VISION – THE FIRST SEMI-TRANSPARENT POLYAMIDE



 **BASF**

We create chemistry

VISION

The background features a complex abstract design. It consists of several overlapping circles in various colors: a large green circle at the top, a blue circle at the bottom left, and a red circle at the bottom right. A dark blue circle is also visible in the center. The entire composition is overlaid on a fine, light-colored grid pattern that recedes into the distance, creating a sense of depth and perspective.

Ultramid® Vision

THE FIRST SEMI-TRANSPARENT POLYAMIDE

Thanks to their high chemical resistance and heat resistance, semi-crystalline engineering thermoplastics can be used in very challenging environments. Their semi-crystalline character, however, leads to a high level of light scattering, which means these materials are visually opaque. Imagine if such a highly resistant material is translucent – which components would you design with it?

BASF has now succeeded in developing Ultramid® Vision, the first semi-crystalline polyamide that allows light to pass through largely unhindered. Compared to opaque standard polyamides, Ultramid® Vision shows very high light transmission with low light scattering.

This new polyamide combines the best properties of two material groups:

- the chemical resistance, temperature resistance and easy processing of semi-crystalline, opaque resins with
- the transparency of amorphous polymers,
- at a competitive price level.

Thus, Ultramid® Vision is a cost-efficient material solution for applications in chemically challenging environments which require a high level of light transmission or even transparency.

The free colorability with low-migration colorants makes it possible to achieve luminous color effects that offer a wide range of design options. In addition, the highly light-permeable Ultramid® Vision can be combined with other polyamide materials in a multi-component injection-molding process. This leads to easy production of multifunctional parts with transparent or illuminated sections.

Ultramid® Vision

SEMI-TRANSPARENCY MEETS DURABILITY

The most important product properties

Ultramid® Vision has physical and thermal properties which are largely comparable to those of conventional unreinforced PA6 compounds, but stands apart from these compounds significantly because of its exceptional visual properties.

In addition to the uncolored base grade Ultramid® Vision B3K UN, there is the option of producing specially equipped products featuring diffuse light scattering along with high transmittance (Ultramid® Vision B3K DLT*). Customers can also obtain specially colored products. Alternatively, Ultramid® Vision can be colored with polyamide-based color masterbatches which can be procured from e.g. BASF Color Solutions.

* DLT = diffuse light transmission

Property	Standard	Ultramid® Vision B3K UN dry / cond.	Ultramid® Vision B3K DLT UN dry / cond.
Tensile modulus	ISO 527-1/-2	3.100 / 1.000	3.100 / 980
Notched impact strength	ISO 179/1eA	5 / 35 kJ/m ²	3 / 13 kJ/m ²
Heat distortion temperature (HDT B, 0.45 MPa)	ISO 75-1/-2	170 °C	150 °C
Haze 1 mm	ASTM D 1003	17 %	100 %
Haze 2 mm	ASTM D 1003	35 %	100 %
Transmission 1 mm	ASTM D 1003	82 %	80 %
Transmission 2 mm	ASTM D 1003	70 %	61 %

Fig. 1: Overview of the most important product properties of Ultramid® Vision

Influence of the wall thickness on the haze

The haze value is a parameter indicating the optical cloudiness. For Ultramid® Vision, there is a linear correlation between the haze values and the component thickness. In contrast to this, standard polyamides such as the PA6 injection-molding compound Ultramid® B3S un, show a highly non-linear behavior of the haze value as a function of the wall thickness. With wall thicknesses above 0.5 mm, the haze values of Ultramid® Vision are significantly lower than those of standard polyamides, which are fully opaque with wall thicknesses >1 mm.

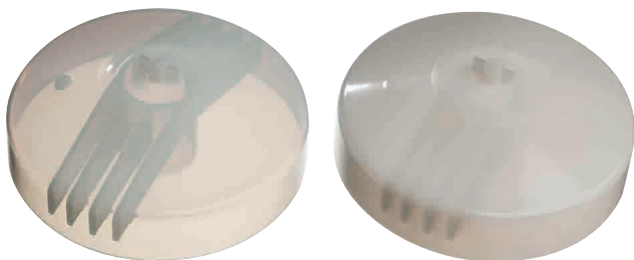


Fig. 2: Comparison of the degree of haze for test components made of Ultramid® Vision (left) and a standard PA6 (right)

Haze vs. Wall Thickness

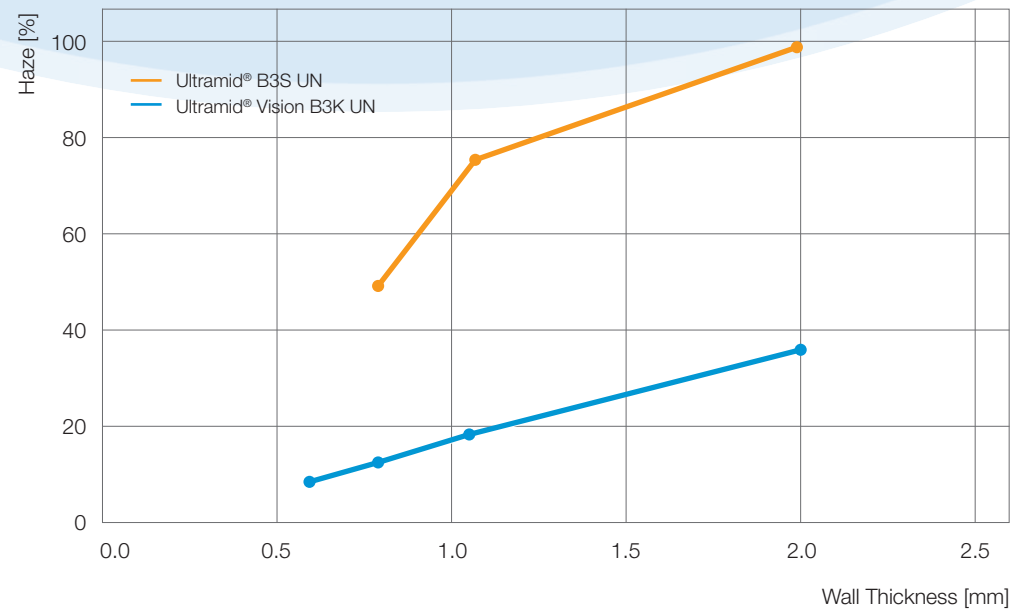


Fig. 3: For Ultramid® Vision there is a linear correlation between the haze values and the component thickness – in contrast to standard polyamides such as Ultramid® B3S UN.

Ultramid® Vision

FOR HIGH-QUALITY VISUAL PROPERTIES UNDER CHALLENGING CONDITIONS

Influence of moisture and temperature on the visual properties

The visual properties of Ultramid® Vision are described by the haze and the light transmission, with the light transmission representing a measure of the quantity of light passing through. Both properties are almost unaffected by environmental influences such as temperature and moisture. Even if components made from Ultramid® Vision are exposed to elevated temperatures and moisture levels, the haze and transmission values hardly change compared to being freshly molded. The haze even declines slightly when there is direct contact with water over a prolonged period of time.

Conditioning	Light transmission	Haze
Freshly molded	73 %	27 %
Stored in oven at 80 °C, 1 h	73 %	28 %
Stored in oven at 80 °C, 24 h	73 %	27 %
Stored in climate chamber at 70 °C, 62 % r. h., 14 days	73 %	28 %
Stored in water at 80 °C, 14 days	73 %	23 %

Fig. 4: Change in the visual properties of Ultramid® Vision under different storage conditions, determined on plaques with a wall thickness of 1.5 mm

UV stability

Ultramid® Vision has outstanding UV resistance and is therefore highly suitable for applications involving direct exposure to sunlight. The UV resistance was examined both for indoor use and under outdoor weathering conditions using conventional accelerated weathering tests. For both exposure types, no noticeable change in the visual properties (color, haze) was observed up to a test duration of 2,000 hours.

Weathering period	0	500 h	1000 h	2000 h
Haze (%)	40	43	41	42
Transmission (%)	69	69	70	69
Yellowness index (YI) as per DIN 6167	4.2	-2.3	-1.3	-1.3

Fig. 5: Artificial accelerated indoor weathering according to ISO 4892-2B on plaques with a wall thickness of 2 mm

Weathering period	0	500 h	1000 h	2000 h
Haze (%)	40	41	39	42
Transmission (%)	69	70	70	70
Yellowness index (YI) as per DIN 6167	4.2	1.4	2.4	2.4

Fig. 6: Artificial accelerated outdoor weathering according to ISO 4892-2A on plaques with a wall thickness of 2 mm

Ultramid® Vision

PROPERTIES THAT ARE PLAIN TO SEE

Chemical resistance

Ultramid® Vision shows excellent chemical resistance. It provides complete stress cracking resistance both to non-polar media such as lipophilic solvents (e.g. cyclohexane), fats and oils, and to solvents of medium polarity (methyl ethyl ketone) and high polarity (isopropanol). In contrast to this, fully transparent amorphous materials show stress cracking or even fracture when exposed to many of these media.

	Ultramid® Vision	Transparent PA12 copolymer	Polyether sulfone	Polycarbonate	Copolyester	SAN
Sun screen	✓	✓	✓	Fracture	Large cracks	Fracture
Cyclohexane	✓	Fine cracks	✓	Large cracks	Large cracks	Large cracks
Methyl ethyl keton	✓	Fine cracks	Fracture	Clouding (Fracture after 24h)	Fracture	Fracture
Isopropanol	✓	✓	Large cracks	Large cracks	Large cracks	Large cracks

Fig. 7: Storage of different material samples at room temperature for 1h in different media with 2% outer fiber strain

Scratch resistance

Ultramid® Vision shows good scratch resistance. In a needle scratch test according to DIN EN ISO 1518-1, the sample surface was not scratched when applying a test force of up to 3.5 N.

Material	Visual assessment	Profile depth
Ultramid® Vision	No scratch mark ✓	-
Transparent PA12 copolymer	No scratch mark ✓	-
Polyether sulfone	Visible scratch mark	approx. 0.25 µm
Polycarbonate	Highly visible scratch mark	approx. 1 µm
Copolyester	Barely visible scratch mark	approx. 0.2 µm
SAN	Highly visible scratch mark	approx. 0.3 µm
Polypropylene with clarifier	Highly visible scratch mark	approx. 0.5 µm

Fig. 8: Scratch resistance of different material samples acc. to DIN EN ISO 1518-1 (stylus A, 3.5 N test force, 35 mm/s)

Flame retardancy

Due to the intrinsically flame-retardant properties of polyamides, Ultramid® Vision is an interesting option for electrical and electronics applications where flame retardancy is required.

Test	0.75 mm	1.5 mm	3 mm
HWI	PLC-0	PLC-0	PLC-3
UL94	HB	HB	V-2
GWFI	960	960	960
GWIT	900	850	750

Fig. 9: Values for Ultramid® Vision in selected flame retardancy and glow wire tests

Ultramid® Vision DLT

DIFFUSE LIGHT SCATTERING WITH HIGH TRANSMISSION

While retaining its high light transmission rate, Ultramid® Vision can be modified in such a way that light is scattered homogeneously (DLT - diffuse light transmission). Thus, Ultramid® Vision B3K DLT enables additional application fields, for example back-lit switches and buttons or diffusely scattering light covers in chemically challenging environments, e.g. in direct contact with aggressive media such as sunscreen, cleaning agents, and solvents.

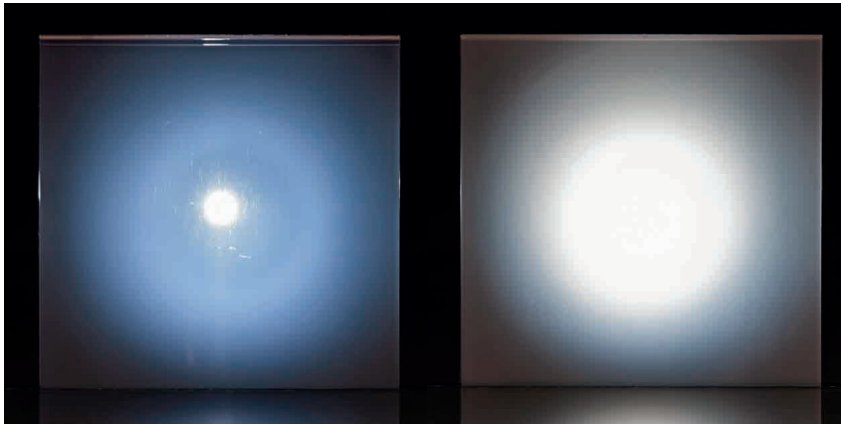


Fig. 10: Visual properties of Ultramid® Vision without (left) and with (right) light diffusion feature (DLT)

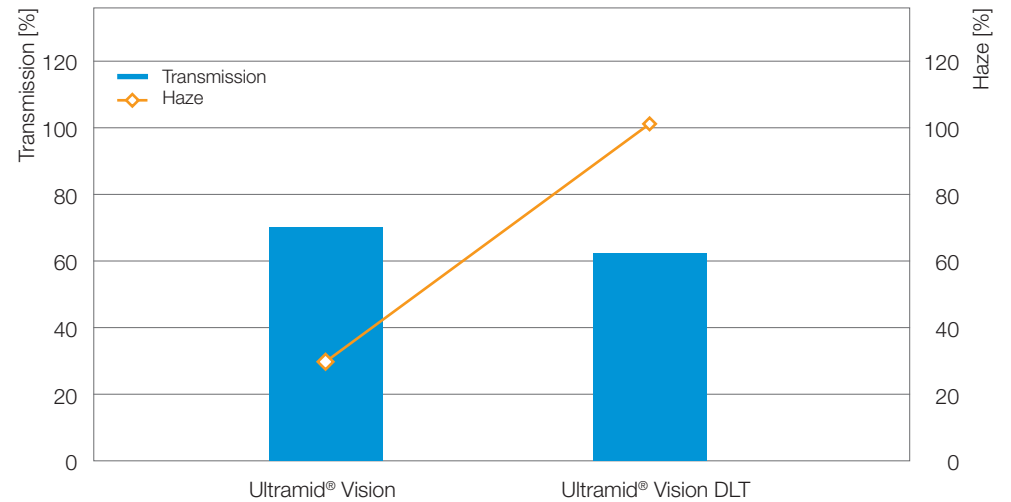


Fig. 11: Visual properties of Ultramid® Vision without and with light diffusion feature (DLT), measured with a 2 mm plaque

The outstanding scattering properties of Ultramid® Vision DLT are reflected in the angle-dependent transmission values, which also depend on the material thickness. The half-value angle – means the angle under which 50 % of transmittance is measured against the normal direction – is at an angle of 46° for a wall thickness of 2 mm. This allows very homogeneous scattering of point-shaped light sources such as LED spots.

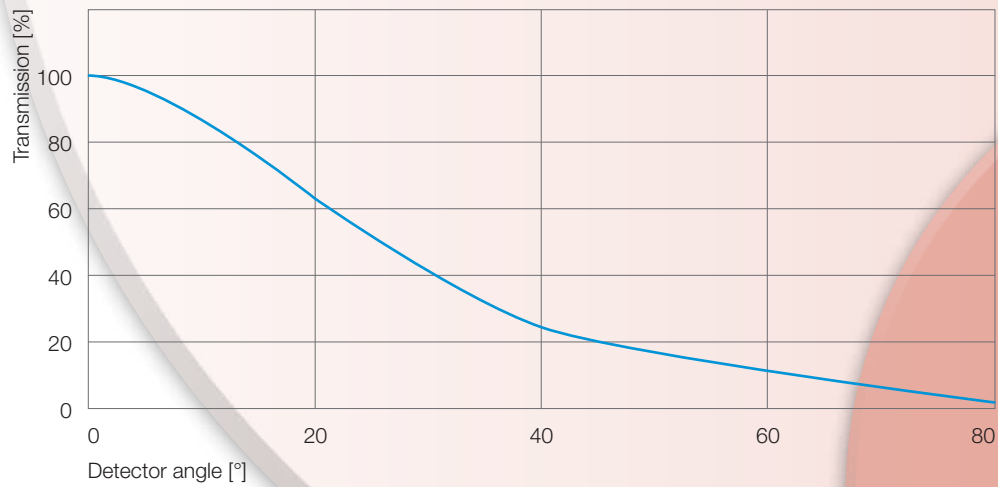


Fig. 12: Angle-dependent transmission of Ultramid® Vision B3K DLT, 1 mm

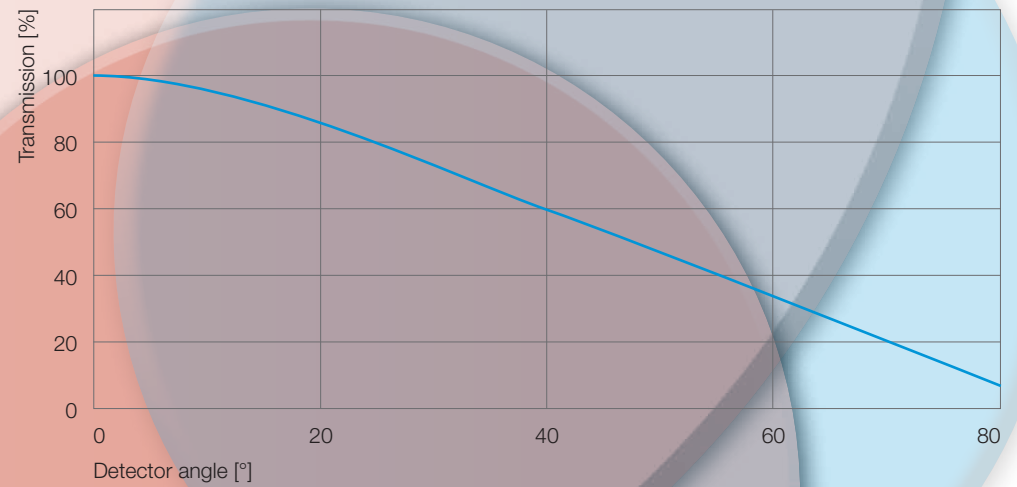


Fig. 13: Angle-dependent transmission of Ultramid® Vision B3K DLT, 2 mm

Ultramid® Vision

POTENTIAL APPLICATIONS

Ultramid® Vision can be employed for manufacturing components in various industries. The use is recommended if one of the following functions has to be fulfilled:

- visual check
- visually attractive light design
- illumination

Visual check

The use of Ultramid® Vision is especially advantageous for applications requiring a visual check, e.g. to recognize a control lamp, or for transparent components which allow the review of a critical assembly step, while at the same time demanding high standards of chemical and thermal resistance.

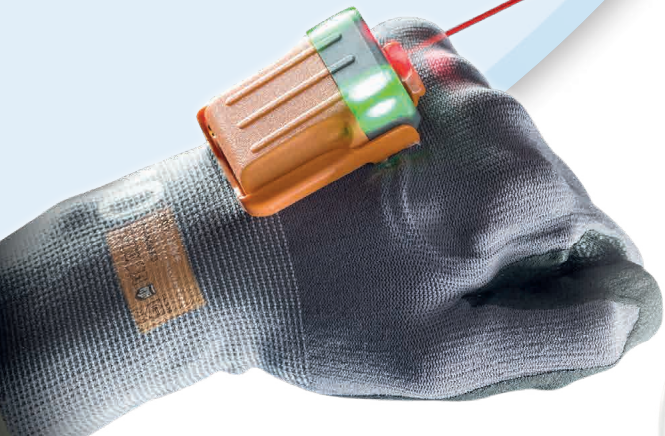


Fig. 14:
Scanner glove

Design

The virtually unlimited scope for coloring Ultramid® Vision with low-migration and lightfast colorants, coupled with the high light transmittance and long-term stability, makes the material an obvious choice for creating design objects or design features. Particularly in combination with lighting elements, visually attractive effects can be achieved.



Fig. 15: Components made of Ultramid® Vision can be colored with low-migration and lightfast colorants.

Illumination

Because of its high transmission rate and the largely wavelength-independent light transmission, Ultramid® Vision can be used for back-lit elements such as switches or operating displays. Ultramid® Vision B3K DLT is especially suited for shockproof and chemically resistant light covers with homogeneous light diffusion.

In multi-component injection molding processes, Ultramid® Vision can be readily combined with other polyamide-based materials and allows for excellent 2K adhesion. This enables simple production of multi-functional components with transparent or illuminated areas.

As the material can be repeatedly exposed to aggressive media such as sun cream, cleaning agents and disinfectants without sustaining damage, it is ideally suited for back-lit switches or buttons for car interiors, medical devices as well as in demanding industrial environments.



Fig. 16:
Window regulator module

Ultramid® Vision

ADVICE BEYOND THE MATERIAL

Considering the ever-shorter innovation cycles, efficient cooperation between BASF and its customers is becoming more and more important. In the new BASF Creation Centers, BASF experts can work together with customers to develop ideas in an inspiring workshop atmosphere, find suitable materials, simulations and prototypes. Coupled with first-class technology and latest digitalization tools, innovations can be created quickly, modernly and collaboratively: From inspiration to solution in one place. Depending on the nature of the project, the competencies of BASF, which are required for the respective project, are available to the customer.

designfabrik®: support in every phase of the design process

BASF supports customers closely with product development or material substitution. The designers and engineers of the designfabrik® are available to act as a strategic consulting partner for design-oriented sectors. They can help with questions relating to plastic-optimized design, suitable processing methods and tools, surfaces as well as form and function. In addition, color specialists help to implement color ideas to the exact specification.

Ultrasim®: precise component design

BASF's Ultrasim® simulation tool is used in the design of components from all industries. As well as accurately predicting the component behavior as a function of manufacturing parameters and the load direction or load speed, mathematical component optimization makes it possible to identify the best possible design. Ultrasim® is thus a unique instrument which allows customer components to be optimized to suit the load situation at a very early stage. Thanks to the accurate predictions, costs and time associated with prototypes or extensive corrections to molds can be avoided.

Technical support: from material and component testing to processing

The laboratory for molded compound and material testing can advise customers about materials and tests. The range of advice covers all the mechanical, thermal and electrical properties, but also topics such as weathering or fire behavior. Another important service is offered by the laboratory for component testing and joining technology: With its service packages Ultratest™ and Ultrajoin™, BASF supports customers to develop better plastic parts in a shorter period of time. An experienced team of experts is ready to answer questions on processing and special techniques. A well-equipped processing center is available for research, development and project studies.



**Further information on Ultramid® Vision
can be found on the internet:**
www.ultramid-vision.basf.com

Please visit our websites:
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