

# Apec<sup>®</sup>



**Product range**  
Typical values

# Apec<sup>®</sup>

Apec<sup>®</sup> is the brand name for copoly-carbonates that constitute a further development of Makrolon<sup>®</sup> polycarbonate. Its unique combination of high heat resistance, toughness, transparency, light stability and flowability, its high heat resistance, which can be as high as 203 °C (VST/B 120), makes Apec<sup>®</sup> ideal for molded parts that are subject to such pronounced thermal stressing that general-purpose polycarbonate is no longer adequate.

## Characterization

The Apec® grades are linear, amorphous copolycarbonates (PC-HT), made of BPA, the building block for Makrolon®, and BPTMC, a special polymer constitutional unit. Depending on the ratio in which the two bisphenol components are mixed, products are obtained whose heat resistance increases in proportion to the BPTMC content.

Apec® belongs to the polycarbonate family and is a further development of the standard (BPA) polycarbonate, Makrolon®, with a higher heat resistance.

Apec® is noted for its particularly favorable combination of the following properties:

- High heat resistance
- High toughness
- High transparency
- Good flowability
- High dimension stability

Together with a low-temperature impact strength that is sufficient for many applications, this allows Apec® to be used over a broad range of temperatures from approximately –30 °C to approximately +180 °C.

## Apec® product range

Grade	Vicat softening temperature (°C)	MVR1 (cm <sup>3</sup> /10 min)	UV-stabilized	Easy release
<b>Easy-flowing grades</b>				
1695	158	45		X
1697	157	45	X	X
1795	173	30		X
1797	172	30	X	X
1895	183	18		X
1897	182	18	X	X
2095 <sup>2)</sup>	203	8		X
2097	202	8	X	X
<b>Grades with elevated viscosity</b>				
1603	159	25	X	
1703	171	17	X	
1803	184	10	X	
<b>Medical grade</b>				
1745 <sup>3)7)</sup>	170	17		X
<b>Flame-retardant grades</b>				
DP1-9354 <sup>4)</sup>	185	12		
FR1892 <sup>5)</sup>	183	18		X
<b>Reflective White grade</b>				
RW1697 <sup>6)</sup>	157	45	X	X

<sup>1)</sup> 330 °C/2.16 kg

<sup>2)</sup> Not available in clear transparent color 551022, use alternatively Apec® 2097 551022.

<sup>3)</sup> Suitable for hot steam sterilization, biocompatible according to many test conditions of ISO10993-1 standard, only available in color 551022 (clear transparent).

<sup>4)</sup> Listed V-0/1.5 mm; V-0/3.0 mm; 5 VA/3.0 mm according to UL 94. Only opaque colors available.

<sup>5)</sup> Listed V-0/3.0 mm according to UL 94. Transparent colors possible.

<sup>6)</sup> Light reflection ca. 95 % (color-no. 010226)

<sup>7)</sup> Disclaimer of Warranty (see warranty on page 23)

## Delivery form

Granules, packed in 25-kg PE bags, Big-Bags, large cartons with a PE inliner or delivered in silo trucks. Apec® is available in a large number of transparent and opaque colors.

All Apec® grades are homogenized.

The production plants for Apec® are certified to ISO 9001.

## Designation of Sales Products

The designation of Apec® sales products is based on a 4-digit, self-explanatory nomenclature.

The first two digits denote the heat resistance.

- 16..** Vicat approx. 160 °C
- 17..** Vicat approx. 170 °C
- 18..** Vicat approx. 185 °C
- 20..** Vicat approx. 203 °C

Digits 3 and 4 describe the grade.

- ..95** Easy-flowing, easy release
- ..97** Easy-flowing, UV-stabilized, easy release
- ..03** Grade with elevated viscosity, UV-stabilized
- ..45<sup>1)</sup>** Medical grade, easy release
- ..92** Easy-flowing, flame retardant, transparent

## Prefixes

- FR..** Flame retardant
- RW..** Reflective White

## Color designations

These are based on a six-digit code. The first two digits indicate the main color while the four remaining digits are used to distinguish between the different shades.

	Opaque color shades	Transparent color shades	Translucent color shades
<b>White</b>	01	–	02 (milky)
<b>Yellow</b>	10	15	12
<b>Orange</b>	20	25	22
<b>Red</b>	30	35	32
<b>Violet</b>	40	45	42
<b>Blue</b>	50	55	52
<b>Green</b>	60	65	62
<b>Gray</b>	70	75	72
<b>Brown</b>	80	85	82
<b>Black</b>	90	–	–
<b>Natural</b>	00	00	–

<sup>1)</sup> Suitable for hot-steam sterilization, biocompatible according to many test conditions of ISO 10993-1 standard.

## Applications

Thanks to its unique combination of properties (excellent transparency, heat resistance and toughness), Apec® yields moldings with a broad spectrum of applications.

### Automotive:

- Automotive headlamp reflectors/bezels
- Headlamp lenses
- Reflectors for indicator- and rear lights
- Housings for license-plate lights
- Automotive brake and indicator bulb caps
- High mounted stop lights
- Interior light covers and housings
- Flat fuses

### Electronics/electrical engineering; domestic appliances:

- Domestic appliances/measurement transformer components
- Lamp covers (for tumble dryers, cooker hoods, bus bar supports, insulators)
- Fuse housings
- Front panels for electric cookers
- Covers for food appliances
- Socket housings
- Illuminated rotary switches
- Chip trays

### Lighting:

- Signal lamp systems
- Lights/recessed lights
- Covers for industrial lamps
- Dentists' operating lamps
- Housings for halogen lights
- Housings for spotlights
- Fittings for halogen systems
- Lenses for ships' lights

### Medical technology\*:

- Syringe tops
- Contact lens holders
- Hot steam sterilization safety valves for respiratory aids
- Medical vessels
- Medical packaging film

### Safety:

- Visors of firefighter helmets
- Glasses of gas masks

\*Please find further hints in our brochure „Makrolon, Apec and Bayblend for medical devices“ ([www.plastics.covestro.com](http://www.plastics.covestro.com)).

## Heat resistance/aging behavior

The outstanding property of Apec® is its graded, high-level heat resistance in conjunction with excellent transparency, only slight inherent color, good flowability and high impact strength. At present, products produced on an industrial scale are available with a Vicat softening temperature of up to 203 °C.

With short-term thermal loading and parts subject to only a low level of mechanical stress, the service temperatures possible for the Apec® grades are approximately 15 °C below the Vicat softening temperature.

The long-term service temperature of Apec® parts depends on the demands placed on the part.

As with all thermoplastics, long-term high-temperature loading can cause changes in the property level (e.g. mechanical properties and color). The extent of the changes also depends on the duration of the loading. With excessive thermal loading, part failure can result in extreme cases as a result of brittle fracture or incipient melting.

The temperature indices to UL 746B constitute guidelines for the temperature stressing and service life of parts in Apec® (see reference data table). These are the temperatures at which the tested material property displays at least 50 % of its starting level for a defined exposure time.

## Optical properties

Apec® is available with a crystal clear bluish tinted color (551022). With this color Apec® is reaching a light transmittance of 89 % at 1 mm wall thickness. The refractive index is affected by the ratio of the two monomer components and falls as the heat resistance increases. Typical Apec® properties are its high surface gloss and excellent surface quality.

## Toughness

Apec® shows a high impact strength over a broad temperature range. The material's high energy absorption capacity is also apparent under biaxial stress in the penetration test.

### Apec® 1695

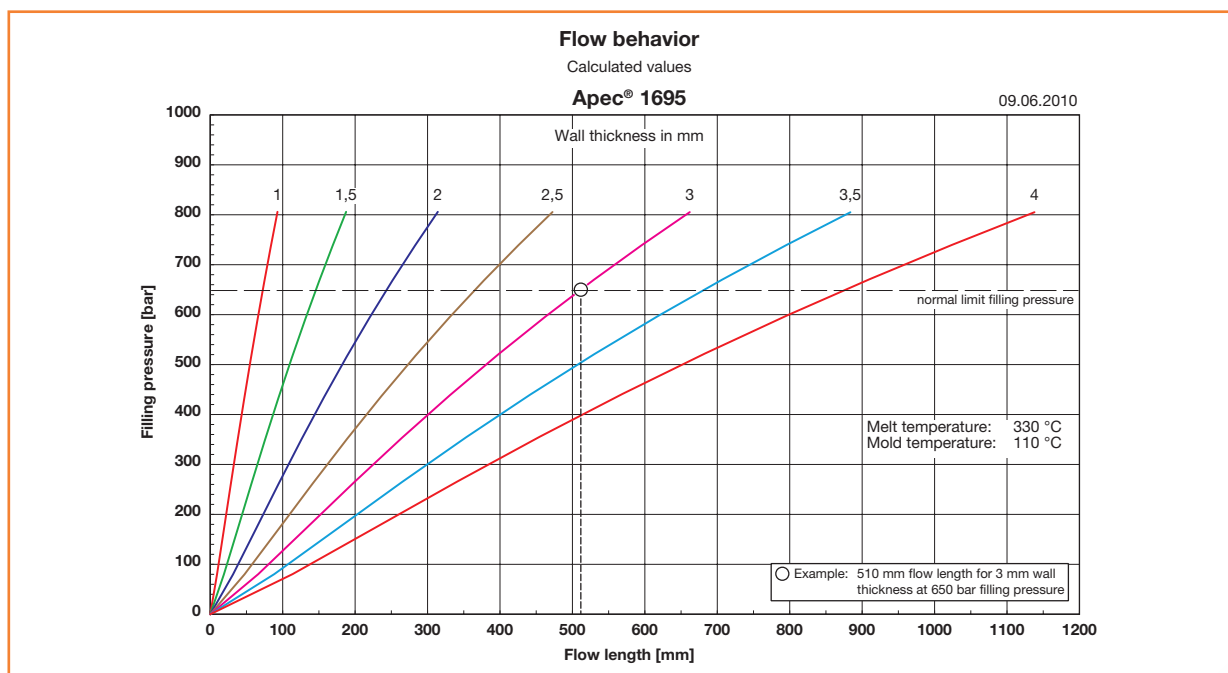


Fig. 1: A. 1695 (A. 1697)

## Melt viscosity; flow properties

Like most resins, the increased heat resistance of Apec® also means higher viscosity. Compared with other amorphous thermoplastics with comparable heat resistance such as polyarylates, however,

Apec® exhibits a markedly lower melt viscosity and hence better flow properties. (See the following injection pressure/flow length diagrams.)

### Apec® 1795

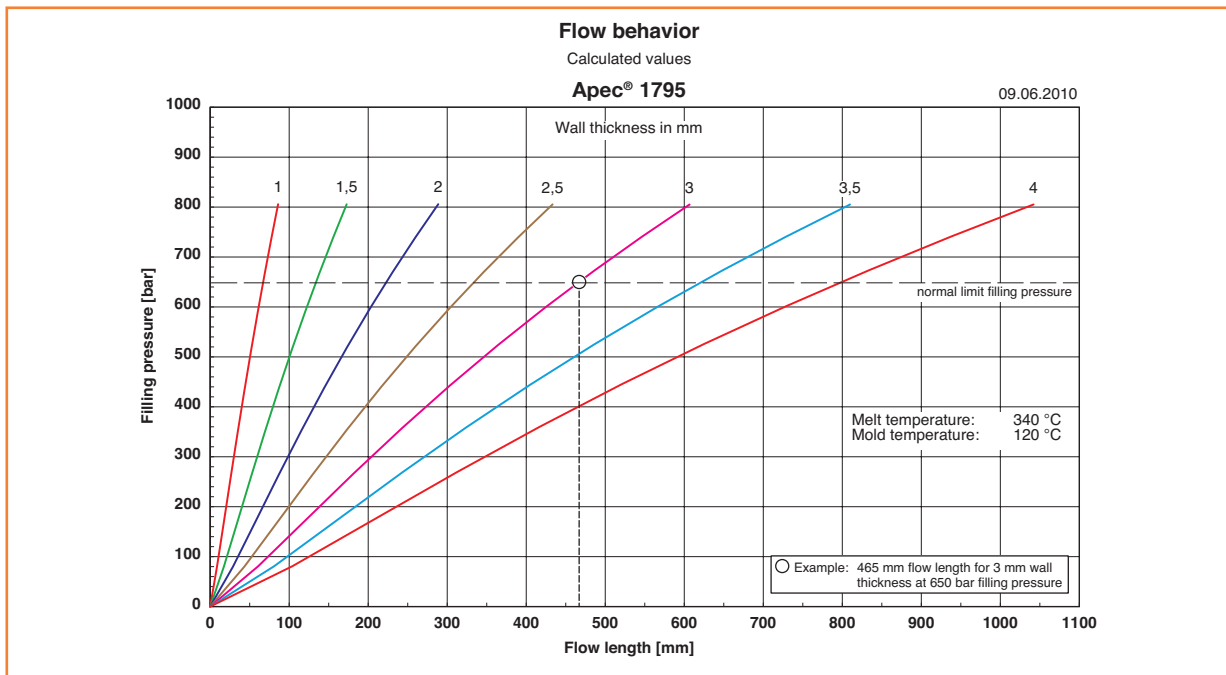


Fig. 2: A. 1795 (A. 1797)

### Apec® 1895

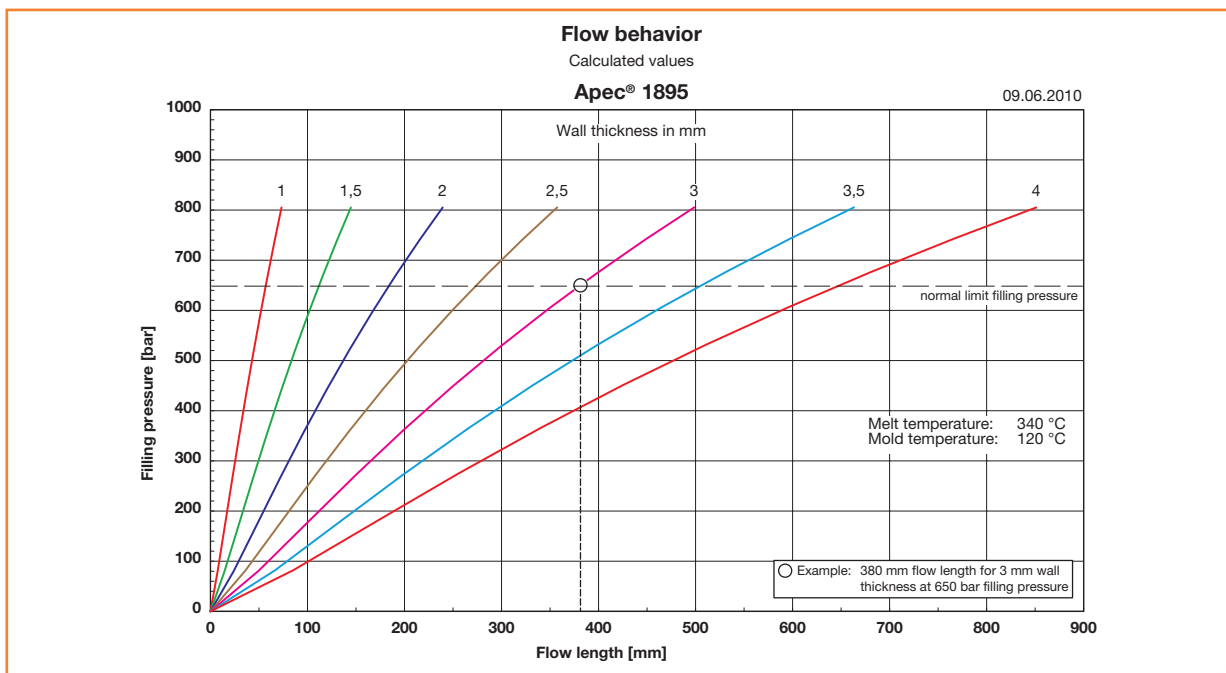


Fig. 3: A. 1895 (A. 1897)

**Apec® 2095**

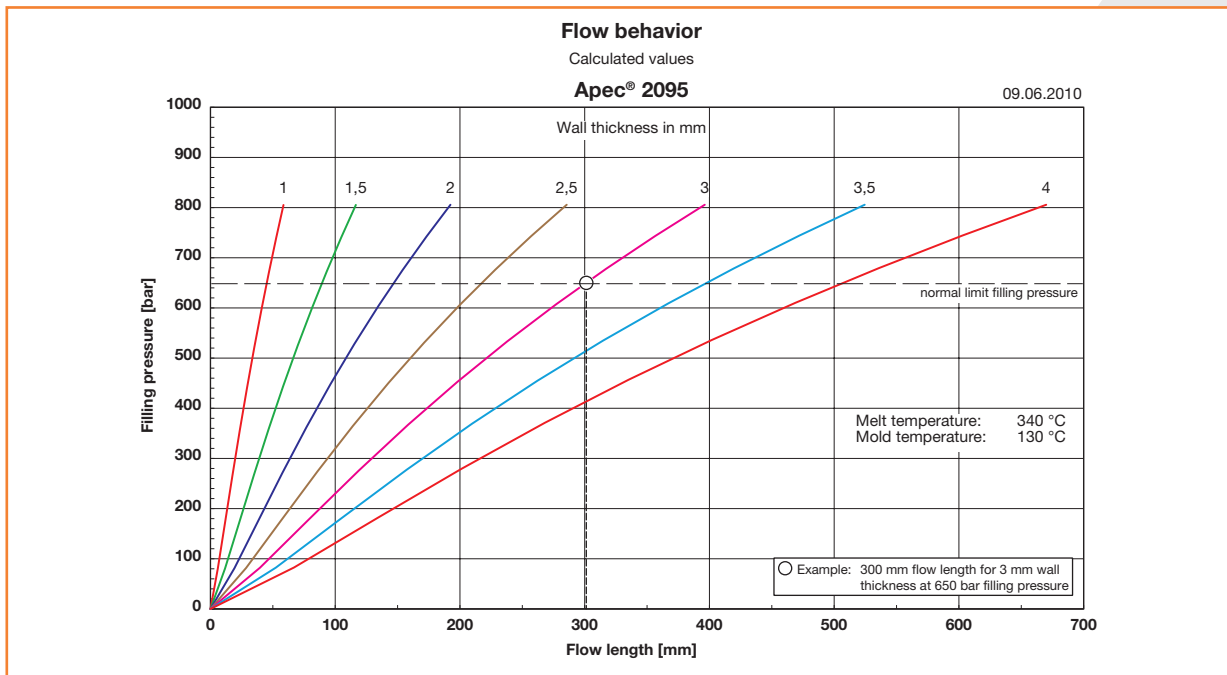


Fig. 4: A. 2095 (A. 2097)

**Apec® 1703**

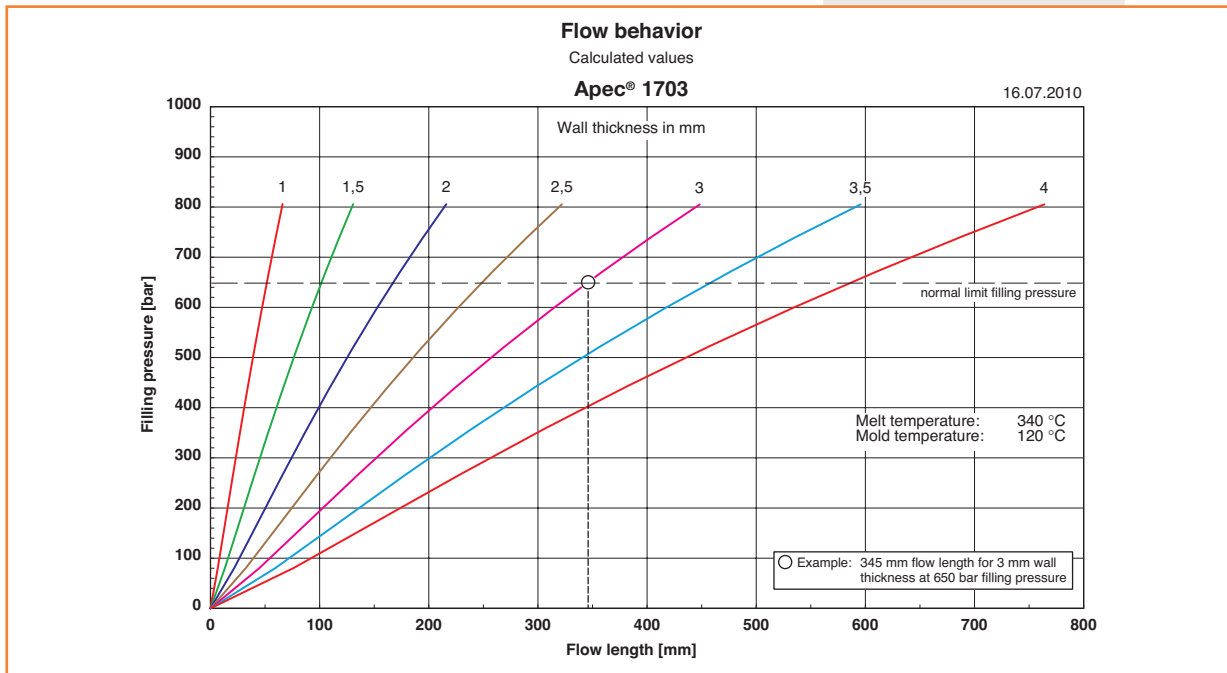


Fig. 5: A. 1703 (A. 1745)



## Apec® 1803

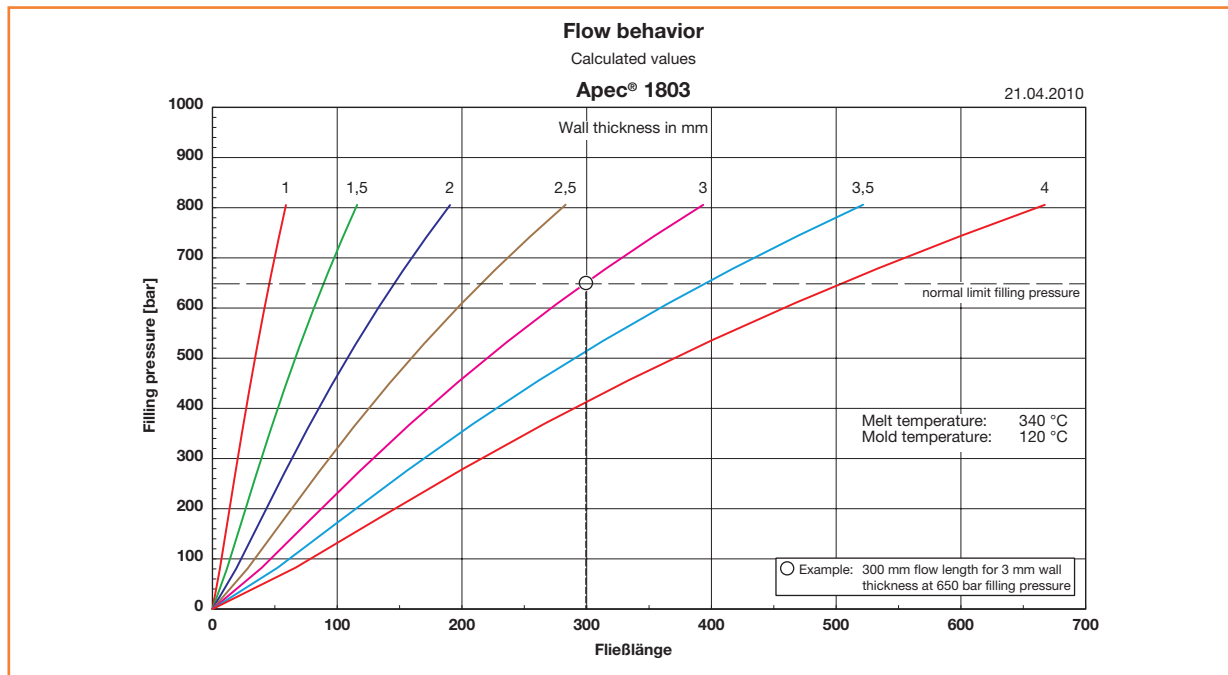


Fig. 6: A. 1803

### Electrical properties

The electrical properties of Apec® and polycarbonate parts are also broadly similar. This applies particularly to surface resistivity, volume resistivity and the dielectric constant. The grades with the highest softening temperature (A. 2095 and A. 2097) are reaching a remarkable high CTI (Comparative tracking index).

### Flame retardance

Apec® without flame retardant additives is classified HB in accordance with UL 94. The FR grade Apec® FR1892 (available in transparent colors) and Apec® DP1-9354 (only available in opaque colors) are listed V-0/3.0 mm, respectively V-0/1.5 mm according to UL94

### UV resistance

Apec is absorbing UV light which leads to discoloration/yellowing when exposed to sunlight over a period of time. UV-stabilized Apec® grades show a markedly reduced tendency to yellowing of transparent colors. For applications requiring an exceptionally high level of UV stability, an additional UV protective coating is recommended.

### Light reflectance

The new Apec® grade RW1697<sup>1)</sup> allows high diffuse reflectance applications on a higher temperature level than known from the corresponding Makrolon® RW grades. Grades with even higher temperature resistance are in preparation.

<sup>1)</sup> RW = Reflective White

Due to variable content of filler, diffuse light reflection of ca 95 % is possible. The mechanical behavior is something more brittle compared with A. 1697

### **Chemical resistance, stress crack resistance**

Apec® parts show good resistance to saturated aliphatic hydrocarbons, alcohols, dilute mineral acids, and both neutral and acid salt solutions. Apec® is not resistant to aromatic hydrocarbons, ammonia, amines and aqueous alkaline solutions.

The behavior of Apec® in contact with chemicals is similar to that of standard polycarbonate.

The chemical resistance and stress crack resistance are also largely dependent on the stress level of the parts, the temperature of the objects and the concentration of the chemicals. A practical test should therefore always be conducted in cases of doubt. If this is not possible, the bent strip test (DIN 53 449/3) at least provides a rough guide. In order to avoid stress cracking, care must always be taken to ensure that the residual outer fiber strain does not exceed 0.3 %.

### **Resistance to hydrolysis**

Hot water leads to gradual chemical degradation, coupled with a reduction in the impact strength and elongation at break. Permanent service in water at temperatures of above 60 °C is therefore not recommended.

### **Solubility**

As their heat resistance or TMC bisphenol content increases, the solubility of Apec® grades in nonhalogenated solvents, such as toluene, acetic acid ethyl ester, methyl ethyl ketone and tetrahydrofuran also increases.



## Processing

### Material preparation/drying

To achieve optimum molded part properties, it is essential for Apec® granules to be dried prior to processing. Insufficiently dried granules will lead to a molecular weight reduction during processing, which can affect the properties of the finished part in the following ways:

- “silver streaks” and bubbles on the surface
- Embrittlement (deterioration in mechanical properties, e.g. impact strength, tensile strain at break, flexural strength)
- Impairment of flammability properties
- Increased susceptibility to stress cracking

Apec® will absorb up to 0.12 % water from the air (23 °C/50 % relative humidity) and up to 0.3 % when in direct contact with water. In order to avoid the property deteriorations referred to above it is vital for the water content to be reduced to  $\leq 0.02$  % prior to processing, for critical applications  $\leq 0.01$  %. We recommend the following drying conditions as a function of the moisture content of the granules and the efficiency of the dryer:

To prevent the granules from becoming moist once again, particularly when they are subject to prolonged residence times in the injection molding machine, a heated hopper should be used.

The moisture content of the granules should be measured by the Karl Fischer test method, or another appropriate method.

If the permitted moisture content is exceeded, the finished part may still have suffered material degradation, even if it looks perfect on the surface. The TVI test (Tomasetti’s Volatile Indicator) provides reliable information on the degree of drying, which will be adequate for most cases, for only a low outlay in terms of the apparatus and time involved. To perform the test, it is necessary to have a hotplate which can be heated to a surface temperature of approximately 330 °C (material temperature). Two microscope slides are heated at this temperature for two minutes. Three or four granules of the polymer are then placed on one of the glass slides using tweezers. The second glass slide is positioned on top of the first one and pressed down on it as hard as possible using an appropriate object.

	Drying temperature (granule temperature)	Drying time		
		Circulating air dryer (50 % fresh air)	Fresh-air dryer	Dry-air dryer
All grades	130 °C	4 to 12 h	2 to 4 h	2 to 4 h

Recommended drying conditions for Apec®

Summer temperatures, especially when coupled with a high relative humidity, create the need for longer drying times in circulating air and fresh-air dryers, which can exceed the number of hours specified in the table. In extreme cases, it may not even be possible for the requisite  $\leq 0.02$  %, respective  $\leq 0.01$  % to be achieved with dryers of this type. In order to ensure independence from external climatic conditions, dry-air dryers should be generally used.

This causes the molten grains to be squeezed into thin, round films (with a diameter of approximately 10 mm). After a further minute on the hotplate, with the pressure removed, the specimen is allowed to cool in the air. If bubbles are visible in the films then the granules are not yet sufficiently dry. This method is suitable for transparent and opaque colors (see also ATI 8024 en “Determining the dryness of Makrolon® by the TVI test”).

## Processing temperatures/ processing advice

Injection molding is the chief process employed for the production of parts in Apec®. The advice set out below thus relates exclusively to this form of processing.

Present-day injection molding machines are suitable for the injection molding of Apec®. Open nozzles of the free-flow type with a relatively large crosssection have proved successful. If there is a slight leakage of melt, this can generally be prevented by retracting the screw somewhat (removing the pressure from the melt).

Grade	Melt temperature in °C	Mold temperature in °C
16xx	320–340	100–120
17xx	320–340	110–130
18xx	330–340	120–140
20xx	330–340	130–150
FR1892	330–340	120–140
DP1-9354*	330–340	120–140
RW1697	320–340	100–120

Recommended mold and melt temperatures for Apec®

In order to obtain parts with the lowest possible level of inherent stress (and particularly in the case of parts that have to be suitable for superheated steam sterilization), we recommend that the mold temperature be set as high as possible. The injection velocity, holding pressure level and holding pressure time are a function not only of the thermoplastic being processed but also, and more especially, of the geometry of the part and the layout of the gating system. Apec® can be injected at high speeds as a matter of principle, and graded injection has also proved successful. The holding pressure should not be set higher than is absolutely necessary or allowed to act for longer than strictly required.

It is important to bear the following in mind in the event of interruptions to production:

Nitrided steel injection molding machines are generally no more recommended.

If a wear and corrosion-proof screw is being used (centrifuged cylinder with a chromium steel screw), this can be allowed to cool to room temperature.

As a rule, no problems will be encountered when parts made of Apec® are demolded (recommended demolding drafts  $\geq 1\%$ ). When demolding cores, experience has shown a high mold temperature to have a positive influence. If demolding problems are still encountered, it may be possible to switch to a grade that contains release agent. We do not recommend the use of mold lubricants, however, since these can damage the injection molded part. Further advice on processing can be obtained from our general information brochure "Processing data for the injection molder".

Apec® can similarly be processed by the following methods:

- Sheet extrusion
- Film extrusion
- Profile extrusion
- Extrusion blow molding
- Injection blow molding
- Film casting

## Recycling, material disposal

Rejects and processing waste can be reground and processed into new moldings while observing the same drying and processing advice as for virgin product. It is essential to check the property level and color of molding compounds containing recyclate in order to ensure their suitability for the intended application. The permitted content of recyclate must be established in each individual case.

When using regrind, it must be borne in mind that the different grain geometry of regrind compared with extrusion granules affects the feed and plasticating behavior. For this same reason, physical mixtures of regrind and granules tend to separate when moved during transport, conveying and metering.

When re-using Apec®, it is important to ensure that no foreign materials or dirt are introduced. Apec® displays good compatibility with additive-free non-blended BPA-PC, which means that the two can essentially be recycled together. It should be borne in mind that, with homogeneous mixtures of the two molding compounds, the properties obtained will be a function of the mixing ratio.

Apec® can be disposed of in an environmentally friendly manner, either on a landfill or through correctly performed incineration.

The identification for the different Apec® grades is as follows:

Standard grades: > PC-HT <

Easy flowing grades: > PC-HT <

FR grades: > PC-HT FR <

More detailed information on this may be obtained from our brochure "Marking products made of technical thermoplastics".

## Designing with Apec®

Apec® is an amorphous thermoplastic with a high heat deflection temperature which belongs to the family of polycarbonates. Apec® displays good flowability in comparison with other amorphous thermoplastics with a high heat deflection temperature. This gives the design engineer a high level of freedom in design and means that the processor can benefit from a broad processing range.

## Shrinkage, tolerances

Apec® displays identical shrinkage properties both parallel to and across the direction of flow. This is essential for the production of molded parts with a high dimensional stability. With optimum processing conditions, it is possible to achieve tolerances of  $\pm 0.1\%$  for a nominal dimension of 100 mm.





Apec®-grades	With flow/across flow
1695/1697	0.70/0.70
1795/1797	0.75/0.75
1895/1897	0.80/0.80
2095/2097	0.90/0.90
1603	0.75/0.75
1703/1745	0.80/0.80
1803	0.85/0.85
FR1892	0.80/0.80
DP1-9354	0.85/0.85
RW1697	0.70/0.70

Molding shrinkage<sup>1)</sup>

### Mechanical properties, permitted stresses and strains

If Apec® is subject to prolonged mechanical stressing, it can suffer stress cracking in the same way as other amorphous thermoplastics. This process will be accelerated under the action of media that trigger stress cracking. It is not possible for all the factors that influence stress cracking to be recorded or taken into account at the design stage. If mechanical stressing is specified, then the design should be such that irreversible elongation does not exceed 0.3 %. Under short-time loading, considerably higher strain values are possible. Up to 50 % of the tensile strain at yield is permissible for once-only short-time loading, and up to 25 % of the tensile strain at yield for repeated short-time loading. If there is any uncertainty regarding the mathematical determination of the stress, the appropriate safety factors should be applied. The chemical resistance and stress cracking behavior of Apec® are largely conditioned by the temperature of the object, the nature and composition of the chemicals involved and the internal and external stresses acting on the molded parts. Both compressive stresses and tensile stresses occur as a function of the geometry of the molded part.

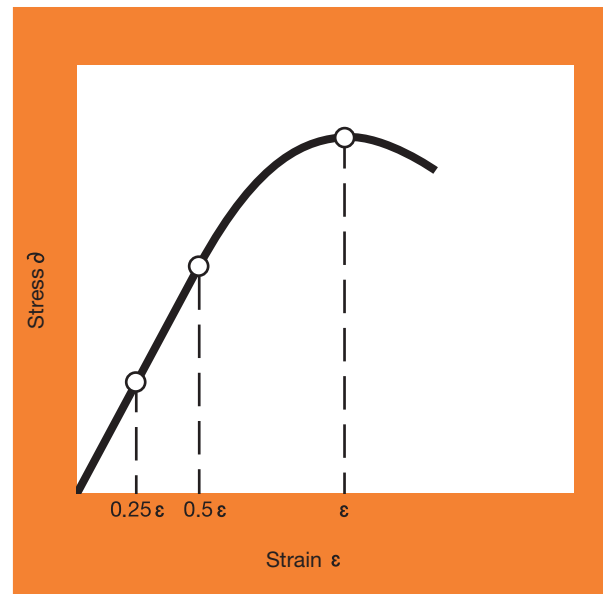


Fig. 7: Permitted stresses and strains for Apec®

Apec®	Short-time once-only MPa/%	Short-time repeated MPa/%	Long-term MPa/%
All grades	56/3.4	35/1.7	7/0.3

If excessive tensile stresses prevail, this can lead to local deformation zones in the surface and in the regions close to the surface (microcracks, crazes) and hence to weak points.

In order to produce parts with a high serviceability, it is in the manufacturer's interest to avoid weak points of this type by ensuring that the stresses are properly under control.

As with standard polycarbonate, there is also a quick method for estimating the frozen-in tensile stresses in molded parts made of Apec®: The molded part to be tested, which has cooled to room temperature ( $22 \pm 3 \text{ }^\circ\text{C}$ ), is fully immersed in a test medium. After 15 minutes' immersion, it is taken out of the medium and visually examined for any cracks that may have developed, together with their dimensions. If cracks are present, this indicates an unfavorable design or mold layout, or processing errors. The response threshold, i.e. tensile stresses that exceed this value are released in the form of stress cracks.

<sup>1)</sup> The shrinkage values were measured on a rectangular test plate 150 x 90 x 3 mm with a film gate at the 90 mm side. Melt temperature: 330 to 340 °C (as a function of grade), mold temperature: 120 to 150 °C (as a function of grade). Injection time: 1 s. Max. cavity pressure: 600 bar (pressure sensor close to film gate). NB: The shrinkage values given are reference values and thus only suitable for mold layout to a limited extent. Please contact our design department if you require assistance.

Test medium*	Threshold (after 15 min immersion)
n-Propanol	14 MPa
Toluol/n-Propanol 1:10	9 MPa
Toluol/n-Propanol 1:3	5 MPa

\* The test should be conducted under a ventilation hood or in well ventilated surroundings. Protective eyewear and gloves should be worn! We will be pleased to send you our safety data sheet on request.

A molded part in Apec® must at least pass the test in n-propanol – even if no mechanical stressing is to be expected when it is in service. Sometimes, it is difficult to recognize stress cracks on colored plastics. In such cases, it is recommended that sample parts be made of transparent material and checked.

### Radii, transitions in cross-section

Sharp edges and corners lead to excessive stresses (notch effect) in corner and edge regions under loading. In the case of molded parts in Apec® which are subject to mechanical stressing, all edges and corners should be designed with a radius of at least 0.5 mm. In the same way, it is essential to avoid abrupt changes in cross-section (sudden changes in stiffness). Changes in cross-section should be gradual, wherever possible.

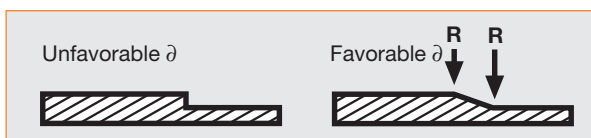


Fig. 8: Design of transitions in cross-section

### Screw connections and snap-fit joints

Screw bosses and snap-fitting hooks are elements of a plastics component that are subject to mechanical load. Screw bosses for self-tapping screws or self-forming screws expand when the screw is inserted, giving rise to long-term stressing.

The degree of expansion and hence the level of stress in the screw boss is determined by the type of screw used and its geometry. In the case of self-forming screws, the degree of expansion is greater than for self-tapping screws. Small thread angles reduce the level of stress in the screw boss. Any grease should be removed from the screws prior to insertion. Brass screws are not recommended for this application, since it is more difficult to remove grease from these than from nickel-plated screws, for instance. Determining the level of stress by mathematical means is difficult and always involves a high level of uncertainty (screw tolerances). In practical tests, favorable results have been obtained by observing the design guidelines given below (see also our brochure "Self-Tapping screws for thermoplastics").

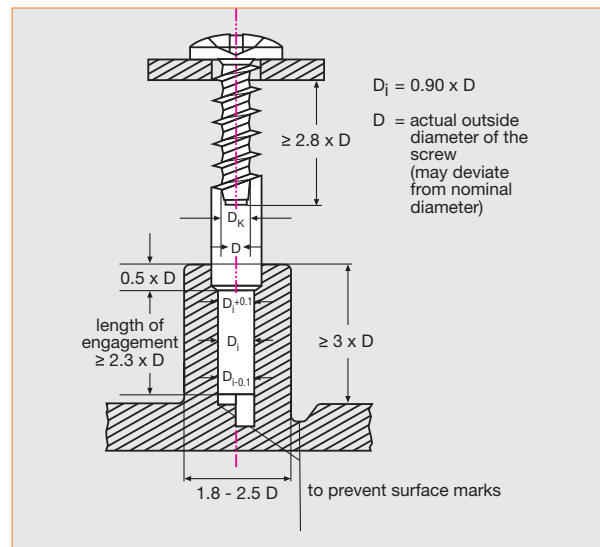


Fig. 9: Dimensioning of screw bosses for Apec®

Core diameter $D_K$ (mm)	$< 0,65 \times D$
Pitch $P$ (mm)	$0,35 \times D$ to $0,55 \times D$
Thread angle $\alpha$	$< 40^\circ$

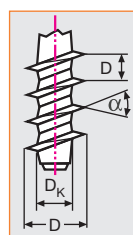


Fig. 10: Screw coupling with Apec® (recommended screw geometry)

Snap-fit joints are a simple and inexpensive type of connection. A snap-fit joint is subject to short-time mechanical load during the assembly operation. Once it has been assembled, the joint is then generally only subject to a low level of mechanical stressing. In most cases, stresses and strains can be determined mathematically (for calculation formulae and sample applications for a wide range of different snap-fit joints please see our brochure "Snap-fit Joints for Plastic – A Design Guide"). High stresses can be avoided through skilful dimensioning, as shown in the diagram below.

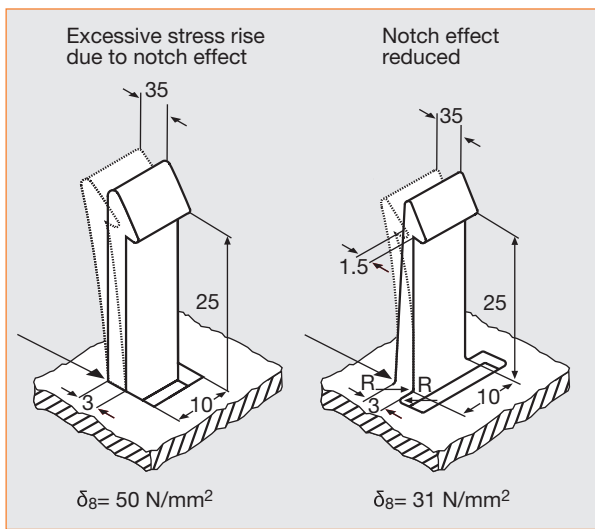


Fig. 11: Designing of snap-fit joints for Apec®  
**Gate layout**

All the standard gating techniques can be employed for Apec®. Apart from the customary cold runner molds, molds with hot runner systems can also be used. If a hot runner system is employed, however, this should satisfy the requirements set out in the diagram below:

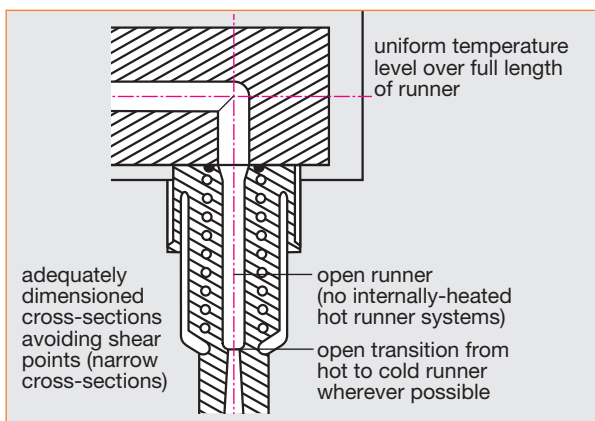


Fig. 12: Requirements for the hot runner system

Molded parts made of Apec® should be produced with a low level of stress. In the case of pinpoint gates, the point of injection is the area where the highest stress level prevails within the mold. These frozen-in stresses are caused by the very high flow velocity close to the gate.

The level of stress can be reduced not only by employing large gate cross-sections but also by partially increasing the wall thickness in the region of the mold. If tunnel gates are used, a version with an accumulator base is recommended. This variant permits a clear reduction in melt stressing (Fig. 13).

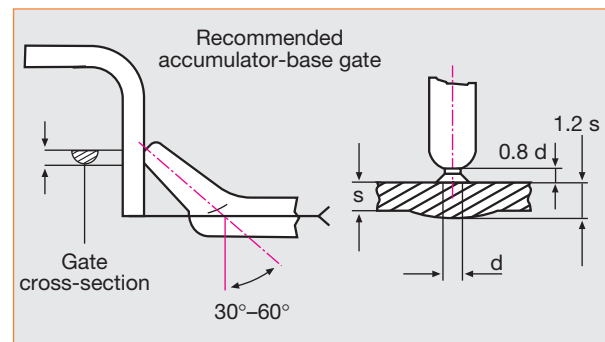


Fig. 13: Gate dimensioning – minimum gate diameter ( $d = 60\%$  of wall thickness ( $s$ ))

The cross-sections of the feed channels must be dimensioned as a function of the grade of Apec® employed, the weight of the molded part and the length of the gate. It is not possible to give general recommendations on account of the many different influencing factors that are involved.

By using rheological computer programs, however, it is possible to reliably dimension gate systems with a low outlay.



## ■ Easy-flowing grades

<b>1695</b>	MVR (330 °C/2.16 kg) 45 cm <sup>3</sup> /10 min; easy release; softening temperature (VST/B 120) = 157 °C; Covers for brake lights and indicator lights; Headlamp reflectors/bezels	<b>1895</b>	MVR (330 °C/2.16 kg) 18 cm <sup>3</sup> /10 min; easy release; softening temperature (VST/B 120) = 183 °C; Covers for brake lights and indicator lights; Recessed light fixtures/reflectors; Raised brake lights; Headlamp reflectors/bezels
<b>1697</b>	MVR (330 °C/2.16 kg) 45 cm <sup>3</sup> /10 min; low viscosity; easy release; UV stabilized; softening temperature (VST/B 120) = 157 °C	<b>1897</b>	MVR (330 °C/2.16 kg) 18 cm <sup>3</sup> /10 min; easy release; UV stabilized; softening temperature (VST/B 120) = 182 °C; Lamp covers; Headlamp lenses
<b>1795</b>	MVR (330 °C/2.16 kg) 30 cm <sup>3</sup> /10 min; easy release; low viscosity; softening temperature (VST/B 120) = 173 °C; Covers for brake lights and indicator lights; Headlamp reflectors/bezels	<b>2095</b>	MVR (330 °C/2.16 kg) 8 cm <sup>3</sup> /10 min; high viscosity; easy release; softening temperature (VST/B 120) = 203 °C; Covers for brake lights and indicator lights; Recessed light fixtures/reflectors; Blade-type fuses; Headlamp reflectors/bezels
<b>1797</b>	MVR (330 °C/2.16 kg) 30 cm <sup>3</sup> /10 min; low viscosity; easy release; UV stabilized; softening temperature (VST/B 120) = 172 °C	<b>2097</b>	MVR (330 °C/2.16 kg) 8 cm <sup>3</sup> /10 min; high viscosity; easy release; UV stabilized; softening temperature (VST/B 120) = 202 °C; Lamp covers; Headlamp lenses

## ■ Grades with elevated viscosity

<b>1603</b>	MVR (330 °C/2.16 kg) 25 cm <sup>3</sup> /10 min; high viscosity; UV stabilized; softening temperature (VST/B 120) = 159 °C	<b>1803</b>	MVR (330 °C/2.16 kg) 10 cm <sup>3</sup> /10 min; UV stabilized; softening temperature (VST/B 120) = 184 °C; Covers for brake lights and indicator lights; car interior light covers; Domestic lamp covers; Headlamp lenses; Covers for ships' lights; Connector pieces for halogen systems
<b>1703</b>	MVR (330 °C/2.16 kg) 17 cm <sup>3</sup> /10 min; UV stabilized; softening temperature (VST/B 120) = 171 °C; Covers for brake lights and indicator lights; Covers for domestic/industrial lamps; car interior light covers; Headlamp lenses		

## ■ Medical grade

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**1745** MVR (330 °C/2.16 kg) 17 cm<sup>3</sup>/10 min; easy release; suitable for superheated steam sterilisation up to 143 °C as well as for pharmaceutical applications according to United States Pharmacopeia (USP) XXII Class VI; softening temperature (VST/B 120) = 170 °C; Films for medical packaging; Contact lens holders; Medical vessels; Safety valve for respiration aids; Syringe tops

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## ■ Flame-retardant grades

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**FR1892** MVR (330 °C/2.16 kg) 18 cm<sup>3</sup>/10 min; easy release; V-2/1.5 mm (UL 94); V-0/3.0 mm (UL 94); softening temperature (VST/B 120) = 183 °C; transparent colors possible; Visors for firemen's helmets

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**DP1-9354** MVR (330 °C/2.16 kg) 12 cm<sup>3</sup>/10 min; flame retardant; high viscosity; only opaque colors available; V-0/1.5 mm (UL 94); V-0/3.0 mm (UL 94); 5VA/3.0 mm (UL 94); softening temperature (VST/B 120) = 185 °C

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## ■ Reflective White Grade

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**RW1697** MVR (330 °C/2.16 kg) 45 cm<sup>3</sup>/10 min; easy release; low viscosity; softening temperature (VST/B 120) = 157 °C

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# Apec® – Typical values

				Easy-flowing grades			
Properties	Test conditions	Units	Standards	1695	1697	1795	1797
<b>Rheological properties</b>							
• Melt volume-flow rate (MVR)	330 °C; 2.16 kg	cm <sup>3</sup> /10 min	ISO 1133	45	45	30	30
Melt mass-flow rate (MFR)	330 °C; 2.16 kg	g/10 min	ISO 1133	46	46	31	31
• Molding shrinkage, parallel	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.7	0.7	0.8	0.8
Molding shrinkage, transverse	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.7	0.7	0.8	0.8
<b>Mechanical properties (23 °C/50 % r. F.)</b>							
• Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2400	2400	2400	2400
• Yield stress	50 mm/min	MPa	ISO 527-1, -2	68	68	71	71
• Yield strain	50 mm/min	%	ISO 527-1, -2	6.3	6.3	6.6	6.6
• Nominal tensile strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50	> 50
• Charpy impact strength	23 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
• Charpy impact strength	-30 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
Charpy notched impact strength	23 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	10	10	9	9
Charpy notched impact strength	-30 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	10	10	9	9
• Puncture maximum force	23 °C	kN	ISO 6603-2	5.2	5.2	5.2	5.2
• Puncture maximum force	-30 °C	kN	ISO 6603-2	6.0	6.0	6.0	6.0
• Puncture energy	23 °C	J	ISO 6603-2	54	54	54	54
• Puncture energy	-30 °C	J	ISO 6603-2	57	57	57	57
Flexural modulus	2 mm/min	MPa	ISO 178	2400	2400	2400	2400
Flexural strength	5 mm/min	MPa	ISO 178	100	100	105	105
Ball indentation hardness	-	N/mm <sup>2</sup>	ISO 2039-1	120	120	124	124
<b>Thermal properties</b>							
• Deflection temperature under load, Af	1.80 MPa	°C	ISO 75-1, -2	138	137	148	147
• Deflection temperature under load, Bf	0.45 MPa	°C	ISO 75-1, -2	150	149	161	160
Vicat softening temperature	50 N; 120 K/h	°C	ISO 306	158	157	173	172
RTI, tensile strength	1.5 mm/3.0 min	°C	UL 746B	140	140 <sup>1)</sup>	140	140 <sup>1)</sup>
RTI, tensile impact strength	1.5 mm/3.0 min	°C	UL 746B	130	130 <sup>1)</sup>	130	130 <sup>1)</sup>
RTI, electric strength	1.5 mm/3.0 min	°C	UL 746B	140	140 <sup>1)</sup>	140	140 <sup>1)</sup>
• Coefficient of linear thermal expansion, parallel	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
• Coefficient of linear thermal expansion, transverse	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
Burning behavior UL 94 (UL-Registration)	Thickness: 1.5 mm	Class	UL 94	HB	HB <sup>2)</sup>	HB	HB <sup>2)</sup>
Burning behavior UL 94 (UL-Registration)	Thickness: 3.0 mm	Class	UL 94	HB	HB <sup>2)</sup>	HB	HB <sup>2)</sup>
Burning behaviour FMVSS	Thickness: 1.0 mm	mm/min	ISO 3795	0	0	0	0
• Oxygen index	Method A	%	ISO 4589	26	26	26	26
Glow wire temperature (GWFI)	Thickness: 2.0 mm	°C	IEC 695-2-12	900	900	850	850
<b>Electrical properties (23 °C/50 % r. F.)</b>							
• Relative permittivity	100 Hz	-	IEC 250	3	3	3	3
• Relative permittivity	1 MHz	-	IEC 250	2.9	2.9	2.9	2.9
• Dissipation factor	100 Hz	10 <sup>-4</sup>	IEC 250	10	10	10	10
• Dissipation factor	1 MHz	10 <sup>-4</sup>	IEC 250	90	90	90	90
• Volume resistivity	-	Ohm · m	IEC 93	1E + 15	1E + 15	1E + 15	1E + 15
• Surface resistivity	-	Ohm	IEC 93	1E + 16	1E + 16	1E + 16	1E + 16
• Electric Strength	-	kV/mm	IEC 243-1	35	35	35	35
• Comparative tracking index CTI	Solution A	Rating	IEC 112	250	250	250	250
Comparative tracking index CTI M	Solution B	Rating	IEC 112	125	125	125	125
Electrolytic corrosion	-	Rating	IEC 426	A1	A1	A1	A1
<b>Other properties (23 °C)</b>							
• Water absorption (saturation value)	in water at 23 °C	%	ISO 62	0.3	0.3	0.3	0.3
• Water absorption (equilibrium value)	23 °C/50 %	%	ISO 62	0.12	0.12	0.12	0.12
• Density	-	kg/m <sup>3</sup>	ISO 1183	1180	1180	1170	1170
<b>Material-specific properties</b>							
Refractive index	-	-	ISO 489-A	1.578	1.578	1.576	1.576
Light transmittance (color-no. 551022)	1 mm	%	ISO 5036-1	89	89	89	89
• Light transmittance (color-no. 551022)	2 mm	%	ISO 5036-1	89	88	88	88
Light transmittance (color-no. 551022)	3 mm	%	ISO 5036-1	88	87	87	87
<b>Processing conditions for test specimen</b>							
• Injection molding-melt temperature	-	°C	ISO 294	330	330	330	330
• Injection molding-mold temperature	-	°C	ISO 294	100	100	100	100
• Injection molding-flow front velocity	-	mm/s	ISO 294	200	200	200	200

• These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalog of basic data for plastics according to ISO10350.

- 1) Expected RTI
- 2) Covestro Test



# Apec® – Typical values

				Easy-flowing grades			
Properties	Test conditions	Units	Standards	1895	1897	2095	2097
<b>Rheological properties</b>							
• Melt volume-flow rate (MVR)	330 °C; 2.16 kg	cm <sup>3</sup> /10 min	ISO 1133	18	18	8	8
Melt mass-flow rate (MFR)	330 °C; 2.16 kg	g/10 min	ISO 1133	19	19	8	8
• Molding shrinkage, parallel	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.85	0.85	1.05	1.05
Molding shrinkage, transverse	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.85	0.85	1.05	1.05
<b>Mechanical properties (23 °C/50 % r. F.)</b>							
• Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2450	2450	2450	2450
• Yield stress	50 mm/min	MPa	ISO 527-1, -2	74	71	76	76
• Yield strain	50 mm/min	%	ISO 527-1, -2	6.6	6.6	6.8	6.8
• Nominal tensile strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50	> 50
• Charpy impact strength	23 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
• Charpy impact strength	-30 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
Charpy notched impact strength	23 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	8	8	6	6
Charpy notched impact strength	-30 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	8	8	6	6
• Puncture maximum force	23 °C	kN	ISO 6603-2	5.2	5.2	5.0	5.0
• Puncture maximum force	-30 °C	kN	ISO 6603-2	6.0	6.0	5.5	5.5
• Puncture energy	23 °C	J	ISO 6603-2	54	54	50	50
• Puncture energy	-30 °C	J	ISO 6603-2	57	57	48	48
Flexural modulus	2 mm/min	MPa	ISO 178	2450	2450	2450	2450
Flexural strength	5 mm/min	MPa	ISO 178	108	108	110	110
Ball indentation hardness	-	N/mm <sup>2</sup>	ISO 2039-1	127	127	130	130
<b>Thermal properties</b>							
• Deflection temperature under load, Af	1.80 MPa	°C	ISO 75-1, -2	158	157	173	172
• Deflection temperature under load, Bf	0.45 MPa	°C	ISO 75-1, -2	173	172	192	191
Vicat softening temperature	50 N; 120 K/h	°C	ISO 306	183	182	203	202
RTI, tensile strength	1.5 mm/3.0 min	°C	UL 746B	150	150	150	150
RTI, tensile impact strength	1.5 mm/3.0 min	°C	UL 746B	130	130	130	130
RTI, electric strength	1.5 mm/3.0 min	°C	UL 746B	150	150	150	150
• Coefficient of linear thermal expansion, parallel	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
• Coefficient of linear thermal expansion, transverse	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
Burning behavior UL 94 (UL-Registration)	Thickness: 1.5 mm	Class	UL 94	HB	HB	HB	HB
Burning behavior UL 94 (UL-Registration)	Thickness: 3.0 mm	Class	UL 94	HB	HB	HB	HB
Burning behaviour FMVSS	Thickness: 1.0 mm	mm/min	ISO 3795	0	0	0	0
• Oxygen index	Method A	%	ISO 4589	26	26	25	25
Glow wire temperature (GWFI)	Thickness: 2.0 mm	°C	IEC 695-2-12	850	850	800	800
<b>Electrical properties (23 °C/50 % r. F.)</b>							
• Relative permittivity	100 Hz	-	IEC 250	2.9	2.9	2.9	2.9
• Relative permittivity	1 MHz	-	IEC 250	2.8	2.8	2.8	2.8
• Dissipation factor	100 Hz	10 <sup>-4</sup>	IEC 250	10	10	10	10
• Dissipation factor	1 MHz	10 <sup>-4</sup>	IEC 250	90	90	90	90
• Volume resistivity	-	Ohm · m	IEC 93	1E + 15	1E + 15	1E + 15	1E + 15
• Surface resistivity	-	Ohm	IEC 93	1E + 16	1E + 16	1E + 16	1E + 16
• Electric Strength	-	kV/mm	IEC 243-1	35	35	35	35
• Comparative tracking index CTI	Solution A	Rating	IEC 112	250	250	600	600
Comparative tracking index CTI M	Solution B	Rating	IEC 112	100	100	100	100
Electrolytic corrosion	-	Rating	IEC 426	A1	A1	A1	A1
<b>Other properties (23 °C)</b>							
• Water absorption (saturation value)	in water at 23 °C	%	ISO 62	0.3	0.3	0.3	0.3
• Water absorption (equilibrium value)	3 °C/50 %	%	ISO 62	0.12	0.12	0.12	0.12
• Density	-	kg/m <sup>3</sup>	ISO 1183	1150	1150	1130	1130
<b>Material-specific properties</b>							
Refractive index	-	-	ISO 489-A	1.573	1.573	1.566	1.566
Light transmittance (color-no. 551022)	1 mm	%	ISO 5036-1	89	89	<sup>3)</sup>	89
• Light transmittance (color-no. 551022)	2 mm	%	ISO 5036-1	89	89	<sup>3)</sup>	89
Light transmittance (color-no. 551022)	3 mm	%	ISO 5036-1	88	88	<sup>3)</sup>	88
<b>Processing conditions for test specimen</b>							
• Injection molding-melt temperature	-	°C	ISO 294	330	330	330	330
• Injection molding-mold temperature	-	°C	ISO 294	100	100	100	100
• Injection molding-flow front velocity	-	mm/s	ISO 294	200	200	200	200

• These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalog of basic data for plastics according to ISO10350.

3) Not available in clear transparent color 551022; please use alternatively Apec 2097 551022.





# Apec® – Typical values

Grades with elevated viscosity **Medical grade**

Properties	Test conditions	Units	Standards	Grades with elevated viscosity			Medical grade
				1603	1703	1803	1745 <sup>7)</sup>
<b>Rheological properties</b>							
• Melt volume-flow rate (MVR)	330 °C; 2.16 kg	cm <sup>3</sup> /10 min	ISO 1133	25	17	10	17
Melt mass-flow rate (MFR)	330 °C; 2.16 kg	g/10 min	ISO 1133	26	17	10	17
• Molding shrinkage, parallel	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.75	0.85	0.9	0.85
Molding shrinkage, transverse	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.75	0.85	0.9	0.85
<b>Mechanical properties (23 °C/50 % r. F.)</b>							
• Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2400	2400	2400	2400
• Yield stress	50 mm/min	MPa	ISO 527-1, -2	68	70	72	70
• Yield strain	50 mm/min	%	ISO 527-1, -2	6.3	6.8	6.8	6.8
• Nominal tensile strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50	> 50
• Charpy impact strength	23 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
• Charpy impact strength	-30 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB	NB
Charpy notched impact strength	23 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	65	12	10	60
Charpy notched impact strength	-30 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	12	12	10	12
• Puncture maximum force	23 °C	kN	ISO 6603-2	5.7	5.5	5.5	5.5
• Puncture maximum force	-30 °C	kN	ISO 6603-2	6.6	6.4	6.2	6.4
• Puncture energy	23 °C	J	ISO 6603-2	62	60	58	60
• Puncture energy	-30 °C	J	ISO 6603-2	70	68	65	68
Flexural modulus	2 mm/min	MPa	ISO 178	2400	2400	2400	2400
Flexural strength	5 mm/min	MPa	ISO 178	103	105	108	105
Ball indentation hardness	-	N/mm <sup>2</sup>	ISO 2039-1	120	120	121	120
<b>Thermal properties</b>							
• Deflection temperature under load, Af	1.80 MPa	°C	ISO 75-1, -2	137	149	159	148
• Deflection temperature under load, Bf	0.45 MPa	°C	ISO 75-1, -2	150	161	174	160
Vicat softening temperature	50 N; 120 K/h	°C	ISO 306	159	171	184	170
RTI, tensile strength	1.5 mm/3.0 min	°C	UL 746B	140 <sup>1)</sup>	140	150	-
RTI, tensile impact strength	1.5 mm/3.0 min	°C	UL 746B	130 <sup>1)</sup>	130	130	-
RTI, electric strength	1.5 mm/3.0 min	°C	UL 746B	140 <sup>1)</sup>	140	150	-
• Coefficient of linear thermal expansion, parallel	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
• Coefficient of linear thermal expansion, transverse	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65	0.65
Burning behavior UL 94 (UL-Registration)	Thickness: 1.5 mm	Class	UL 94	HB <sup>2)</sup>	HB	HB	HB
Burning behavior UL 94 (UL-Registration)	Thickness: 3.0 mm	Class	UL 94	HB <sup>2)</sup>	HB	HB	HB
Burning behaviour FMVSS	Thickness: 1.0 mm	mm/min	ISO 3795	0	0	0	0
• Oxygen index	Method A	%	ISO 4589	26	25	25	25
Glow wire temperature (GWFI)	Thickness: 2.0 mm	°C	IEC 695-2-12	900	850	850	850
<b>Electrical properties (23 °C/50 % r. F.)</b>							
• Relative permittivity	100 Hz	-	IEC 250	3	3	2.9	3
• Relative permittivity	1 MHz	-	IEC 250	2.9	2.9	2.8	2.9
• Dissipation factor	100 Hz	10 <sup>-4</sup>	IEC 250	10	10	10	10
• Dissipation factor	1 MHz	10 <sup>-4</sup>	IEC 250	90	80	80	80
• Volume resistivity	-	Ohm · m	IEC 93	1E + 15	1E + 15	1E + 15	1E + 15
• Surface resistivity	-	Ohm	IEC 93	1E + 16	1E + 16	1E + 16	1E + 16
• Electric Strength	-	kV/mm	IEC 243-1	35	35	35	35
• Comparative tracking index CTI	Solution A	Rating	IEC 112	250	250	450	250
Comparative tracking index CTI M	Solution B	Rating	IEC 112	125	125	100	125
Electrolytic corrosion	-	Rating	IEC 426	A1	A1	A1	A1
<b>Other properties (23 °C)</b>							
• Water absorption (saturation value)	in water at 23 °C	%	ISO 62	0.3	0.3	0.3	0.3
• Water absorption (equilibrium value)	23 °C/50 %	%	ISO 62	0.12	0.12	0.12	0.12
• Density	-	kg/m <sup>3</sup>	ISO 1183	1180	1170	1150	1170
<b>Material-specific properties</b>							
Refractive index	-	-	ISO 489-A	1.578	1.578	1.573	1.578
Light transmittance (color-no. 551022)	1 mm	%	ISO 5036-1	89	89	89	88
• Light transmittance (color-no. 551022)	2 mm	%	ISO 5036-1	88	88	88	87
Light transmittance (color-no. 551022)	3 mm	%	ISO 5036-1	87	87	87	86
<b>Processing conditions for test specimen</b>							
• Injection molding-melt temperature	-	°C	ISO 294	330	330	330	330
• Injection molding-mold temperature	-	°C	ISO 294	100	100	100	100
• Injection molding-flow front velocity	-	mm/s	ISO 294	200	200	200	200

• These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalog of basic data for plastics according to ISO10350.

1) Expected RTI

2) Covestro Test

7) Disclaimer of Warranty (See warranty on page 23)





# Apec® – Typical values

Properties	Test conditions	Units	Standards	Flame retardant grade		Reflective white grade
				FR1892	DP1-9354	RW1697
<b>Rheological properties</b>						
• Melt volume-flow rate (MVR)	330 °C; 2.16 kg	cm <sup>3</sup> /10 min	ISO 1133	18	12	45
Melt mass-flow rate (MFR)	330 °C; 2.16 kg	g/10 min	ISO 1133	19	12	45
• Molding shrinkage, parallel	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.85	0.9	0.7
Molding shrinkage, transverse	60 x 60 x 2 mm <sup>3</sup> ; 500 bar holding pressure	%	ISO 2577	0.85	0.9	0.7
<b>Mechanical properties (23 °C/50 % r. F.)</b>						
• Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2450	2400	2500
• Yield stress	50 mm/min	MPa	ISO 527-1, -2	74	72	68
• Yield strain	50 mm/min	%	ISO 527-1, -2	6.6	6.8	6.0
• Nominal tensile strain at break	50 mm/min	%	ISO 527-1, -2	> 50	50	50
• Charpy impact strength	23 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB
• Charpy impact strength	-30 °C	kJ/m <sup>2</sup>	ISO 179/1eU	NB	NB	NB
Charpy notched impact strength	23 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	8	8	9
Charpy notched impact strength	-30 °C, 3 mm	kJ/m <sup>2</sup>	acc. ISO 179/1eA	8	8	9
• Puncture maximum force	23 °C	kN	ISO 6603-2	5.0	5.2	-
• Puncture maximum force	-30 °C	kN	ISO 6603-2	5.8	6.6	-
• Puncture energy	23 °C	J	ISO 6603-2	50	52	-
• Puncture energy	-30 °C	J	ISO 6603-2	52	56	-
Flexural modulus	2 mm/min	MPa	ISO 178	2450	2400	2500
Flexural strength	5 mm/min	MPa	ISO 178	108	108	110
Ball indentation hardness	-	N/mm <sup>2</sup>	ISO 2039-1	127	121	-
<b>Thermal properties</b>						
• Deflection temperature under load, Af	1.80 MPa	°C	ISO 75-1, -2	158	159	137
• Deflection temperature under load, Bf	0.45 MPa	°C	ISO 75-1, -2	173	174	149
Vicat softening temperature	50 N; 120 K/h	°C	ISO 306	183	185	157
RTI, tensile strength	1.5 mm/3.0 min	°C	UL 746B	140 <sup>1)</sup>	140	-
RTI, tensile impact strength	1.5 mm/3.0 min	°C	UL 746B	130 <sup>1)</sup>	130	-
RTI, electric strength	1.5 mm/3.0 min	°C	UL 746B	140 <sup>1)</sup>	140	-
• Coefficient of linear thermal expansion, parallel	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65
• Coefficient of linear thermal expansion, transverse	23 to 55 °C	10 <sup>-4</sup> /K	ASTM E 831	0.65	0.65	0.65
Burning behavior UL 94 (UL-Registration)	Thickness: 1.5 mm	Class	UL 94	V2	V0	V2 <sup>2)</sup>
Burning behavior UL 94 (UL-Registration)	Thickness: 3.0 mm	Class	UL 94	V0	V0	HB <sup>2)</sup>
Burning behaviour FMVSS	Thickness: 1.0 mm	mm/min	ISO 3795	0	0	-
• Oxygen index	Method A	%	ISO 4589	30	33	-
Glow wire temperature (GWFI)	Thickness: 2.0 mm	°C	IEC 695-2-12	960	960	-
<b>Electrical properties (23 °C/50 % r. F.)</b>						
• Relative permittivity	100 Hz	-	IEC 250	2.9	2.9	-
• Relative permittivity	1 MHz	-	IEC 250	2.8	2.8	-
• Dissipation factor	100 Hz	10 <sup>-4</sup>	IEC 250	10	10	-
• Dissipation factor	1 MHz	10 <sup>-4</sup>	IEC 250	90	90	-
• Volume resistivity	-	Ohm · m	IEC 93	1E + 14	1E + 14	-
• Surface resistivity	-	Ohm	IEC 93	1E + 15	1E + 15	-
• Electric Strength	-	kV/mm	IEC 243-1	35	35	-
• Comparative tracking index CTI	Solution A	Rating	IEC 112	225	225	-
Comparative tracking index CTI M	Solution B	Rating	IEC 112	100	100	-
Electrolytic corrosion	-	Rating	IEC 426	A1	A1	-
<b>Other properties (23 °C)</b>						
• Water absorption (saturation value)	in water at 23 °C	%	ISO 62	0.3	0.3	0.3
• Water absorption (equilibrium value)	23 °C/50 %	%	ISO 62	0.12	0.12	0.12
• Density	-	kg/m <sup>3</sup>	ISO 1183	1150	1150	-
<b>Material-specific properties</b>						
Refractive index	-	-	ISO 489-A	1.573	<sup>4)</sup>	<sup>4)</sup>
Light transmittance (color-no. 551022)	1 mm	%	ISO 5036-1	90 <sup>5)</sup>	<sup>4)</sup>	<sup>4)</sup>
• Light transmittance (color-no. 551022)	2 mm	%	ISO 5036-1	90 <sup>5)</sup>	<sup>4)</sup>	<sup>4)</sup>
Light transmittance (color-no. 551022)	3 mm	%	ISO 5036-1	89 <sup>5)</sup>	<sup>4)</sup>	95 <sup>4)</sup> , <sup>6)</sup>
<b>Processing conditions for test specimen</b>						
• Injection molding-melt temperature	-	°C	ISO 294	330	330	330
• Injection molding-mold temperature	-	°C	ISO 294	100	100	100
• Injection molding-flow front velocity	-	mm/s	ISO 294	200	200	200

• These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalog of basic data for plastics according to ISO10350.

1) Expected RTI  
2) Covestro Test

4) Only opaque colors  
5) Natural colored

6) Light reflection acc. to JIS8722 (color-no. 010226)

**Typical value**

These values are typical values only. Unless explicitly agreed in written form, they do not constitute a binding material specification or warranted values. Values may be affected by the design of the mold/die, the processing conditions and coloring/pigmentation of the product. Unless specified to the contrary, the property values given have been established on standardized test specimens at room temperature.

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