Makroblend®

covestro

Product range

Typical values

Makroblend®

Makroblend® is the brand name of our blend series, which combines the first-class properties of polycarbonate and polyester (PET or PBT). Makroblend® has an excellent property profile, which includes high impact strength (even at low temperatures), excellent chemical resistance to many lubricants, solvents and cleaning agents, low susceptibility to stress cracking, good paintability and low moisture absorption. Also, some types offer high stiffness with an E-modulus of up to 6.5 GPa. Flame-retardant types are also available. With this property combination, Makroblend® is a proven material for a wide variety of applications in the fields of electrical engineering, electronics, sports goods, lawn and garden and automotive engineering.

Characterization

Makroblend® is an engineering plastic that combines the outstanding properties of polycarbonate (PC) and polybutylene terephthalate (PBT) or polyethylene terephthalate (PET).

Characteristic features

- High strength, even at low temperatures
- Good resistance to chemicals
- Good paintability
- Reduced tendency to stress cracking
- Easy flowing
- Low moisture uptake
- Grades with very low and isotropic linear thermal expansion coefficient available
- Flame-retardant grades (antimony-, chlorine- and bromine-free flame-retardant)

Main areas of application

Automotive:
Bumpers, radiator grilles, external components, bodywork components

Electrical engineering and electronics:
Housings of power tools

Sports and leisure:
Toecaps of safety shoes

Characteristic features

Color:
Naturally light ivory in color, available in many opaque colors, light stable

Surface finish:
Glossy on smooth surfaces or matt on grained surfaces

Stiffness:
High, tensile modulus: 1,800 to 6,500 MPa, depending on the grade

Toughness:
High impact strength, good strength, even at low temperatures

Heat resistance:
High; Vicat VST B120 119°C to 140°C depending on the grade

Dimensional accuracy and stability:

Good, significantly better than partially crystalline thermoplastics, absorbs only a minimum amount of moisture

Resistance to chemicals:

Makroblend® is resistant to hydrocarbons, alcohols, organic acids, inorganic aqueous salts, and mild base and acid solutions. This makes them suitable for applications requiring resistance to intermittent contact with fuels, oils, cleaners, and other automotive-type chemicals. Makroblend® resin is not resistant to strong alkalis or chlorinated, aromatic, ketone- or ester-containing solvents.

Additional influence parameters of the chemical resistance properties of material are the:

- Composition of the surrounding media
- Temperature
- Duration of exposure
- Level of inherent or applied stress level in the molded part

If finished parts are likely to come into contact with aggressive media during use, it is essential to test them under actual operating conditions first.

Processing and fabrication

Processing the raw material
Injection molding, extrusion, rotational molding

Secondary processing
Thermoforming, e.g., deep-drawing, bending and stamping; cold forming, e.g., by high-pressure molding

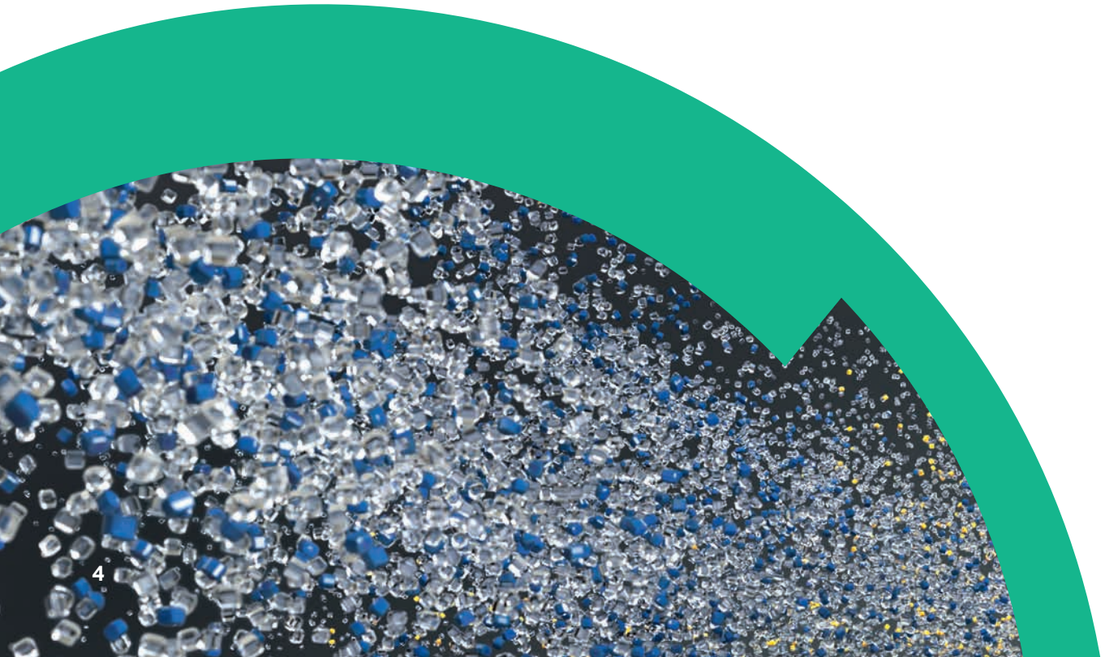
Machining
Sawing, drilling, turning, milling, planing, grinding, tapping, die-cutting and cutting

Joining
Screwing, bonding, welding and riveting

Finishing
Painting, printing, metallizing and laser marking

Delivery form
The products are supplied in the form of oval, spherical or cylindrical granules in 25-kg polyethylene sacks, in large cartons with a PE liner, in big bags or by silo truck. The Makroblend® grades are available in natural color or opaque in a wide range of shades. The production plants for Makroblend® in Europe, Asia and in the United States have been certified to ISO 9001: 2008 by the DQS (German Association for the Certification of Quality Systems, Berlin). The certificate can be found on the Internet at www.plastics.covestro.com.

Recycling
Part labeling is in accordance with DIN EN ISO 11469. After use, single-sort, uncontaminated moldings made from Makroblend® can be recycled. Contaminated moldings can be recycled chemically or thermally.



Processing

Material preparation/drying
To achieve optimum molded part properties, it is essential for Makroblend® 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

Makroblend® will absorb up to 0.2% water from the air (23°C/50% relative humidity) and up to 0.5% when in direct contact with water. To avoid the property deteriorations referred to above, it is vital to reduce the PC/PBT grades in the water content to ≤ 0.02% prior to processing, PC/PET grades to ≤ 0.01%. We recommend the following drying conditions as a function of the moisture content of the granules and the efficiency of the dryer:

Grade	Drying temperature	Drying time		
	(granule temperature)	Circulating air dryer (50% fresh air)	Fresh air dryer	Dry-air dryer recommended
PC/PBT grades	100–105°C	4 to 12 h	up to 8 h	**4 to 6 h**
PC/PET grades	110°C	4 to 12 h	up to 8 h	**4 to 6 h**

Recommended drying conditions for Makroblend®

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 ≤ 0.02%, respective ≤ 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.

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

Processing temperatures/processing advice

The main process employed for the production of parts using Makroblend® is injection molding. The advice set out below thus relates exclusively to this form of processing.

Present-day injection molding machines with standard, 3-zone screws are suitable for the injection molding of Makroblend®.

Grade	Mold temperature in °C	Melt temperature in °C
PC/PBT grade	60–70	250–270
PC/PET grade	60–80	260–280

Recommended mold and melt temperatures for Makroblend®

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. Makroblend® can be injected at high speeds, and graded injection has also proved successful. The holding pressure should not be set higher than is absolutely necessary or applied for longer than strictly required.

Further advice on processing can be obtained from our general information brochure “Processing data for the injection molder.”

(PC+PBT) blends

Unreinforced

UT3907	(PC+PBT) blend, high flow, impact-modified, easy release, UV-stabilized, injection molding grade. Makroblend® DP UT3907* offers superior flowability, good impact strength and excellent chemical resistance.	**UT6007**	PC+PBT) blend, impact-modified, easy release, UV-stabilized, injection molding grade. Makroblend® DP UT6007* offers an exceptional low-temperature impact strength, good flowability and excellent chemical resistance.
KU2-7912	(PC+PBT) blend, impact-modified, injection molding grade, medium flow, high toughness at low temperatures, ideal for painted applications, unreinforced, applications: automotive body panels	**KU2-7912/4**	(PC+PBT) blend, impact-modified, injection molding grade, high toughness at low temperatures, ideal for painted applications, unreinforced, applications: automotive body panels
S7916	(PBT+PC) blend, impact-modified, injection molding grade, excellent chemical resistance, high toughness at low temperatures, ideal for painted applications, unreinforced, applications: motorcycle body parts	**UT5205**	(PC+PBT) blend, (region: NAFTA); impact-modified, easy release, injection molding grade. Makroblend® UT5205 offers an exceptional low-temperature impact strength, good flowability and excellent chemical resistance. Suitable for metal insert molding.

(PC+PBT) blend

Medical grade

M525	(PC+PBT) blend, impact-modified, easy release, injection molding grade. Makroblend® M525 offers an exceptional low-temperature impact strength, good flowability and excellent chemical resistance. Manufactured according to GMP, tested only according to ISO 10993-5 and ISO 10993-10 for contact with uncompromised skin only; for questions regarding biocompatibility send an email inquiry to plastics@covestro.com.

(PC+PBT) blends

Reinforced		Glass fiber-reinforced	
KU2-7609	(PC+PBT) blend, impact modified, Injection molding grade, 20% mineral filled, applications: automotive exterior body panels	**UT4045 G**	(PC+PBT) blend, 20% glass fiber-reinforced, easy release, injection molding. Makroblend® UT4045G offers a high stiffness, excellent chemical resistance, good flowability and exceptional dimensional stability.

(PC+PET) blend

Reinforced

UT235 M	(PC+PET) blend, mineral-filled, easy flow, low coefficient of linear thermal expansion, easy release, injection molding. Molded parts from UT235M have exceptional dimensional stability.

(PC+PET) blends

Unreinforced

AR205	(PC+PET) blend, easy flow, impact-modified; application: automotive body panels	**DP7645**	(PC+PET) blend, impact-modified, injection molding grade, unreinforced; applications: automotive radiator grills
UT250	(PC+PET) blend, impact-modified, easy release, injection molding. Makroblend® UT250 offers high heat resistance, good chemical resistance and flowability. Additionally, molded parts from UT250 have exceptional dimensional stability.	**UT305**	PC+PET) blend, easy release, injection molding. Makroblend® UT305 offers high heat resistance and flowability. Molded parts from UT305 provide a good surface appearance and exceptional dimensional stability, even in high moisture environments.
UT250 HR	(PC+PET) blend, (region: NAFTA), impact-modified, improved hydrolysis resistance compared to standard Makroblend® UT grades, injection molding grade. Good low-temperature impact strength, flowability, and chemical resistance. Applications include lead-acid battery housings.	**UT1018**	(PET+PC) blend, (region: NAFTA), unreinforced, impact-modified, injection molding grade. Good dimensional stability, excellent low-temperature impact and chemical resistance. UL746C f2 rated.
UT203	(PC+PET) blend, (region: NAFTA), impact-modified, UV-stabilized, injection molding grade	**UT403**	PC+PET) blend, (region: NAFTA), unreinforced, UV-stabilized, impact-modified, high flow, injection molding grade. Good impact strength, dimensional stability and chemical resistance. UL746C f1 rated.
UT408	(PC+PET) blend, (region: NAFTA), unreinforced, impact-modified, high flow, injection molding grade, good impact strength, dimensional stability and chemical resistance. Suitable for some food contact applications (contact Covestro for more information).		

Makroblend®

(PC+PET) blends

Flame-retardant

EL700	(PC+PET) blend, (region: NAFTA), unreinforced, flame-retardant, impact-modified, injection molding grade. Good impact strength, dimensional stability and chemical resistance. Uses include indoor electrical enclosures.	**EL703**	(PC+PET) blend, (region: NAFTA), unreinforced, flame-retardant, UV-stabilized, impact-modified, high flow, injection molding grade. Good impact strength, dimensional stability and chemical resistance. Uses include outdoor electrical enclosures. UL746C f1 rated.

Makroblend® – typical values

				(PC+PBT) blends			
				Unreinforced			
Typical Properties	**Test conditions**	**Units**	**Standards**	**UT3907**	**UT6007**	**KU2-7912**	**KU2-7912/4**
Rheological properties							
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	44	18	21	16
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	–	–	–	–
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	245	390	290	460
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	190	315	–	–
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	0.7–0.9	0.7–0.9	0.7–0.9	0.7–0.9
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	0.1–0.2	0.1–0.2	0.1–0.2	0.1–0.2
Mechanical properties (23°C/50% r. h.)							
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2200	2200	2100	2150
C Yield stress	50 mm/min	MPa	ISO 527-1, -2	60	60	50	50
C Yield strain	50 mm/min	%	ISO 527-1, -2	5	5	4	4
C Nominal strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50	> 50
Stress at break	50 mm/min	MPa	ISO 527-1, -2	50	50	40	45
Flexural modulus	2 mm/min	MPa	ISO 178	2150	2150	2000	2100
Flexural strain at flexural strength	2 mm/min	%	ISO 178	6	6	5.6	5.5
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	70	70	70	66
Flexural strength	2 mm/min	MPa	ISO 178	80	80	80	75
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	N	N	N	N
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	N	N	N	N
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	55	60	60	60
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	25	40	45	45
Izod impact strength	23°C	kJ/m^2	ISO 180-U	N	N	N	N
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	N	N	N	N
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	40	50	60	60
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	25	35	45	45
Ball indentation hardness	–	N/mm^2	ISO 2039-1	107	108	100	100
Thermal properties							
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	82	85	84	82
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	105	110	100	106
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	122	126	120	120
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.9	0.9	0.9	0.9
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.9	0.9	0.9	0.9
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	HB*	HB*	HB	HB
C Oxygen index	Method A	%	ISO 4589-2	21	21	21	21
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	passed	passed	passed	passed
Electrical properties (23°C/50% r. h.)							
C Relative permittivity	100 Hz	–	IEC 60250	3.2	3.2	3.2	3.2
C Relative permittivity	1 MHz	–	IEC 60250	3.0	3.0	3.1	3.1
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	6	7	10	15
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	45	45	125	130
C Volume resistivity	–	Ohm · m	IEC 60093	> 1E15	> 1E15	> 1E15	> 1E15
C Surface resistivity	–	Ohm	IEC 60093	> 1E17	> 1E17	> 1E17	> 1E17
C Electrical strength	1 mm	kV/mm	IEC 60243-1	30	30	31	35
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	600	600	600	500
Other properties (23°C)							
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.5	0.5	0.5	0.5
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.2	0.2	0.2	0.2
C Density	–	kg/m^3	ISO 1183-1	1200	1200	1200	1200
Bulk density	–	g/m^3	ISO 60	0.65	0.65	0.7	0.7
Processing conditions for test specimens							
C Injection molding – melt temperature	–	°C	ISO 294	260	260	260	260
C Injection molding – mold temperature	–	°C	ISO 294	70	70	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Makroblend® – typical values

				(PC+PBT) blends		
				Unreinforced		Medical
Typical Properties	**Test conditions**	**Units**	**Standards**	**S7916**	**UT5205**	**M525**
Rheological properties						
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	13	21	21
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	–	–	–
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	340	–	–
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	–	–	–
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	1.2–1.6	0.7–0.9	0.7–0.9
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	0.1–0.2	0.1–0.2	0.1–0.2
Mechanical properties (23°C/50% r. h.)						
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	1800	2000	2000
C Yield stress	50 mm/min	MPa	ISO 527-1, -2	40	55	55
C Yield strain	50 mm/min	%	ISO 527-1, -2	4	4.5	4.5
C Nominal strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50
Stress at break	50 mm/min	MPa	ISO 527-1, -2	35	45	45
Flexural modulus	2 mm/min	MPa	ISO 178	1700	2000	2000
Flexural strain at flexural strength	2 mm/min	%	ISO 178	5.0	–	–
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	54	65	65
Flexural strength	2 mm/min	MPa	ISO 178	63	–	–
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	N	–	–
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	N	–	–
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	69	–	–
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	–	–	–
Izod impact strength	23°C	kJ/m^2	ISO 180-U	N	–	–
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	N	–	–
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	66	60	60
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	47	–	–
Ball indentation hardness	–	N/mm^2	ISO 2039-1	85	–	–
Thermal properties						
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	60	75	75
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	91	100	100
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	119	122	122
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	1.1	0.9	0.9
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	1.1	0.9	0.9
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	HB	–	–
C Oxygen index	Method A	%	ISO 4589-2	20	–	–
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	passed	passed	passed
Electrical properties (23°C/50% r. h.)						
C Relative permittivity	100 Hz	–	IEC 60250	3.1	3.2	–
C Relative permittivity	1 MHz	–	IEC 60250	2.9	3.1	–
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	23	30	–
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	140	150	–
C Volume resistivity	–	Ohm · m	IEC 60093	> 1E15	> 1E14	> 1E14
C Surface resistivity	–	Ohm	IEC 60093	> 1E17	> 1E15	> 1E15
C Electrical strength	1 mm	kV/mm	IEC 60243-1	–	33	–
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	600	225	225
Other properties (23°C)						
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.5	0.5	0.5
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.2	0.2	0.2
C Density	–	kg/m^3	ISO 1183-1	1200	1220	1220
Bulk density	–	g/m^3	ISO 60	0.7	–	–
Processing conditions for test specimens						
C Injection molding – melt temperature	–	°C	ISO 294	260	260	260
C Injection molding – mold temperature	–	°C	ISO 294	70	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Makroblend® – typical values

				(PC+PBT) blends		(PC+PET) blend
				Reinforced		Reinforced
Typical Properties	**Test conditions**	**Units**	**Standards**	**KU2-7609**	**UT4045 G**	**UT235 M**
Rheological properties						
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	11	30	–
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	–	–	43
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	375	–	–
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	290	220	210
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	0.4–0.6	0.2–0.6	0.5–0.6
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	0.1 – 0.2	< 0.1	–
Mechanical properties (23°C/50% r. h.)						
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	3400	6500	4500
C Yield stress	5 mm/min	MPa	ISO 527-1, -2	50	100	68
C Yield strain	5 mm/min	%	ISO 527-1, -2	3.0	3.0	3.5
C Nominal strain at break	5 mm/min	%	ISO 527-1, -2	–	–	4.0
Stress at break	5 mm/min	MPa	ISO 527-1, -2	50	100	67
Flexural modulus	2 mm/min	MPa	ISO 178	3400	6100	4650
Flexural strain at flexural strength	2 mm/min	%	ISO 178	5.0	3.0	5.0
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	73	–	110
Flexural strength	2 mm/min	MPa	ISO 178	75	160	115
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	155	45	85
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	115	40	85
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	10	–	–
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	–	–	–
Izod impact strength	23°C	kJ/m^2	ISO 180-U	–	40	75
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	–	35	75
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	20	6.0	–
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	–	6.0	–
Ball indentation hardness	–	N/mm^2	ISO 2039-1	90	–	–
Thermal properties						
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	93	110	114
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	106	130	128
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	119	140	139
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.7	–	0.45
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.7	–	0.45
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	HB	–	–
C Oxygen index	Method A	%	ISO 4589-2	21	–	–
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	passed	passed	passed
Electrical properties (23°C/50% r. h.)						
C Relative permittivity	100 Hz	–	IEC 60250	3.2	–	–
C Relative permittivity	1 MHz	–	IEC 60250	3.1	–	–
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	26	–	–
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	95	–	–
C Volume resistivity	–	Ohm · m	IEC 60093	> 1E15	–	–
C Surface resistivity	–	Ohm	IEC 60093	> 1E17	–	–
C Electrical strength	1 mm	kV/mm	IEC 60243-1	34	–	–
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	250	–	–
Other properties (23°C)						
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.8	–	0.4
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.2	–	0,.2
C Density	–	kg/m^3	ISO 1183-1	1300	1400	1340
Bulk density	–	g/m^3	ISO 60	0.7	–	–
Processing conditions for test specimens						
C Injection molding – melt temperature	–	°C	ISO 294	260	260	270
C Injection molding – mold temperature	–	°C	ISO 294	70	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Makroblend® – typical values

				(PC+PET) blends			
				Unreinforced			
Typical Properties	**Test conditions**	**Units**	**Standards**	**AR205**	**DP7645**	**UT250**	**UT305**
Rheological properties							
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	–	12	22	–
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	38	21		49
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	170	340	330	205
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	155	–	–	–
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	0.7–0.9	0.6–0.8	0.6–0.8	0.65
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	–	0.1–0.2	0.1–0.2	0.1
Mechanical properties (23°C/50% r. h.)							
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2200	2100	2250	2600
C Yield stress	50 mm/min	MPa	ISO 527-1, -2	54	50	55	70
C Yield strain	50 mm/min	%	ISO 527-1, -2	4.8	4.5	5	5.5
C Nominal strain at break	50 mm/min	%	ISO 527-1, -2	> 50	> 50	> 50	–
Stress at break	50 mm/min	MPa	ISO 527-1, -2	48	40	50	54
Flexural modulus	2 mm/min	MPa	ISO 178	2200	2100	2300	2600
Flexural strain at flexural strength	2 mm/min	%	ISO 178	5.8	5.7	6.1	6.2
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	68	65	72	82
Flexural strength	2 mm/min	MPa	ISO 178	80	75	88	100
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	N	N	N	N
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	N	N	N	N
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	45	55	70	8
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	20	–	30	6
Izod impact strength	23°C	kJ/m^2	ISO 180-U	–	N	–	N
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	–	N	–	N
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	45	50	60	8
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	20	–	25	8
Ball indentation hardness	–	N/mm^2	ISO 2039-1	–	100	100	–
Thermal properties							
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	98	94	110	108
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	126	–	125	128
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	138	133	140	140
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.81	0.8	0.8	0.7
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.82	0.8	0.8	0.7
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	–	HB	–	HB
C Oxygen index	Method A	%	ISO 4589-2	–	20	–	–
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	passed	passed	passed	passed
Electrical properties (23°C/50% r. h.)							
C Relative permittivity	100 Hz	–	IEC 60250	–	3.2	3.2	–
C Relative permittivity	1 MHz	–	IEC 60250	–	3.3	3.0	–
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	–	13	16	–
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	–	144	146	–
C Volume resistivity	–	Ohm · m	IEC 60093	–	> 1E15	> 1E15	–
C Surface resistivity	–	Ohm	IEC 60093	–	> 1E17	> 1E17	–
C Electrical strength	1 mm	kV/mm	IEC 60243-1	–	33	34	–
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	–	175	250	–
Other properties (23°C)							
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.5	0.3	0.55	0.55
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.2	0.15	0.2	0.25
C Density	–	kg/m^3	ISO 1183-1	1210	1200	1220	1240
Bulk density	–	g/m^3	ISO 60	0.65	0.7	–	–
Processing conditions for test specimens							
C Injection molding – melt temperature	–	°C	ISO 294	270	270	270	270
C Injection molding – mold temperature	–	°C	ISO 294	70	70	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Makroblend® – typical values

				(PC+PET) blends				
				Unreinforced				
Typical Properties	**Test conditions**	**Units**	**Standards**	**UT250 HR**	**UT1018**	**UT203**	**UT403**	**UT408**
Rheological properties								
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	–	–	17	–	–
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	22	13	–	34	20
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	–	–	–	–	–
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	–	–	300	–	–
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	0.6–0.8	0.7–0.9	0.6–0.8	0.6–0.8	0.6–0.8
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	–	–	–	–	–
Mechanical properties (23°C/50% r. h.)								
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2200	2000	2350	2400	2400
C Yield stress	50 mm/min	MPa	ISO 527-1, -2	55	49	59	58	59
C Yield strain	50 mm/min	%	ISO 527-1, -2	4.9	4.5	–	5.0	5.5
C Nominal strain at break	50 mm/min	%	ISO 527-1, -2	110	100	50	100	100
Stress at break	50 mm/min	MPa	ISO 527-1, -2	57	46	–	58	64
Flexural modulus	2 mm/min	MPa	ISO 178	2200	1900	–	2300	2350
Flexural strain at flexural strength	2 mm/min	%	ISO 178	–	–	–	–	–
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	68	60	–	72	71
Flexural strength	2 mm/min	MPa	ISO 178	82	70	–	86	88
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	N	–	–	–	–
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	N	–	–	–	–
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	65	65	–	–	–
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	35	35	–	–	–
Izod impact strength	23°C	kJ/m^2	ISO 180-U	–	–	–	–	–
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	–	–	–	–	–
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	–	60	75	–	60
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	–	–	–	–	10
Ball indentation hardness	–	N/mm^2	ISO 2039-1	–	–	–	–	–
Thermal properties								
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	102	78	106	98	109
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	123	108	128	124	131
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	137	132	138	139	142
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.75	0.8	–	0.7	0.7
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.75	0.9	–	0.8	0.8
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	HB*	HB	HB	HB	HB
C Oxygen index	Method A	%	ISO 4589-2	–	–	–	–	–
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	–	–	–	–	–
Electrical properties (23°C/50% r. h.)								
C Relative permittivity	100 Hz	–	IEC 60250	–	3.2	–	3.2	3.2
C Relative permittivity	1 MHz	–	IEC 60250	–	3.1	–	3.1	3.1
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	–	20	–	17	13
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	–	150	–	150	140
C Volume resistivity	–	Ohm · m	IEC 60093	–	1.00E+14	–	1.00E+14	1.00E+14
C Surface resistivity	–	Ohm	IEC 60093	–	1.00E+16	–	1.00E+16	1.00E+16
C Electrical strength	1 mm	kV/mm	IEC 60243-1	–	34	–	34	34
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	–	600	–	200	375
Other properties (23°C)								
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.5	0.7	–	0.5	0.5
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.16	0.2	–	0.2	0.2
C Density	–	kg/m^3	ISO 1183-1	1215	1220	1210	1230	1220
Bulk density	–	g/m^3	ISO 60	–	–	–	–	–
Processing conditions for test specimens								
C Injection molding – melt temperature	–	°C	ISO 294	270	270	270	270	270
C Injection molding – mold temperature	–	°C	ISO 294	70	70	70	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200	200	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Makroblend® – typical values

				(PC+PET) blends	
				Flame-retardant	
Typical Properties	**Test conditions**	**Units**	**Standards**	**EL700**	**EL703**
Rheological properties					
C Melt volume-flow rate (MVR)	260°C; 5 kg	cm^3/(10 min)	ISO 1133	–	–
C Melt volume-flow rate (MVR)	270°C; 5 kg	cm^3/(10 min)	ISO 1133	15	26
Melt viscosity	1000 s^{-1}; 260°C	Pa · s	b. o. ISO 11443-A	–	–
Melt viscosity	1000 s^{-1}; 270°C	Pa · s	b. o. ISO 11443-A	–	–
Molding shrinkage, parallel/normal	Value range based on general practical experience (600 bar)	%	b. o. ISO 2577	0.6–0.8	0.6–0.8
Post-shrinkage, parallel/normal	Value range based on general practical experience (1 h; 90°C)	%	b. o. ISO 2577	–	–
Mechanical properties (23°C/50% r. h.)					
C Tensile modulus	1 mm/min	MPa	ISO 527-1, -2	2350	2300
C Yield stress	50 mm/min	MPa	ISO 527-1, -2	58	56
C Yield strain	50 mm/min	%	ISO 527-1, -2	4.5	4.5
C Nominal strain at break	50 mm/min	%	ISO 527-1, -2	100	100
Stress at break	50 mm/min	MPa	ISO 527-1, -2	57	55
Flexural modulus	2 mm/min	MPa	ISO 178	2300	2250
Flexural strain at flexural strength	2 mm/min	%	ISO 178	–	–
Flexural stress at 3.5% strain	2 mm/min	MPa	ISO 178	72	71
Flexural strength	2 mm/min	MPa	ISO 178	86	83
C Charpy impact strength	23°C	kJ/m^2	ISO 179-1eU	–	–
C Charpy impact strength	–30°C	kJ/m^2	ISO 179-1eU	–	–
C Charpy notched impact strength	23°C	kJ/m^2	ISO 179-1eA	65	50
C Charpy notched impact strength	–30°C	kJ/m^2	ISO 179-1eA	30	15
Izod impact strength	23°C	kJ/m^2	ISO 180-U	–	–
Izod impact strength	–30°C	kJ/m^2	ISO 180-U	–	–
Izod notched impact strength	23°C	kJ/m^2	ISO 180-A	60	50
Izod notched impact strength	–30°C	kJ/m^2	ISO 180-A	30	15
Ball indentation hardness	–	N/mm^2	ISO 2039-1	–	–
Thermal properties					
C Temperature of deflection under load	1.80 MPa	°C	ISO 75-1, -2	100	96
C Temperature of deflection under load	0.45 MPa	°C	ISO 75-1, -2	123	119
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	136	132
C Coefficient of linear thermal expansion, parallel	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.8	0.7
C Coefficient of linear thermal expansion, transverse	23 to 55°C	10^{-4}/K	ISO 11359-1, -2	0.9	0.8
C Burning behavior UL 94 (1.5 mm)	1.5 mm	Class	UL 94	V-0	V-0
C Oxygen index	Method A	%	ISO 4589-2	–	–
Burning rate (US-FMVSS)	≥ 1.0 mm	mm/min	ISO 3795	–	–
Electrical properties (23°C/50% r. h.)					
C Relative permittivity	100 Hz	–	IEC 60250	3.1	3.5
C Relative permittivity	1 MHz	–	IEC 60250	3.0	3.3
C Dissipation factor	100 Hz	10^{-4}	IEC 60250	20	30
C Dissipation factor	1 MHz	10^{-4}	IEC 60250	130	200
C Volume resistivity	–	Ohm · m	IEC 60093	1.00E+14	1.00E+14
C Surface resistivity	–	Ohm	IEC 60093	1.00E+16	1.00E+16
C Electrical strength	1 mm	kV/mm	IEC 60243-1	34	34
C Comparative tracking index CTI	Solution A	Stufe	IEC 60112	225	200
Other properties (23°C)					
C Water absorption (saturation value)	Water at 23°C	%	ISO 62	0.5	0.5
C Water absorption (equilibrium value)	23°C; 50% r. h.	%	ISO 62	0.2	0.2
C Density	–	kg/m^3	ISO 1183-1	1280	1300
Bulk density	–	g/m^3	ISO 60	–	–
Processing conditions for test specimens					
C Injection molding – melt temperature	–	°C	ISO 294	270	270
C Injection molding – mold temperature	–	°C	ISO 294	70	70
C Injection molding – injection velocity	–	mm/s	ISO 294	200	200

C These property characteristics are taken from the CAMPUS® plastics data bank and are based on the international catalogue of basic data for plastic according to ISO 10350.

Impact properties:
N = non break
P = partial break
C = complete break

*(Covestro Test)

Typical values

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.

The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance, information and recommendations to determine to your own satisfaction whether our products, technical assistance and information are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by Covestro. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale which are available upon request. All information and technical assistance is given without warranty or guarantee and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance, and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with any claim of any patent relative to any material or its use. No license is implied or in fact granted under the claims of any patent.

With respect to health, safety and environment precautions, the relevant Material Safety Data Sheets (MSDS) and product labels must be observed prior to working with our products.

This product is not designated for the manufacture of a medical device or of intermediate products for medical devices[1]. This product is also not designated for other specifically regulated applications (e.g., including cosmetics, plant protection, fertilisers, plant strengtheners, food processing, food contact and others). If the intended use of the product is for the manufacture of a medical device or of intermediate products for medical devices or for other specifically regulated applications Covestro must be contacted in advance to provide its agreement to sell such product for such purpose. Nonetheless, any determination as to whether a product is appropriate for use in a medical device or intermediate products for medical devices, for food contact products or cosmetic applications must be made solely by the purchaser of the product without relying upon any representations by Covestro.

[1] Please see the „Guidance on Use of Covestro Products in a Medical Application" document.

Covestro Deutschland AG
Business Unit Polycarbonates
D-51365 Leverkusen

plastics@covestro.com
www.plastics.covestro.com

COV00083876
Edition 2018-06