

# Makrolon® 2256

Food contact grades / Low viscosity

MVR (300 °C/1.2 kg) 34 cm³/10 min; food contact quality; low viscosity; easy release; injection molding - melt temperature 280 - 320 °C; available in transparent, translucent and opaque colors

ISO Shortname

PC

| Property                                        | Test Condition                                    | Unit       | Standard                  | typical Value |
|-------------------------------------------------|---------------------------------------------------|------------|---------------------------|---------------|
| <b>Rheological properties</b>                   |                                                   |            |                           |               |
| C Melt volume-flow rate                         | 300 °C/ 1.2 kg                                    | cm³/10 min | ISO 1133                  | 34            |
| C Molding shrinkage, parallel                   | 60x60x2 mm/ 500 bar                               | %          | ISO 294-4                 | 0.65          |
| C Molding shrinkage, normal                     | 60x60x2 mm/ 500 bar                               | %          | ISO 294-4                 | 0.65          |
| Molding shrinkage, parallel/normal              | Value range based on general practical experience | %          | b.o. ISO 2577             | 0.5 - 0.7     |
| Melt mass-flow rate                             | 300 °C/ 1.2 kg                                    | g/10 min   | ISO 1133                  | 37            |
| <b>Mechanical properties (23 °C/50 % r. h.)</b> |                                                   |            |                           |               |
| C Tensile modulus                               | 1 mm/min                                          | MPa        | ISO 527-1,-2              | 2400          |
| C Yield stress                                  | 50 mm/min                                         | MPa        | ISO 527-1,-2              | 65            |
| C Yield strain                                  | 50 mm/min                                         | %          | ISO 527-1,-2              | 6.0           |
| C Nominal strain at break                       | 50 mm/min                                         | %          | ISO 527-1,-2              | > 50          |
| Stress at break                                 | 50 mm/min                                         | MPa        | ISO 527-1,-2              | 60            |
| Strain at break                                 | 50 mm/min                                         | %          | b.o. ISO 527-1,-2         | 125           |
| C Tensile creep modulus                         | 1 h                                               | MPa        | ISO 899-1                 | 2200          |
| C Tensile creep modulus                         | 1000 h                                            | MPa        | ISO 899-1                 | 1900          |
| Flexural modulus                                | 2 mm/min                                          | MPa        | ISO 178                   | 2350          |
| Flexural strength                               | 2 mm/min                                          | MPa        | ISO 178                   | 97            |
| Flexural strain at flexural strength            | 2 mm/min                                          | %          | ISO 178                   | 7.1           |
| Flexural stress at 3.5 % strain                 | 2 mm/min                                          | MPa        | ISO 178                   | 73            |
| C Charpy impact strength                        | 23 °C                                             | kJ/m²      | ISO 179-1eU               | N             |
| C Charpy impact strength                        | -30 °C                                            | kJ/m²      | ISO 179-1eU               | N             |
| Charpy impact strength                          | -60 °C                                            | kJ/m²      | ISO 179-1eU               | N             |
| Charpy notched impact strength                  | 23 °C/ 3 mm                                       | kJ/m²      | ISO 7391/b.o. ISO 179-1eA | 55P(C)        |
| Charpy notched impact strength                  | -30 °C/ 3 mm                                      | kJ/m²      | ISO 7391/b.o. ISO 179-1eA | 12C           |
| Izod notched impact strength                    | 23 °C/ 3 mm                                       | kJ/m²      | ISO 7391/b.o. ISO 180-A   | 55P           |
| Izod notched impact strength                    | -30 °C/ 3 mm                                      | kJ/m²      | ISO 7391/b.o. ISO 180-A   | 12C           |
| C Puncture maximum force                        | 23 °C                                             | N          | ISO 6603-2                | 4900          |
| C Puncture maximum force                        | -30 °C                                            | N          | ISO 6603-2                | 5900          |
| C Puncture energy                               | 23 °C                                             | J          | ISO 6603-2                | 55            |
| C Puncture energy                               | -30 °C                                            | J          | ISO 6603-2                | 60            |
| Ball indentation hardness                       |                                                   | N/mm²      | ISO 2039-1                | 115           |

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|-------------------------------------------------------|--------------------------------------|---------------------------------------------|----------------|---------------|
| <b>Thermal properties</b>                             |                                      |                                             |                |               |
| C Glass transition temperature                        | 10 °C/min                            | °C                                          | ISO 11357-1,-2 | 145           |
| C Temperature of deflection under load                | 1.80 MPa                             | °C                                          | ISO 75-1,-2    | 124           |
| C Temperature of deflection under load                | 0.45 MPa                             | °C                                          | ISO 75-1,-2    | 137           |
| C Vicat softening temperature                         | 50 N; 50 °C/h                        | °C                                          | ISO 306        | 145           |
| Vicat softening temperature                           | 50 N; 120 °C/h                       | °C                                          | ISO 306        | 146           |
| C Coefficient of linear thermal expansion, parallel   | 23 to 55 °C                          | 10 <sup>-4</sup> /K                         | ISO 11359-1,-2 | 0.65          |
| C Coefficient of linear thermal expansion, transverse | 23 to 55 °C                          | 10 <sup>-4</sup> /K                         | ISO 11359-1,-2 | 0.65          |
| C Oxygen index                                        | Method A                             | %                                           | ISO 4589-2     | 28            |
| Thermal conductivity, cross-flow                      | 23 °C; 50 % r. h.                    | W/(m·K)                                     | ISO 8302       | 0.20          |
| Resistance to heat (ball pressure test)               |                                      | °C                                          | IEC 60695-10-2 | 136           |
| Glow wire test (GWFI)                                 | 0.75 mm                              | °C                                          | IEC 60695-2-12 | 850           |
| Glow wire test (GWFI)                                 | 1.5 mm                               | °C                                          | IEC 60695-2-12 | 875           |
| Glow wire test (GWFI)                                 | 3.0 mm                               | °C                                          | IEC 60695-2-12 | 930           |
| Glow wire test (GWIT)                                 | 0.75 mm                              | °C                                          | IEC 60695-2-13 | 875           |
| Glow wire test (GWIT)                                 | 1.5 mm                               | °C                                          | IEC 60695-2-13 | 875           |
| Glow wire test (GWIT)                                 | 3.0 mm                               | °C                                          | IEC 60695-2-13 | 875           |
| Application of flame from small burner                | Method K and F/ 2.0 mm               | Class                                       | DIN 53438-1,-3 | K1, F1        |
| Needle flame test                                     | Method K/ 1.5 mm                     | s                                           | IEC 60695-11-5 | 5             |
| Needle flame test                                     | Method K/ 2.0 mm                     | s                                           | IEC 60695-11-5 | 5             |
| Needle flame test                                     | Method K/ 3.0 mm                     | s                                           | IEC 60695-11-5 | 10            |
| Needle flame test                                     | Method F/ 1.5 mm                     | s                                           | IEC 60695-11-5 | 60            |
| Needle flame test                                     | Method F/ 2.0 mm                     | s                                           | IEC 60695-11-5 | 120           |
| Needle flame test                                     | Method F/ 3.0 mm                     | s                                           | IEC 60695-11-5 | 120           |
| Burning rate (US-FMVSS)                               | >=1.0 mm                             | mm/min                                      | ISO 3795       | passed        |
| Flash ignition temperature                            |                                      | °C                                          | ASTM D1929     | 480           |
| Self ignition temperature                             |                                      | °C                                          | ASTM D1929     | 550           |
| <b>Electrical properties (23 °C/50 % r. h.)</b>       |                                      |                                             |                |               |
| C Relative permittivity                               | 100 Hz                               | -                                           | IEC 60250      | 3.1           |
| C Relative permittivity                               | 1 MHz                                | -                                           | IEC 60250      | 3.0           |
| C Dissipation factor                                  | 100 Hz                               | 10 <sup>-4</sup>                            | IEC 60250      | 5             |
| C Dissipation factor                                  | 1 MHz                                | 10 <sup>-4</sup>                            | IEC 60250      | 90            |
| C Volume resistivity                                  |                                      | Ohm·m                                       | IEC 60093      | 1E14          |
| C Surface resistivity                                 |                                      | Ohm                                         | IEC 60093      | 1E16          |
| C Electrical strength                                 | 1 mm                                 | kV/mm                                       | IEC 60243-1    | 34            |
| C Comparative tracking index CTI                      | Solution A                           | Rating                                      | IEC 60112      | 250           |
| Comparative tracking index CTI M                      | Solution B                           | Rating                                      | IEC 60112      | 125M          |
| Electrolytic corrosion                                |                                      | Rating                                      | IEC 60426      | A1            |
| <b>Other properties (23 °C)</b>                       |                                      |                                             |                |               |
| C Water absorption (saturation value)                 | Water at 23 °C                       | %                                           | ISO 62         | 0.30          |
| C Water absorption (equilibrium value)                | 23 °C; 50 % r. h.                    | %                                           | ISO 62         | 0.12          |
| C Density                                             |                                      | kg/m <sup>3</sup>                           | ISO 1183-1     | 1190          |
| Water vapor permeability                              | 23 °C; 85 % RH/ 100 µm film          | g/(m <sup>2</sup> ·24 h)                    | ISO 15106-1    | 15            |
| Gas permeation                                        | Oxygen/ 100 µm film                  | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 750           |
| Gas permeation                                        | Oxygen/ 25.4 µm (1 mil) film         | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 3150          |
| Gas permeation                                        | Nitrogen/ 100 µm film                | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 150           |
| Gas permeation                                        | Nitrogen/ 25.4 µm (1 mil) film       | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 630           |
| Gas permeation                                        | Carbon dioxide/ 100 µm film          | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 4500          |
| Gas permeation                                        | Carbon dioxide/ 25.4 µm (1 mil) film | cm <sup>3</sup> /(m <sup>2</sup> ·24 h·bar) | b.o. ISO 2556  | 18900         |
| Bulk density                                          | Pellets                              | kg/m <sup>3</sup>                           | ISO 60         | 660           |

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|--------------------------------------------------------|----------------|------|-------------|---------------|
| <b>Material specific properties</b>                    |                |      |             |               |
| Refractive index                                       | Procedure A    | -    | ISO 489     | 1.586         |
| Haze for transparent materials                         | 3 mm           | %    | ISO 14782   | < 0.8         |
| Luminous transmittance (clear transparent materials)   | 1 mm           | %    | ISO 13468-2 | 89            |
| C Luminous transmittance (clear transparent materials) | 2 mm           | %    | ISO 13468-2 | 89            |
| Luminous transmittance (clear transparent materials)   | 3 mm           | %    | ISO 13468-2 | 88            |
| Luminous transmittance (clear transparent materials)   | 4 mm           | %    | ISO 13468-2 | 87            |
| <b>Processing conditions for test specimens</b>        |                |      |             |               |
| C Injection molding-Melt temperature                   |                | °C   | ISO 294     | 280           |
| C Injection molding-Mold temperature                   |                | °C   | ISO 294     | 80            |
| C Injection molding-Injection velocity                 |                | mm/s | ISO 294     | 200           |
| <b>Recommended Processing and Drying Conditions</b>    |                |      |             |               |
| Melt Temperatures                                      |                | °C   | -           | 280 - 320     |
| Standard Melt Temperature                              |                | °C   | -           | 300           |
| Barrel Temperatures - Rear                             |                | °C   | -           | 250 - 260     |
| Barrel Temperatures - Middle                           |                | °C   | -           | 270 - 280     |
| Barrel Temperatures - Front                            |                | °C   | -           | 280 - 290     |
| Barrel Temperatures - Nozzle                           |                | °C   | -           | 290 - 300     |
| Mold Temperatures                                      |                | °C   | -           | 80 - 120      |
| Hold Pressure (% of injection pressure)                |                | %    | -           | 50 - 75       |
| Plastic Back Pressure (specific)                       |                | bar  | -           | 50 - 150      |
| Peripheral Screw Speed                                 |                | m/s  | -           | 0.05 - 0.2    |
| Shot-to-Cylinder Size                                  |                | %    | -           | 30 - 70       |
| Dry Air Drying Temperature                             |                | °C   | -           | 120           |
| Dry Air Drying Time                                    |                | h    | -           | 2-3           |
| Moisture Content max. (%)                              |                | %    | -           | <= 0,02       |
| Vent Depth                                             |                | mm   | -           | 0.025 - 0.075 |

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

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

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## Disclaimer

### 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.

### General

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.

### Recommended Processing and Drying Conditions

Barrel temperatures are valid for a standard 3-zone barrel. Temperature set-up for different barrel types may change according to configuration. Values for hold pressure as percentage of injection pressure may vary depending on, amongst others, part geometry, injection molding machine and injection mold. Drying conditions are for dry air dryers only. Drying times and drying temperatures may differ depending on valid dryer type. Further information is provided by your local Covestro support as well as in the following brochures: Injection Molding of High Quality Molded Parts - Drying; Determining the Dryness of Makrolon by TVI Test; The fundamentals of shrinkage in thermoplastics; Shrinkage and deformation of glass fiber reinforced thermoplastics [...]. <https://www.plastics.covestro.com/Library/Overview.aspx>

### Food Contact Grades

This product is not designated for the manufacture of a medical device or of intermediate products for medical devices<sup>1)</sup>. Nonetheless, any determination as to whether a product is appropriate for use in a pharmaceutical, medical device or intermediate products for medical devices or for the use in other specifically regulated applications, must be made solely by the purchaser of the product without relying upon any representations by Covestro, irrespective of the existence of any regulatory obligation for the registration, approval or notification. 1) Please see the "Guidance on Use of Covestro Products in a Medical Application" document.

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