

## CYCLOOLEFIN POLYMER – COP (Zeonex)

**Physical and mechanical properties:** Recently COP, which was originally developed around 1990, has been used as an optical material for parts that require high quality. COP is a polymer with an alicyclic structure synthesized using a cycloolefin as a monomer. Its main chain has a bulky cyclic structure. This polymer is amorphous and has high transparency and heat resistance. It has also outstanding environmental durability and no hygroscopic property when it is composed only of hydrocarbons. It has already been commercialized as ZEONEX® by Zeon Corporation, especially. These materials have high heat resistance and no property transformation due to moisture absorption. They are thus used in optical parts that would otherwise use poly-methyl methacrylate (PMMA). The catalyst and other impurities used in the polymer synthesis have been almost completely removed. Its transparency is outstanding even among COPs.

The major physical and mechanical characteristics are as follows:

- Low specific gravity (approximately 1.0). This is less than that of PMMA and polycarbonate (PC).
- Transparent. No absorption in the whole visible region; almost the same transmittance as PMMA.
- Low scattering. Refractive index is approximately 1.51–1.53. The wavelength dependence is relatively weak.
- Low birefringence. Outstanding birefringence performance especially to diagonal incident light compared to PC. The optoelastic constant is the same as that of PMMA.

**Chemical properties:** Zeonex has very low water absorption and in fact the lowest water absorption among optical plastics. Up to 60°C, it resists fairly well organic acids and diluted minerals as well as diluted alkaline solutions, and common cleaning products like acetone, methanol or iso-propanol. Its resistance to diminishing light transmission due to aging is very good. However, it must not be used with the following materials:

- Limonene
- Lipids / Fatty acids
- Oil, Hydrocarbon
- Oil, Vegetables

And it must be used with caution with Butanone and silicone oil.

**Electrical properties:** Zeonex is applied to medical applications that take advantage of its high purity property, as well as to electric insulating components that require low dielectric constant and dielectric tangent.

**Thermal properties:** Zeonex has a relatively low thermal expansion coefficient, comparable as the one of PMMA. As the later, Zeonex is combustible and burns without producing an excessive amount of smoke (UL 94 HB). Depending on the particular grade, the glass transition temperature is between 123 and 156°C. This makes a much more permissive use of Zeonex, allowing to be used in a environment with a temperature up to 100°C, even more for some grades. This is not the case for PMMA.

**Printing and marking properties:** Zeonex is suitable for both vacuum-applied metallization and silk-screening.

### Implementation properties:

- Injection: The peculiarity of Zeonex is that it needs a total absence of humidity and oxygen during the melting process. Thereby, a nitrogen flux system is implemented in the injection screw.
- Machining: As Zeonex very well resist to high temperature, machining is feasible on this material.

Summary by GAGGIONE SAS

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