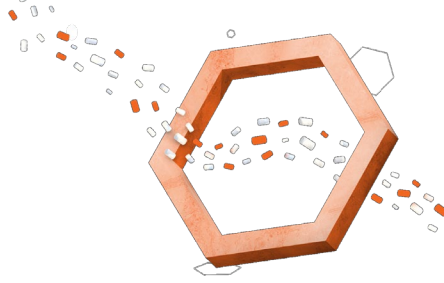


# BEYOND

# Illumination

High Performance Polymer Solutions  
for Today's Lighting Industry





# Introduction

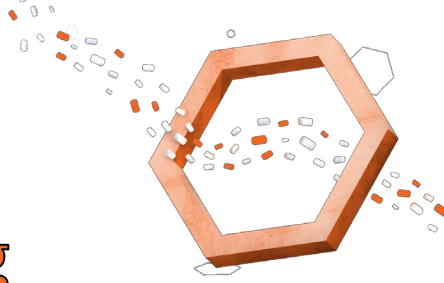
Polymeric materials for lighting applications require a very specific combination of properties. Primary material considerations include flammability, electrical, thermal, mechanical, and weatherability. Lighting applications are highly regulated and need to meet or exceed several international industry standards such as IEC, ISO, EN, and UL. End use devices are tested to application specific standards to ensure compliance with these standards.

Conventus Polymers offers a broad portfolio of semicrystalline and amorphous resins from producers that offer regulatory compliance, supply surety, custom color compounds, low minimum order quantities, and global support. As a technical compounder and distributor of polymers, the priority and focus are on helping customers find the right solution for their application.

## Contents

•	<u>Introduction</u>	<u>2</u>
•	<u>Advantages of Plastics in Lighting</u>	<u>3</u>
○	<u>Dependable Clarity</u>	<u>3</u>
○	<u>Freedom of Design</u>	<u>5</u>
○	<u>Advanced Durability</u>	<u>7</u>
•	<u>Application Examples</u>	<u>10</u>
•	<u>UL Flammability</u>	<u>11</u>
•	<u>Material Solutions</u>	<u>13</u>





# Advantages of Plastics in Lighting

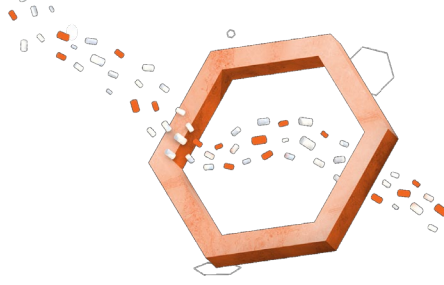
Plastic materials offer several advantages to conventional glass, silicone, or metal materials typically used in lighting applications. Utilizing plastics enables manufacturers to take advantage of features such as dependable clarity, freedom of design, and advanced durability; each with their own set of separate advantages.

- **Dependable Clarity**
  - Transparency
  - Low Haze
- **Freedom of Design**
  - Diffusion & Light Transmission
  - Colorability
  - Reflectivity
- **Advanced Durability & Performance**
  - Flame Retardance
  - Impact & Scratch Resistance
  - Thermal Conductivity
  - Chemical Resistance
  - Low Yellowness Index (YI) Shift



Material Type	Average Specific Gravity	Heat Deflection (°C)	Flame Retardance	Impact Rating
ABS	1.05	100	Low	Good
PMMA	1.17	93	Moderate	Low
Polycarbonate	1.20	119	High	Excellent
Amorphous Nylon	1.06	140	Moderate	Good
Silicon Carbide	2.30	1649	Very High	Excellent
Glass	2.60	221	High	Low
Aluminum	2.70	177	Very High	Moderate
Carbon-based Steel	7.80	399	Very High	Excellent
Copper	8.90	260	Very High	Good





# Dependable Clarity

Lenses, light guides, and other transparent components all have their own requirements regarding the permissible amount of light transmission. Some applications require a certain degree of light diffusion, while others demand more focused light emission.

## Transparency

Many polymer families can meet or exceed the transparency of glass. Polycarbonate (PC), Methyl Methacrylate Acrylonitrile Butadiene Styrene (mABS), Acrylic (PMMA), and Amorphous Nylon (PA12) are all examples of polymers that offer good transparency, while delivering exceptional thermal and mechanical ratings.

For example, we offer a broad portfolio of transparent polycarbonates under our DURATOUGH product family. Extrusion and Injection Molding grades available.

- **Product Highlight: DURATOUGH™ Polycarbonates**
  - High Light Transmittance (90%)
  - High Impact (Notched Izod up to 19 ft-lb/in)
  - Elevated Electrical RTI – 125°C
  - UL94 V2
- **Example Application: LENSES / SPOT-LIGHTS**

**Requirements:** High RTI, glow wire flammability index (GWFI), clarity, flame retardant

**Example Solution: DURATOUGH™ PC23U**

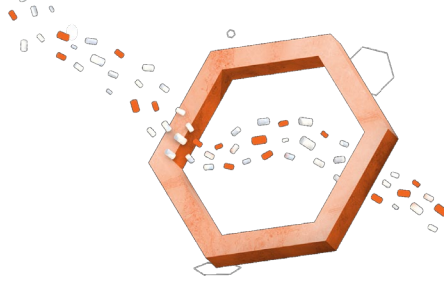
  - ▶ UL94 V-2 @ 0.5mm
  - ▶ REACH/RoHS compliant
  - ▶ 125°C RTI
  - ▶ Haze: 0.4%

## Low Haze / UV Resistance

While PC is a great general-purpose material, it tends to haze / yellow due to prolonged UV exposure. Haze is measured as the percentage of incident light scattered by more than 2.5° through the plastic specimen. The lower the haze value, the higher the clarity. A material with a haze value greater than 30% is considered a diffusing material. While diffusion is an important factor in some applications, others depend on high light transmission and low haze.

Not only do some applications require materials that have high clarity, but there are some that also require a high degree of UV resistance. The sun can pose a big problem to some materials, especially polycarbonate. Untreated PC will develop a yellow hue and lose impact properties when utilized in environments with long-term UV exposure. An example of this phenomena is in car headlight covers – where the yellowing effect becomes dangerous.





# Dependable Clarity

## Low Haze / UV Resistance (Cont'd)

- Product Highlight: **DURATOUGH™ Siloxane PC**
  - Good Weather Resistance
  - High Light Transmittance (90 – 92%)
  - Scratch Resistant
- Example Application: **OUTDOOR LIGHTING**

**Requirements:** Ultraviolet stability (UL 746C-f1), impact resistant, flame retardant

**Example Solution: DURATOUGH™ PCSi08FR4U**

  - ▶ UL94 V-0 @ 1.5mm, UL94 5VA @ 3.0mm
  - ▶ UL746C f1 Weatherability
  - ▶ 130°C Electrical RTI
  - ▶ -60°C Impact resistance



## Chemical Resistance + Low Haze + Transparency

Not only do some applications require materials that have high clarity and low haze, but there are some that additionally require a high degree of chemical resistance. A great example of this is medical lighting devices. These devices need to be able to withstand contact with harsh chemical cleaning agents and sterilization techniques such as EtO, gamma, E-beam, Autoclave, and UVC. In addition, these materials must be able to withstand multiple cleaning cycles.

- Product Highlight: **CONVENTUS POLYMERS DURACLEAR™ Cyclic Block Copolymers (CBC)**
  - New polymer class: fully hydrogenated block copolymers of styrene and conjugated diene
  - High UV transmittance down to UVC range (<280nm wavelength)
  - High light transmittance
  - Haze Resistant
- Example Application: **MEDICAL LIGHTING DEVICES**

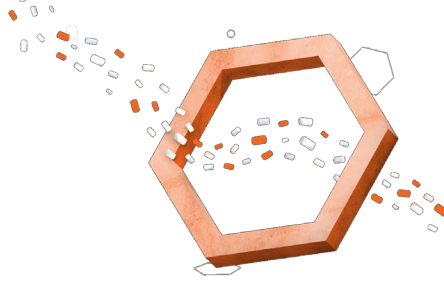
**Requirements:** High Transparency, Low Haze, Chemical and Sterilization Resistance, UVC Resistance

**Example Solution: DURACLEAR™ CBC821**

  - ▶ Suitable for UVC transmittance (<280nm)
  - ▶ High clarity - Haze <0.5% and 92% Light Transmission
  - ▶ Low Specific Gravity (<1.0)
  - ▶ High and low melt grades available







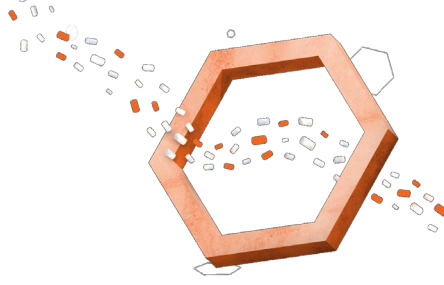
# Dependable Clarity

## Flame Retardance

Flame retardance may be the most important factor when selecting a material to utilize in a lighting application. Selected materials must be self-extinguishable, and the thinner the material while maintaining flame retardance, the better. In years past, FR additives affected the clarity of PC resulting in a cloudy appearance. Today's latest clear FR PC products offer high clarity (87-88% Light Transmission) while pushing the boundaries of UL94 V0 in very thin walls.

- Product Highlight: **DURATOUGH™ PC03FR2**
  - UL 94 V0 @ 0.5mm
  - Elevated Electrical RTI - 125°C @ 1.0mm
  - Translucent
  - High impact – Notched Izod @ 19 ft-lb/in





# Freedom of Design

Using plastics in lighting applications allows for much more freedom in component design. Rather than being limited to glass material, for instance, you are now free to explore a multitude of options across various polymer families. Some of the most important customizable elements include diffusion and light transmission percentage, colorability, and the level of reflectivity that the material exhibits.

## Diffusion & Light Transmission

Diffusion occurs when a light source meets a material, such as a lens, which contains small transparent particles. These particles cause light refraction and scattering, creating the diffusion effect. Diffusive materials / agents maximize the efficiency of lighting fixtures without exposing the source of illumination. Diffusion is expressed as a percentage for a given material, making this a customizable parameter given application needs.

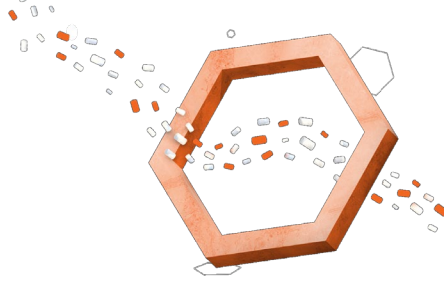
- Product Highlight: **DURATOUGH™ PC Grades**
  - Customizable Diffusion
  - UL94 V-0 down to 0.5mm
  - Elevated Electrical RTI up to 125°C

## Reflectivity

LED substrates benefit from highly reflective surfaces that revert the light in the desired direction. Highly pigmented whites that offer up to 95% reflectivity are available in many engineering resins such as PC and PBT. Reflectors traditionally use multi-step process of molding, treating, and vacu-metallizing. CP produces highly-reflective polycarbonates that eliminate the need for this process in certain applications by using pre-colored white material.

- Product Highlight: **DURATOUGH™ XR**
  - High Reflectivity (Up to 95%)
  - UL 94 V2 @ 1.5mm
  - UV Resistant
  - Between 420 – 700 nm
- Example Application: **LED SUBSTRATE**
  - Requirements:** High RTI, bright whites (reflection), flame retardant
  - Example Solution:** **DURATOUGH™ XR PC2289**
    - ▶ Superior Reflectivity
    - ▶ Cost-saving pre-colored white material
    - ▶ UL94 V-2 @ 1.5mm
    - ▶ Elevated Electrical RTI @ 125°C

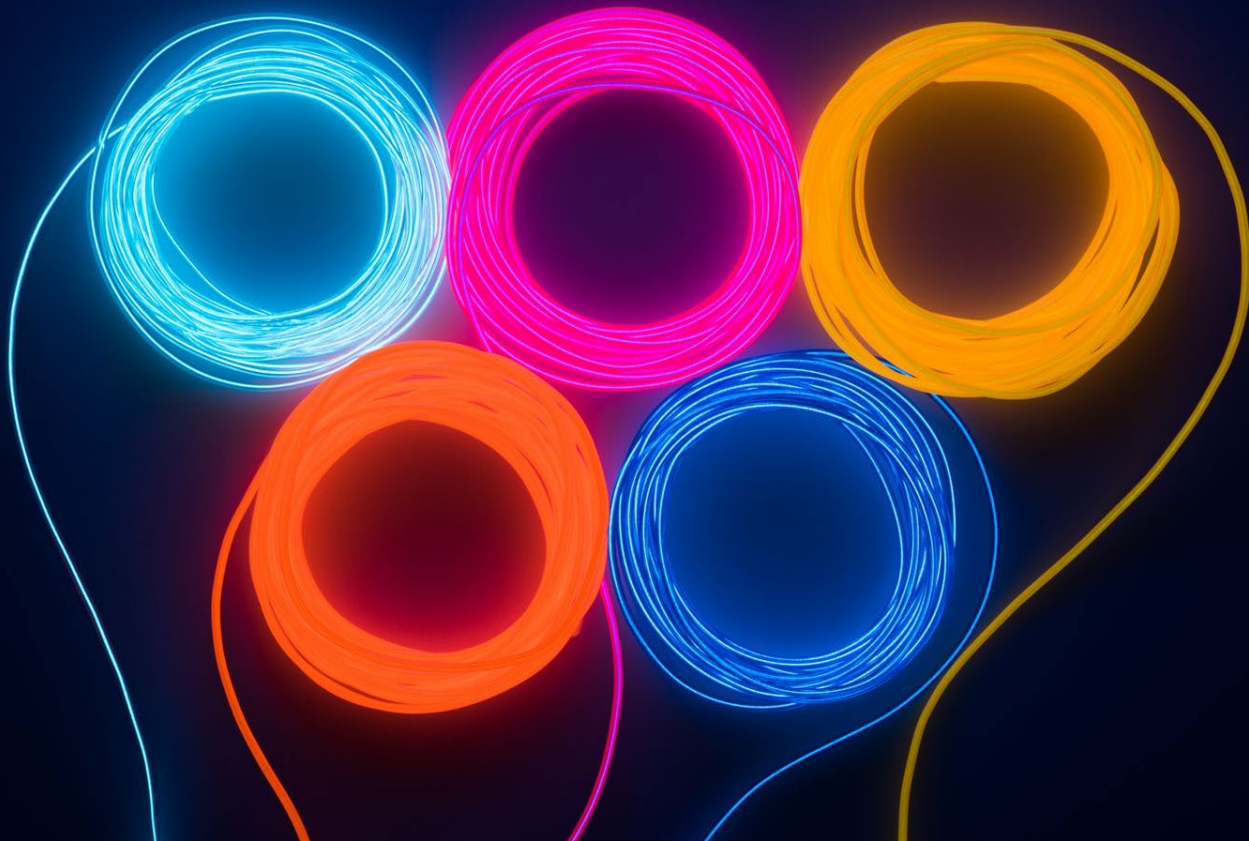




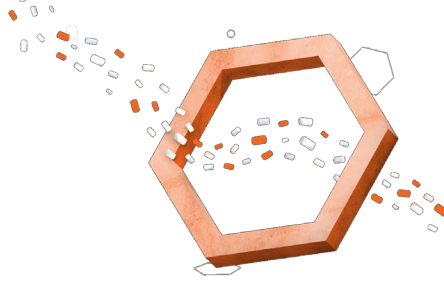
# Freedom of Design

## Colorability

One of the signature advantages of utilizing polymers is colorability. During molding and extrusion processes, it is commonplace to add color additives to match virtually any hue that the application calls for. This can be done with transparent polymers as well as opaque ones. Conventus Polymers offers pre-color compounds in almost all our base resins. Color matches can be completed in 3 – 4 weeks with small (55lb) evaluation samples provided virtually in the same time frame if needed.







# Advanced Durability

Perhaps the greatest advantage of utilizing polymeric materials in lighting applications is the superior durability and resistance to various elemental factors. While indoor lighting applications themselves can present durability challenges, when you bring the light source outdoors, a whole new host of factors are now in play. Materials in these applications and environments need to be flame retardant, impact resistant (hale, maintenance), lightweight, thermally conductive, and often resistant to chemical attack as well as impact and scratching.

## Flame Retardance (Opaque Housings) / Thermal Conductivity

Flame retardance is not only important for clear materials, but for the opaque materials that form housings, substrates, heat sinks, and other lighting device components. Selected materials must be self-extinguishable, and the thinner the material while maintaining flame retardance, the better. Thermal conductivity and management are important factors in lighting applications given the high heat that lighting fixtures can give off. Improper management of the heat that these fixtures give off (even in LED fixtures) can be detrimental and potentially catastrophic to these fixtures and their performance. Heat sinks are one of the most popular ways to regulate this heat, and therefore the materials that they are made of are crucial to lighting fixture performance.

- **Product Highlight: Toray TORELINA PPS**

- UL94 Flame Rated
- Dimensional Stability (anti-creep)



- **Example Application: LED Bulb Heat Sinks**

**Requirements:** High heat deflection rating, flame retardant, dimensional stability at high temperatures

**Example Solution: Toray TORELINA A395**

- ▶ HDT > 500 °F
- ▶ UL94 V-0 @ 0.7mm
- ▶ Elevated Electrical RTI @ 130°C

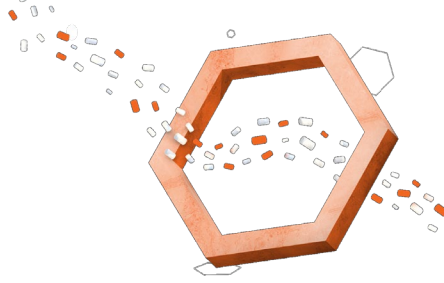
## Flame Retardance, Impact and Chemical Resistance, and Weatherability

While most lighting applications require a degree of flame retardance, some also require a high degree of impact resistance, abrasion (scratch) resistance, chemical resistance, and weatherability. Example applications include automotive headlight covers, outdoor light lenses, outdoor signage, and sporting goods. Impact resistance is measured by a few tests, including notched and un-notched Izod, as well as notched and un-notched Charpy.

- **Product Highlight: EMS GRILAMID TR Amorphous Nylon**

- High impact retention and abrasion resistance
- Excellent weather / UV resistance
- Good chemical resistance
- Low density





# Advanced Durability

## Flame Retardance, Impact and Chemical Resistance, and Weatherability (cont'd)

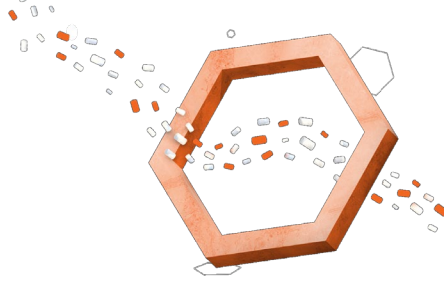
- Example Application: **OUTDOOR LIGHT COVERS**

**Requirements:** Weatherability, Impact and Scratch Resistance, Flame Retardance, Haze Resistance

**Example Solution:** EMS GRILAMID TR90 UV

- ▶ Excellent weather / UV resistance
- ▶ Resistance to chemical degradation
- ▶ Transparent (94% Light Transmittance)
- ▶ UL94 HB @ 0.75mm





# UL94 Flammability

Underwriters Laboratories (UL) performs tests, such as UL 94, on products to measure the resistance of plastics to a flame source. UL 94 is a standard of flammability of plastic materials. The test will normally result in a rating of HB, V-0, V-1, V-2, 5VA, or 5VB.

The UL approval is then given for a particular product based on the measured thickness as determined by the rating. UL 94 employs a horizontal burn rating, as well as the more-stringent vertical burn ratings:

- **Horizontal Ratings:** an HB (Horizontal Burn) rating represents a burn test that was performed on the material in a horizontal position.
- **Vertical Ratings:** V-0, V-1, and V-2 ratings are assigned to materials that were tested in a vertical position. In order to classify a material with one of these vertical ratings, the material must self-extinguish within a certain time parameter after the ignition source is removed. These parameters can be found in the table below. 5VA and 5VB ratings are assigned to materials that are subjected to up to five test flame applications. A 5VA rating represents the most flame retardant UP94 rating.

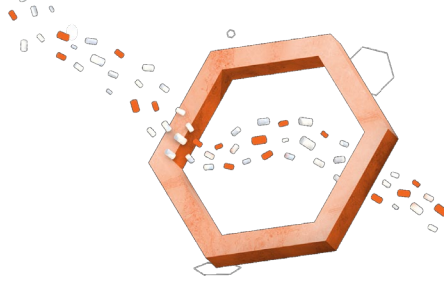


Criteria Conditions	V-0	V-1	V-2
After flame time for each individual specimen t1 or t2	10 sec	30 sec	30 sec
Total after flame time for any condition set (t1 + t2) for the 5 specimens	50 sec	250 sec	250 sec
Burn through (hole) of any plaque specimen	30 sec	60 sec	60 sec
After flame or after glow of any specimen up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or drops	No	No	Yes

Criteria Conditions	5VA	5VB
After flame time plus after glow time after 5th flame application for each individual bar specimen	60 sec	60 sec
Cotton indicator ignited by flaming particles or drops from any bar specimen	No	No
Burn-through (hole) of any plaque specimen	No	Yes

UL94 flammability ratings are absolutely crucial to the lighting industry. In many lighting applications, high voltages and current can pose a safety hazard, so having the right insulative material is important. Along those lines, the heat that some bulbs give off can also pose an ignition threat, again solidifying the importance of choosing the right materials with the correct ratings. At Conventus Polymers, we're here to come along side you in selecting the right materials, as well as assisting with any application development needs that you may have.





# UL746B Relative Thermal Index (RTI)

UL 746B is a program from Underwriters Laboratories for the determination of the relative thermal indices of polymeric materials. A relative thermal index of a material is an indication of the material’s ability to retain a particular property (physical, electrical, etc.) when exposed to elevated temperatures for an extended period of time (thermal endurance). UL 746B measures each sub-category in degrees Celsius or Fahrenheit at various thicknesses (measured in inches or millimeters). The UL 746B standard breaks RTI into three sub-categories:

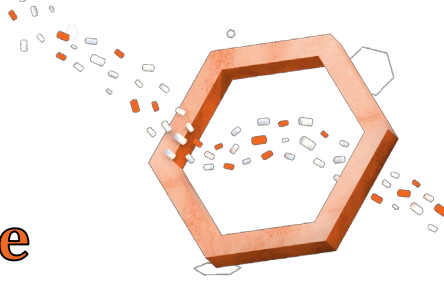


- **Electrical RTI:** A material’s electrical insulation performance
- **Mechanical Impact RTI:** A material’s mechanical performance with impact
- **Mechanical Strength RTI:** A material’s mechanical performance without impact

Conventus Polymers carries a plethora of grades from trusted suppliers that have high flammability ratings, as well as elevated RTI temperatures. Conventus also compounds an increasing number of UL-rated grades under our own trade names. These grades can be found in our UL file number E524290, as well as in the table below:

Grade	UL 94	RTI Elec	RTI Imp	RTI Str	Weatherability
DURATOUGH PCSi(x)FR4(@)(f1)	V0 @ 1.5 mm 5VA @ 3.0mm	130°C @ 0.75mm	115°C @ 0.75mm	130°C @ 0.75mm	f1
DURATOUGH PC(#)FR1(f1)	V0 @3.0 mm V2 @ 1.5 mm	80°C @ 1.50mm	80°C @ 1.50mm	80°C @ 1.50mm	f1
DURATOUGH PC03FR2	V0 @ 0.5 mm	125°C @ 0.75mm	110°C @ 0.75mm	125°C @ 0.75mm	
DURATOUGH PC13FR2	V0 @ 0.5 mm	125°C @ 0.75mm	100°C @ 0.75mm	125°C @ 0.75mm	
DURATOUGH PC23U	V2 @ 0.5 mm	125°C @ 1.50mm	115°C @ 1.50mm	125°C @ 1.50mm	
DURATOUGH PC(#)FR3GF10(f1)	V0 @ 1.5 mm 5VA @ 3.0mm	80°C @ 1.50mm	80°C @ 1.50mm	80°C @ 1.50mm	f1





# A Deep Offering of Materials & Expertise

Conventus Polymers is a global specialty thermoplastics distributor, formulator, and compounder offering the broadest portfolio of high-performance resins, ultra-polymers, and custom compounds. We are North America's leading thermoplastic distributor for high performance resins, ultra-polymers, and custom compounds. Due to our highly focused approach within strategic vertical markets, we are able to offer deep expertise and form close partnerships with industry leading OEMs to solve problems, develop new applications, and introduce the latest polymeric technologies. We combine the best characteristics of resin manufacturers and distributors including material selection, application development, project risk mitigation, inventory management, and competitive pricing.



## Polymer Innovation

We actively partner with producers who invest in and develop the world's next generation of thermoplastic materials.



## New Resins

By keeping a close pulse on the global plastics community, we have a proven track record of bringing the latest resin technologies to our customers.



## Application Development

Because of our application expertise in vertical markets, customers consult with us on their new product introductions from material to design to supply chain.



## Materials Selection

Customers rely on our deep knowledge of plastics to help select the most economical plastic that meets or exceeds all of their requirements.



## One Stop Shop

We offer the broadest portfolio of high performance and ultra-polymers in order to service virtually any critical application on the globe.



## Volume Flexibility

From 25kgs to FCL, we allow for maximum flexibility with minimum order quantities.



## Inventory Management

Between local warehousing and various stocking programs, we offer Just-In-Time delivery to help our customers manage inventory.



## Supply

A valued partner by offering alternative resin options in high performance and ultra-polymer families where producer options are limited.



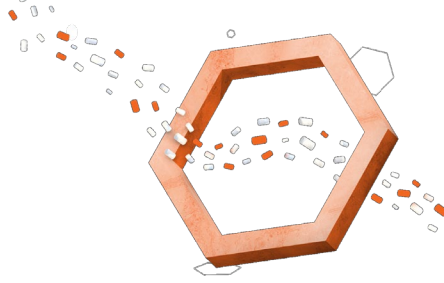
## Economics

To help our customers become more competitive by facilitating cost-out on overpriced resins in markets with low competition amongst suppliers.





# Our Partners



- DURAMIDE™ PA6 and PA66 Compounds
- DURAFLEX™ Thermoplastic Elastomers
- DURATOUGH™ PC Compounds
- DURATEMP™ High Temperature Compounds
- DURAPEEK™ PEEK Compounds
- DURALF™ Long Fiber Compounds



- GRILAMID® L (PA12) and TR (Transparent PA12)
- GRILAMID® 2S (PA6/10) and 2D (PA6/12)
- GRILFLEX® COPA High Performance Elastomers
- GRILON® A (PA66), B (PA6), C (Co-Polyamide), and T (PA66/6)
- GRIVORY® G (Partially Aromatic Polyamide) and HT (PPA)



- TEFABLOC™ TPE-S, TPO, and TPE-E
- TEXPRENE™ TPV
- SUNPRENE™ PVC Elastomers
- DURABIO™ Bio-Based Engineering Polymer



- TAIRILAC® ASA
- TARILAC® ASA
- TARILAC® SAN



- ELECTRAFIL® Conductive and EMI Shielding Compounds
- HIFILL® Compounds for Strength, Stiffness, and Impact
- HIFILL® FR Flame Retardant Compounds
- PLASLUBE® Internally Lubricated Compounds
- STATIBLEND® Static Dissipative Compounds



- TRIBIT® PBT
- TRIEL® TPEE
- TRILOY® PC ALLOYS
- TRIMMA® PMMA
- TRIPET® PET
- TRIREX® PC



Advanced Modified Polymers

- VAMPAMID® PA6 and PA66
- VAMPALEN® PP Compounds
- VAMPTER® PBT Compounds



- PMMA



Innovation by Chemistry

- SIVERAS® LCP
- TI POLYMER® PAI
- TORELINA® PPS
- TOYOLAC® Transparent ABS



- INNOPRENE TPV



- INVISTATM Polypropylene



- EMERGE™ ABS, PC, PC/ABS, and PC/PET
- PULSETM PC/ABS
- CALIBRE™ Polycarbonate
- MAGNUM™ ABS



- PARYLS® PSU
- PARYLS® PPSU
- PARYLS® PES
- PARYLS® mPPSU



- KOCETAL® POM



- POKETONETM POK



- FLURINE PVDF



- VESTAKEEP® PEEK



- XAREC® SPS



- ISOTHANE® TPU



- ORION Performance Compounds



- LUPOY® PC, Siloxane PC, PC/ABS, PC/PBT
- LUMILOY® mPPE
- LUPOX® PBT
- LUMID® PA6 and PA66
- KEYFLEX® COPE
- LUMIPLAS® Light Diffusion PC
- LUSEP® PPS



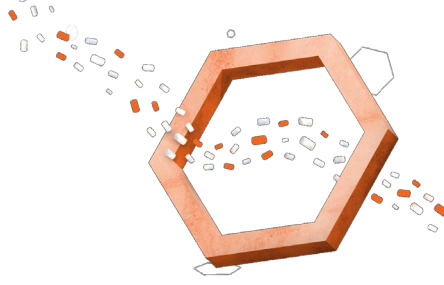
CUSTOM-ENGINEERED TPE AND MORE

- COPEC® TPE-U
- FORTEC® TPE-O
- HIPEX® High Performance TPE
- THERMOLAST® A HSBC, K HSBC, M Medical Elastomer, and V HSBC



- ULTEM™ resin (PEI)
- EXTEM™ resin (TPI)
- SILTEM™ resin (Si-PEI)
- LNPTM COLORCOMP™ compound
- LNPTM ELCREST™ CRX copolymer resin
- LNPTM ELCRIN™ iQ compound
- LNPTM FARADEXTM compound
- LNPTM KONDUIT™ compound
- LNPTM LUBRICOMP™ compound
- LNPTM LUBRILLOY™ compound
- LNPTM STAT-KON™ compound
- LNPTM STAT-LOY™ compound
- LNPTM THERMOCOMP™ compound
- LNPTM THERMOTUF™ compound
- LNPTM VISUALFX™ resin





[www.ConventusPolymers.com](http://www.ConventusPolymers.com)

**USA - New Jersey** 2001 Route 46, #310 | Parsippany, NJ 07054 USA | Tel: 973.343.7669

**USA – Texas** 6431 Cunningham Road | Houston, TX 77041 USA | Tel: 502.396.8070

Email: [info@conventuspolymers.com](mailto:info@conventuspolymers.com) | [www.conventuspolymers.com](http://www.conventuspolymers.com)

ALTHOUGH ANY INFORMATION, RECOMMENDATIONS, OR ADVICE CONTAINED HEREIN IS GIVEN IN GOOD FAITH, CONVENTUS POLYMERS MAKES NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, (I) THAT THE RESULTS DESCRIBED HEREIN WILL BE OBTAINED UNDER END-USE CONDITIONS, OR (II) AS TO THE EFFECTIVENESS OR SAFETY OF ANY DESIGN INCORPORATING CONVENTUS POLYMERS MATERIALS, PRODUCTS, RECOMMENDATIONS OR ADVICE. CONVENTUS POLYMERS AND ITS REPRESENTATIVES SHALL IN NO EVENT BE RESPONSIBLE FOR ANY LOSS RESULTING FROM ANY USE OF ITS MATERIALS OR PRODUCTS DESCRIBED HEREIN. Each user bears full responsibility for making its own determination as to the suitability of Conventus Polymers materials, products, recommendations, or advice for its own particular use. Each user must identify and perform all tests and analyses necessary to assure that its finished parts incorporating Conventus Polymers materials or products will be safe and suitable for use under end-use conditions. Nothing in this or any other document, nor any oral recommendation or advice, shall be deemed to alter, vary, supersede, or waive any provision of Conventus Polymers Standard Conditions of Sale or this Disclaimer, unless any such modification is specifically agreed to in a writing signed by Conventus Polymers.