



Frequently Asked Questions



Torlon®

What is the difference between Torlon® 4203L and 4203?

Torlon 4203L is primarily an injection molding grade resin. Extruded shapes are always made from Torlon 4203 resin. The Chemistry is identical and the performance is equal in all aspects.

Do I need to post cure machined Torlon parts?

The wear resistance and chemical resistance of Torlon improves when machined parts are re-cured after machining. The limiting PV and wear rates can improve by a factor of 5X with re-curing. Many applications are successfully handled with Torlon machined but not re-cured since Drake fully cures the material prior to it ever shipping from our Cypress, TX facility. For high speed (V greater than 0.5 m/sec and PV's above 3.5 MPa.m/sec PSI-FPM) we generally recommend re-curing of machined parts.

Are all Torlon grades certified to an ASTM or AMS spec?

All Drake supplied Torlon can be certified to ASTM D5204 and AMS 3670 at no additional cost.

ASTM D5204 supersedes and has replaced Mil-P-46179A.

Additionally, Torlon can be certified upon request to:

Hamilton Sunstrand MS29.04

Boeing material specification BMS 8269

Honeywell MCS7004

General Electric specification A50TF190

What is the difference between injection molded, extruded and compression molded Torlon shapes?

The base resin used to produce all of these shapes is chemically the same. The uniqueness of each process requires different resin characteristics that result in slightly different properties of the final shape. Fiber orientation and directional differences in properties exist for reinforced grades.

•Extruded 4203 offers the best overall toughness and impact resistance •Compression molded shapes offer larger size capability and a way to make small quantities of tube.

Which Torlon grade is the strongest?

The strongest of the Torlon grades is 5030 with 7130 not far behind.

5030 contains 30% glass fiber which provides strength, dimensional stability over temperature change and excellent thermal isolation and electrical insulation properties.

7130 offers a slightly higher stiffness due to carbon fiber reinforcement.

[Check with Drake, maybe we are developing an even stronger material right now.](#)

Will Torlon parts absorb moisture?

Torlon, like most materials, absorbs water when saturated or placed in high humidity conditions. The grade and geometry of the part influences the rate of water pick up and the resultant growth. Thicker cross sections take very long to reach equilibrium and will likely never reach saturation. Glass and carbon fiber reinforced grades absorb less water than 4203. Many of the bearing grades absorb even less.

Below are some specific examples provided for reference:

- At 90% RH and 43°C Torlon 4203 (3.2 mm thickness) will absorb 4% water and grow 0.5% after 100 days. Torlon 5030 will grow .23%, under the same conditions.
- At 50% RH and 21°C, the water absorbed and resultant growth is 30-40% less even after 400 days.

The bottom line is Torlon will absorb water but effect on physical properties and dimensions is small and highly predictable.

What is the difference between Torlon and Duratron?

Torlon is a trade name of Solvay Specialty Polymers. It is the original PAI having been developed by Amoco in the 1970's. It is commercially available since 1976. Today there are other PAI chemistries being investigated, but Solvay's Torlon PAI remains the premier resin for high performance application. Quadrant EPP, the first to extrude Torlon markets their PAI products under their registered trade name Duratron PAI. They continue to use the Torlon designations of T4203 and T4301 to denote the two primary grades they offer. They also use 4XG and 4XCF designations to denote two reinforced grades (glass and carbon fiber respectively). Drake processes all Torlon grades and uses the Torlon family name for all product identification. We refer to all Torlon materials by their resin designation. Both companies use the same raw material but name their shape products differently for commercial reasons.

Is there a difference between injection molded Torlon and machined Torlon parts?

There can be a difference between the performance of injection molded parts and machined Torlon parts, just as there can be with molded and machined parts made from other polymers. Fiber reinforced Torlon grades can exhibit directionality of strength, stiffness and CLTE related to fiber orientation while the material is molten. In general, the strength and stiffness are greater and the CLTE lower in the flow direction of extruded rods and plates. Seamless Tube has slightly better properties in the "hoop" or circumferential direction. Directional differences in extruded shapes can range from 10 to 25%. Molded components can often be gated to maximize the properties in specific directions.

What is the dark skin on some grades of Torlon and is it different than the interior cross section?

Torlon 4203 after cure develops a dark outer skin. This skin can be thought of as a fully cured phase that results from the chemical reaction PAI undergoes as it changes from a thermoplastic to a thermoset. We often describe it as an oxide to "metal heads" but it is not. It is pure Torlon. It generally is about .01 – 5 mm in thickness and can be machined away or left in place. It may appear slightly harder than interior sections. The darker bearing grades such as 4301, 4275, 4435, and carbon fiber reinforced 7130 have such an outer skin but the dark grey/black color

makes it impossible to see.

Does Torlon have good wear resistance?

Torlon has great wear resistance especially in higher PV applications. The bearing grades are best but even glass reinforced 5030 performs well as rollers and wheels. The wear resistance is maximized by post curing parts after machining and by thoroughly curing injection molded parts. We have seen the limiting PV and the wear rate improve by a factor of 5X with recurring after machining.

What chemical environments are bad for Torlon?

Torlon has a very good chemical resistance to most hydrocarbon based solvents including: jet fuel, and gasoline; acids, mild bases, chlorinated and fluorinated hydrocarbons and alcohols. Strong bases such as NaOH should be avoided. Saturated steam and some high temperature acids will also breakdown Torlon. Post curing after machining improves chemical resistance as well as wear resistance.

What type of tooling is recommended for machining Torlon?

Diamonds are both a girl's and Torlon's best friend. We suggest using polycrystalline diamond insert style tools to provide the best possible finish and closest tolerances for machine Torlon parts. Carbide tooling can be used for short runs but attention to tool wear is required so proper offsets are maintained over medium and longer runs. The bottom line - investing in the right tooling will pay off in the long run via longer tool life and fewer rejected parts. Look for Drake's machine guides under [Resources](#) on our website.

Is Torlon recyclable?

Torlon cannot be recycled after it has been cured. Runners and sprues from an injection molding process can be recycled prior to curing. Machined turnings/swarf and remnants cannot because they have been fully cured by Drake prior to being supplied.

What are the largest and smallest sizes Drake makes?

Drake has extruded rod as small as 1.2 mm. We call it wire, as it can be coiled for feeding into an automated process. The largest diameter solid rod Drake extrudes is 257 mm. We have also extruded 191 mm OD tube. We supply both by the inch up to 1.22 m L. If you are looking for something larger Ask Drake as we are always pushing the status quo.

How does Torlon compare with Vespel and other polyimides?

Vespel, made and supplied in shape form by DuPont is a fully imidized polyimide. It is the original and most recognized of the commercially supplied polyimides.

Torlon is a polyamide-imide in which the chemistry has been modified so that the material can be melt processed (molded or extruded) and then cured. This change provides process flexibility along with the wear resistance and temperature capability normally associated with polyimides.

Here is the biggest surprise... Torlon has greater strength, stiffness and a lower CLTE than Vespel. Torlon also has better wear resistance under most PV conditions.

Vespel does however win in all applications above 260°C.

PEEK

What is the difference between Solvay and Victex PEEK?

Both Solvay PEEK and Victrex PEEK are high quality resins supplied with certifications to relevant ASTM and AMS specifications. Victrex PEEK is the original, having been supplied for more than 30 years. It is slightly stronger but less ductile than Solvay PEEK. Both materials have a similar but not exact light tan to light grey color in the natural form. We find Solvay PEEK to be slightly more ductile and better suited for thick cross section shapes.

Why does Drake offer both grades?

We have a strategic relationship with both Solvay and Victrex and have customers who ask for both brands. Larger cross section shapes such as 102 – 153 mm diameter are mostly made from Solvay grades.

What is the difference between PEEK HT (PEK HT) and standard PEEK?

Both materials belong to the family of materials known as polyarylether ketones (PAEK). HT is based on a slightly different chemistry (PEK) that results in a slightly higher strength and softening temperature than standard PEEK. The strength difference is 5-10% at room temperature and the softening temperature 8-11°C.

What PEEK grades offer the best wear resistance?

All PEEK materials offer good wear resistance but FC30, Drake Bearing Grade, and FE20 are best suited for sliding and rotating bearing applications. FE20 is best for applications requiring FDA compliance.

Is PEEK available in colors?

Yes. On a custom, MTO basis (made-to-order). Black is most common. We stock black resin so a fast turnaround is generally possible.

Which PEEK grades are suitable for FDA regulated applications?

Non-reinforced PEEK based on KT820 (or Victrex 450G), Victrex GF30, CA30, FC30, 450FE20, and HT are compliant with the guidelines for direct food contact specifically European regulations 2002/72/EC and FDA 21 CFR 177.2415.

Does Drake offer implantable PEEK shapes?

Drake does not offer implantable PEEK shapes but offers conversion services via Drake Plastics Medical.

A number of grades can be considered FDA compliant and suitable for instrument handles and parts contacting bio fluids temporarily. Both Victrex (Invibio) and Solvay (Solviva)

supply long term, implantable PEEK directly into the market via subsidiaries focused on the life science market.

Which PEEK is the most chemically inert?

PEEK is one of the most chemically inert polymers. All formulations based on PEEK will exhibit similar resistance to most chemical environments. Strong acids may attack glass fibers more than carbon fibers. HT based on PEK has slightly different resistance than PEEK based grades. It offers less resistance to saturated steam.

What is Drake PEEK?

Drake brand PEEK products are offered for those interested using PEEK in industrial applications where many, but not all, of PEEK's characteristics are required. These products are made from a variety of resin sources and can exhibit greater variations in color and appearance than Victrex or Solvay brand PEEK.

Drake brand PEEK products are not certified to ASTM, ISO, Mil-P Spec or FDA specifications. All Drake PEEK products have been tested for machinability and come with resin properties including tensile strength, elongation and modulus at no extra cost. Tensile properties derived from the extruded shapes are available for a nominal testing fee per size.

What type of tooling do you suggest for machining PEEK?

We suggest using polycrystalline diamond insert style tools to provide the best possible finish and closest tolerances for machined PEEK parts. Carbide tooling can be used for short runs but attention to tool wear is required so proper offsets are maintained over medium and longer runs. The bottom line is investing in the right tooling will pay-off in the long run via longer tool life and fewer rejected parts. Glass and carbon fiber reinforced grades are the most abrasive on tooling.

AvaSpire

Which AV grades are FDA compliant?

AV 621NT and AV621 GF30 are FDA complaint for 21CFR 177.2415 as well as European regulations 2002/72EC.

How do the properties of AvaSpire compare with PEEK?

AvaSpire is a PAEK based blend that offers performance similar to traditional PEEK materials with the following uniqueness:

- AvaSpire offers improved impact properties over PEEK in all grades
- Reinforced AvaSpire grades offer improved stiffness without the brittleness common with reinforced PEEK based materials
- AvaSpire increases the strength and stiffness of PEEK at temperatures above 150°C