PROFESSIONAL PLASTICS, INC.

Leading Global Supplier of Engineering Plastic Parts & Shapes

Overview: Understanding Acetals

Information Provided by Quadrant EPP

There are two general types of acetal products available for both injection molding and machining; **homopolymer acetal and copolymer acetal.** The difference is a chemistry change that does affect certain properties enough, that a better understanding of acetals is often helpful.

Homopolymers are plastics with molecular chains containing identical repeating units (mers), while copolymers chemically contain two different repeating units. Homopolymer acetal is most commonly recognized as Delrin, (a registered trademark of E.I. DuPont) since DuPont is the only manufacturer of homopolymer acetal resin. Copolymer acetal resin is domestically supplied under the tradenames of Celcon (Ticona) and Ultraform (BASF). The chemistry is similar enough that both products are still considered acetals; however, there are some important property differences.

Mechanical Properties:
The strength and stiffness of unfilled homopolymer acetal (Delrin) is approximately 15% greater than the copolymer acetals.

Hot Water/Steam Resistance:
Copolymer acetals exhibit substantially greater resistance to hydrolysis (degradation by hot water) and better dimensional stability, especially after prolonged exposure.

Chemical Resistance:
In general, the chemical resistance is similar, but may be different depending on the chemical, as well as the temperature and concentration encountered. Copolymer acetal does offer better resistance to chlorine-containing solutions, including bleach and strong alkalies, both common-sanitizing chemicals.

Continuous Service Temperature:
Generally, the continuous service temperature for both grades are considered the same (180° F). Copolymer acetal has been reported to resist thermal degradation at higher temperatures better than the homopolymer. However, the higher heat deflection temperature of homopolymer acetal indicates it will exhibit greater mechanical properties during short-term exposure.

Machinability:
Generally, the machinability of acetal products is extremely good. The greater stiffness of Delrin makes it superior for screw machined parts and small diameter parts (less than 1" diameter) machined on high speed NC lathes. It is important to recognize the importance of an extruder's processing sequence, including the annealing cycle on the stability of a stock shape during machining.

Note: Acetron® GP stock shapes are supplied with the lowest internal stress to assure the machinist dimensional consistency during and after machining.

Wear Resistance:
The general wear resistance, including limiting PV and K-factor are equivalent for both unfilled acetals. The enhanced bearing and wear grades each have their own wear resistance properties. Inherently, all acetals have lower abrasion resistance than nylons and polyethylenes.

Appearance:
The cross section of acetal stock shapes has long been recognized to contain micro-porosity along the centerline of rod and plate products. The centerline porosity is created during the extrusion of stock shapes. Characteristically, copolymer acetals yield less centerline porosity, but still exhibit interconnected microporosity ranging from 100 to 150 microns (.1 to .15mm) in stock shapes. This microporosity results in mechanical weakness and leakage of liquids and gases under high pressure.

Note: Acetron® GP stock shapes contain no centerline porosity. Any isolated pores are less than 25 microns in diameter.

ACETAL RESINS AND EXTRUDED STOCK SHAPES

Homo-Polymer Acetals are sold by DuPont under the brand name Delrin® in these Grades:

General Purpose Grades
These low to medium viscosity resins include Delrin 100, 111P, 500, 511P, 900, 911 and 1700. These resins are designed for injection-molding processing. The "P" designation used after certain resin numbers denotes that the resin contains additives to enhance processability during injection molding.

Toughened Grades
These super tough high viscosity grades are developed for injection molding processing and include Delrin 100 ST, 500ST, & 500T.

Low Friction and Wear Grades
These grades contain lubricants that reduce surface friction. The grades are generally designed for injection molding processing and include Delrin 500 AL, 500CL, 100AF, 500AF, 520MP, 510MP,500TL, 900SP, 100KM. Only Delrin 100AF is designed for extrusion. A blend of Delrin AF 100 with Delrin 100, which result in lower PTFE and therefore lower cost is also produced for extrusion.

High Stiffness Grades
These grades are glass reinforced for added mechanical strength. The grades which include Delrin 570 NC, 577BK, 510GR, 525GR are designed for injection molding primarily.

UV Stabilized Grades
These grades are designed for added resistance to UV degradation for outdoor use. They contain a chemical UV stabilizer. The grades are Delrin 127UV, 527UV, 927UV 1727UV. Delrin 127UV is most suitable for extrusion. The other grades are primarily for injection molding processing.

Extrusion Grades
The grades designated as extrusion grades for the stock shapes market are Delrin II 150E, Delrin II 150SA and Delrin II 550SA. The "II" designation is used for these extrusion-grade resins only. It is appropriate to use the designation or to drop it, as there is only one product for these grades. Of the three grades, 150E is the most common used for extruded shapes.

Key Grades	***Characteristics***
100	Special high viscosity injection molding resin, specifically for easy to fill injection molding dies
150E	High viscosity resin, specifically formulated for maximum strength and stiffness of extruded shapes. Lowest centerline porosity of the Delrin grades.
150SA	Similar to 150E, but produced without a process lubricant contained in 150E. The result is a slightly higher impact strength and cleanliness.
500	General purpose, low viscosity injection molding grade, specifically for easy-to-fill molds. The mechanical properties of stock shapes will be lower than those of Delrin 150 or 150SA.
550	Comparable to Delrin 500, but does not contain a process lubricant. Similar to 150SA, but a lower viscosity resin for injection molding. The mechanical properties of stock shapes will be less than those of 150E and 150SA.
500AF/100AF	Teflon filled materials offering lower coefficient of friction and better wear performance than unfilled grades.
AF DE588	Teflon filled material specifically for Naval use for submarine
	valve seat applications.
500CL/100CL	Chemically lubricated resins specifically for improved wear resistance over the unfilled grades, but less than those of Delrin AF.
507/107	UV stabilized grades of Delrin for enhanced resistance to ultraviolet light. Generally, UV stabilized material is recommended for service requiring outdoor exposure times greater than one year. Generally, these grades are black in color. DuPont has recently introduced 4 new UV stabilized grades. The grade most suitable for extrusion is Delrin 127UV.

Co-Polymers Acetals – Celcon, Hostaflon, Kapital, Acetron, etc.

The co-polymer resins are not asked for by grade designation as much as the Delrin grades although most of the stock shapes supplied are based on co-polymer acetals. One of the earliest resins that was asked for by name and still is Celcon. The M25 grade is a high viscosity grade designed for extrusion. It is also supplied in glass reinforced and UV stabilized grades. Two other co-polymer resins produced and supplied by BASF and Kapital. Companies that supply stock shapes typically market products under their own tradenames.

Acetron® GP

Characteristics

General-purpose acetal machining stock produced by Quadrant EPP. This product is fully dense throughout the cross section containing no centerline porosity and is stress relieved to assure the machinist the lowest possible residual stress. It is currently produced from copolymer acetal resin.

TYPICAL PROPERTY COMPARISON

	Acetron GP	Delrin 150E	Delrin 500/550	Delrin 507
Tensile Strength	9,300	10,900	10,000	10,000
Elongation	68	64	15	15
Tensile Modulus	410,000	520,000	450,000	450,000
Tensile Impact	96	152	100	100
Rockwell Hardness	R118	R120	R120	R120
Heat Deflection Temp. 264 psi	230°F	255°F	270°F	270°F
Continuous Use Temperature	200°F	180°F	180°F	180°F
Specific Gravity	1.41	1.42	1.42	1.42

For more information, please contact:

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