


Acetal

Acetal Copolymer and Homopolymer

Acetal Copolymer	2-2 to 2-3
Acetron® GP	2-4 to 2-5
Delrin® Acetal	2-6 to 2-7
Compare: Acetals	2-8 to 2-9
Acetal vs Delrin®	2-10
FDA Blue Acetal	2-11
Detectable Grade Acetal	2-12 to 2-15
Medical Grade Acetal	2-16

 **WARNING:** These products can potentially expose you to chemicals including, 4-Dioxane, Acetaldehyde, Acrylonitrile, Bisphenol-A, Carbon Black, Chromium, Cumene, Dichloromethane, Ethyl Acrylate, Ethylbenzene, Ethylene Glycol, Formaldehyde, Glass Fibers, Hexachlorobenzene, Lead, Methanol, Nickel, Polyvinyl Chloride, Silica-crystalline, Styrene, Tetrafluoroethylene, Titanium Dioxide, and Toluene, which are known to the state of California to cause cancer and/or birth defects or other reproductive harm. For more information, visit www.P65Warnings.ca.gov

Acetal Copolymer

Acetal provides high strength and stiffness coupled with enhanced dimensional stability and ease of machining. As a semi-crystalline material, acetal is also characterized by a low coefficient of friction and good wear properties -- especially in wet environments.

Because acetal absorbs minimal amounts of moisture, its physical properties remain constant in a variety of environments. Low moisture absorption results in excellent dimensional stability for close-tolerance machined parts. In high moisture or submerged applications, acetal bearings outperform nylon 4 to 1. Acetal is ideally suited for close tolerance mechanical parts and electrical insulators which require strength and stiffness. It also offers resistance to a wide range of chemicals including many solvents.

Alro Plastics offers both homopolymer and copolymer grades of acetal including enhanced bearing grade materials. Acetal copolymer is porosity-free and offered as our standard general purpose grade. For slightly higher mechanical properties, we offer a broad size range of the homopolymer acetal (Delrin®) products. For improved frictional properties PTFE-enhanced Delrin® AF products are available.

Common Trade Names:

- Acetron® GP (Mitsubishi Chemical Group)
- Celcon® (Celanese)
- Delrin® (DuPont)
- Pomalux® (Westlake Plastics)
- Sustarin® C (Rochling Sustaplast)
- Tecaform® (Ensinger)
- Ultraform® (BASF)
- ZL™ 900 (ZL Engineering)

Typical Features:

- Low moisture absorption
- High strength and stiffness
- Excellent dimensional stability
- Easy to machine
- No centerline porosity
- Better chemical resistance than Delrin®
- FDA, USDA, NSF, Canada AG and 3-A Dairy compliant

Product Applications:

- Bearings and bushings
- Anti-friction parts
- Electrical components
- Gears and pulleys
- Food and dairy parts
- Structural keels
- Timing screws
- Fuel system parts

Acetal Copolymer

Product Availability

Acetal Copolymer Sheet / Slab

Standard Thickness (inches) :	1/16" up to 8" thick
Standard Sheet Size (inches) :	24 x 48 and 48 x 120
Standard Sheet Color(s) :	Black or Natural (White)

Acetal Copolymer Rod / Round

Standard Diameter (inches) :	1/8" up to 20" diameter
Standard Rod Length (feet) :	4 feet and 8 feet
Standard Rod Color(s) :	Black or Natural (White)

Longer and intermediate lengths available on request.



Acetal Copolymer

Acetron® GP - General Purpose

Acetron® GP is Mitsubishi Chemical Group's general purpose copolymer acetal and is the only porosity-free acetal product available today. Investments in process technology by Mitsubishi Chemical Group provide the performance and machinability of acetal without center core porosity. The MCG in-line photometric quality procedure assures every plate and rod is porosity-free as measured by MCG's dye penetrant test making it the preferred acetal for food contact and medical applications.

Acetron® GP natural is FDA, USDA, NSF, Canada AG and 3A-Dairy compliant.

Typical Features:

- Low moisture absorption
- High strength and stiffness
- Excellent dimensional stability
- Easy to machine
- No centerline porosity
- Better chemical resistance than Delrin®
- FDA, USDA, NSF, Canada AG and 3-A Dairy compliant

Product Applications:

- **Electrical Components** - Porosity-free Acetron® GP acetal can be intricately fabricated into an electrical part with dozens of tight tolerance machined holes required at its centerline.
- **Gears** - Acetron® GP maintains tight tolerances despite environmental and clean in place chemical exposure on dairy equipment.
- **Rollers** - Guide rollers machined from Acetron® GP rod operate smoothly and reliably in lift gate systems used to load cargo onto truck beds.

Engineering Note:

In general, acetals do not perform as well in abrasive wear applications as nylons. Compensation for moisture related growth generally allows Nylatron® nylons to be used for wet, abrasive applications. If your application requires dimensional consistency in an abrasive, high humidity or submerged environment, Ertalylte® PET-P will often offer improved performance.



Acetal Copolymer

Acetron® GP Availability

Sheet / Slab / Plate

Standard Thickness (inches) :	1/16" up to 6" thick
Standard Sheet Size (inches) :	24 x 48 and 48 x 120
Standard Sheet Color(s) :	Black or Natural (White)
Sheet Tolerance(s) :	1/16 to 1/8 +/- .005 >1/8 to 2 +.025" / -0 >2 to 3 +.050" / -0 >3 and up +.125" / -0

Now available in FDA compliant colors, please inquire, minimums may apply



ACETRON® GP is produced from resin certified to ASTM D 4181, POM 211.
ACETRON® GP natural, meets ASTM D 6100 S-POM 0211, LP (Low Porosity), FDA CFR 21, Section 177.2470 (a), (b), (c) and (d)(2) and is 3-A Dairy approved.

Rod / Round Bar

Standard Diameter (inches) :	1/8" up to 10" diameter
Standard Rod Length (inches) :	1/8 to 1 8 ft (+.003" / -0) >1 to 2 8 ft (+.005" / -0) >2 to 2-3/4 8 ft (+.015" / -0) >2-3/4 to 8 4 ft (+.250" / -0) >8 to 10 3 ft (+.300" / -0)
Standard Rod Color(s) :	Black or Natural (White)

Acetal Copolymer rod is available up to 19-1/2" diameter (non stock item)

All registered tradenames listed are the property of their respective owners.

Acetal Homopolymer

Delrin® - DuPont Acetal

Delrin® is an acetal homopolymer characterized as having an excellent combination of physical properties that make it suitable for numerous applications. With low moisture absorption and a low coefficient of friction, Delrin® is uniquely tailored for wear applications in high humidity or moisture environments. Delrin® will maintain constant physical properties under high moisture conditions and out-perform nylon in bearings under these conditions.

Typical Features:

- Excellent dimensional stability
- Excellent machinability
- FDA approved (Natural color)
- Good wear & abrasion resistance
- Low coefficient of friction
- Low moisture absorption
- Good strength and stiffness



Delrin® AF Blend is a combination of oriented PTFE/TFE fluorocarbon fibers uniformly dispersed in Delrin® acetal resin. This combination produces a material that has strength, toughness, dimensional stability and fabrication economy which approaches that of Delrin®, plus the surface characteristics of unlubricated PTFE, the world's most slippery solid material.

Typical Features:

- Excellent dimensional stability
- Good wear & abrasion resistance
- Low coefficient of friction
- No lubrication needed
- No slip or stick



Delrin® 570 GF20 glass-filled stock shapes exhibit the basic Delrin® properties plus high strength. Overall mechanical properties and dimensional stability are enhanced in this tough material. Specific property advantages include increased stiffness, better creep resistance and a higher dimensional stability. Parts designed using glass-filled will exhibit high fatigue endurance, low deformation under load and good impact resistance.

Typical Features:

- Excellent dimensional stability
- Great stiffness
- High tensile strength
- Improved creep resistance
- Lightweight

Acetal Homopolymer

Delrin® Availability

Delrin® Sheet / Slab

Standard Thickness (inches) :	1/8" up to 4" thick
Standard Sheet Size (inches) :	1/4 to 1-1/2 thick..... 24 x 48 and 48 x 96 1-3/4 to 4 thick 24 x 48
Standard Sheet Color(s) :	Black or Natural (White)
Thickness Tolerance(s) :	1/4 to 2 +.025" / -0 >2 to 4 +.050" / -0

DELTRIN® 150 natural, plate and rod, is produced from resin certified to ASTM D 4181, POM 111 and meets ASTM D 6100 S-POM 0111, FDA CFR 21, Section 177.2480.

Delrin® Rod / Round

Standard Diameter (inches) :	1/4" up to 8" diameter
Standard Rod Length (feet) :	1/4 to 1 8 ft (+.003" / -0) >1 to 2 8 ft (+.005" / -0) >2 to 2-3/4 8 ft (+.015" / -0) 3 and up 4 ft (+.250" / -0)
Standard Rod Color(s) :	Black or Natural (White)

Longer and intermediate lengths available by request.

All registered tradenames listed are the property of their respective owners.

Acetal Comparison

Typical Properties Various Acetals

Acetal

PLASTICS GUIDE

PROPERTY TESTED	ASTM	UNITS
MECHANICAL PROPERTIES		
Specific Gravity, 73°F	D792	---
Tensile Strength, 73°F	D638	psi
Tensile Modulus of Elasticity, 73°F	D638	psi
Tensile Elongation (at break), 73°F	D638	%
Flexural Strength, 73°F	D790	psi
Flexural Modulus of Elasticity, 73°F	D790	psi
Shear Strength, 73°F	D732	psi
Compressive Strength, 10% Deformation, 73°F	D695	psi
Compressive Modulus of Elasticity, 73°F	D695	psi
Hardness, Rockwell, Scale as noted, 73°F	D785	M (R)
Hardness, Durometer, Shore "D"	D2240	"D"
Izod Impact (Notched), 73°F	D256, Type "A"	ft.-lb./in. of notch
Coefficient of Friction (Dry vs. Steel) Dynamic	QTM 55007	---
Limiting PV (with 4:1 safety factor applied)	QTM 55007	psi-fpm
Wear Factor "k" x 10 ⁻¹⁰	QTM 55010	10 ⁻¹⁰ in ³ -min/lb-ft-hr
FDA Compliant	---	---
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831 (TMA)	in./in./°F
Heat Deflection Temperature @ 264 psi	D648	°F
Melting Point (Crystalline) Peak	D3418	°F
Continuous Service Temp in Air (Max.)	---	°F
Thermal Conductivity	F433	BTU-in/hr-ft ² -°F
ELECTRICAL PROPERTIES		
Dielectric Strength, Short Term	D149	Volts/mil
Surface Resistivity	EOS/ESD S11.11	Ohm/Sq
Dielectric Constant, 10 ⁶ Hz	D150	---
Dissipation Factor, 10 ⁶ Hz	D150	---
Flammability @ 3.1mm (1/8 in.)	UL 94	---
CHEMICAL PROPERTIES		
Water Absorption Immersion - 24 hours	D570(2)	% by Weight
Water Absorption Immersion - Saturation	D570(2)	% by Weight

Note: Values listed are typical and are meant only as a guide to aid in design only. As always we highly recommend testing any new material in the application first before converting over to new material based on guide data information alone. Applications and usage vary and Alro does not guarantee any results as this data is for information only.

Two page chart, continues on the next page



Acetal Comparison

Typical Properties Various Acetals

ACETRON® GP (Copolymer)	SUSTARIN® C (Copolymer)	TECAFORM® AH (Copolymer)	DELTRIN® (Homopolymer)	DELTRIN® AF (PTFE Blend)
1.41	1.41	1.41	1.41	1.50
9,500	9,500	9,300	11,000	8,000
40,000	---	---	45,000	43,500
30	40	---	30	15
12,000	12,000	13,000	13,000	12,000
400,000	400,000	400,000	450,000	445,000
8,000	---	---	9,000	7,600
15,000	---	12,000	16,000	16,000
400,000	400,000	250,000	450,000	350,000
M88 (120)	M88	M86	M89 (122)	M85 (115)
85D	85D	---	86D	83D
1.00	1.20	1.00	1	0.7
0.25	---	0.21	.25	.19
2,700	---	---	2,700	8,300
200	---	65	200	60
Yes	Yes	Yes	Yes	No
5.4 x 10 ⁻⁵	5.50 x 10 ⁻⁵	4.7 x 10 ⁻⁵	4.7 x 10 ⁻⁵	5 x 10 ⁻⁵
220°	225°	230°	250°	244°
335°	---	329°	347°	347°
180°	---	195°	180°	180°
1.6	---	---	2.5	---
420	450	500	450	400
>10 ¹³	---	---	>10 ¹³	>10 ¹³
3.80	3.80	3.70	3.7	3.1
0.005	---	0.001	0.005	0.01
HB	HB	HB	HB	HB
0.20	0.20	.018	0.20	0.20
0.90	0.90	0.80	0.90	1.00

Note: Values listed are typical and are meant only as a guide to aid in design only. As always we highly recommend testing any new material in the application first before converting over to new material based on guide data information alone. Applications and usage vary and Alro does not guarantee any results as this data is for information only.

All registered tradenames listed above are the property of their respective owners.

Two page chart, continued from previous page

Acetal

PLASTICS GUIDE



Acetal Copolymer

Product Comparison: Acetal vs Delrin®

Acetal is the common name for a family of thermoplastics with the chemical name “PolyOxyMethylene”, or POM. Acetal is available in two general types of resins: Copolymer acetal (POM-C) and Homopolymer acetal (POM-H); commonly called Delrin®. Each type of acetal has its own set of advantages and disadvantages.

Acetal Copolymer (POM-C)

The copolymer grade offers excellent performance at a slightly lower cost than Delrin®. Acetal copolymer offers consistent properties throughout the shape (being free of centerline porosity). Low stress levels and high strength assure flatness and dimensional stability up to a maximum continuous service temperature of 180°F (80°C). Copolymer acetal grades are FDA, USDA, NSF and 3A Dairy compliant. In addition, acetal copolymers are available in a wide variety of colors, including: natural (white), black, blue, red, yellow, green, brown and gray. Advantages over homopolymer acetal are:

- Better dimensional stability due to its lower level of crystallinity.
- Better resistance to hot water and strong caustics, or high pH (basic) solutions.
- Lower coefficient of friction and better impact and wear properties, especially in wet or moist environments.

Acetal Homopolymer (POM-H)

Delrin® acetal homopolymer offers slightly higher mechanical properties than acetal copolymer, but may contain a low density center (also known as “centerline porosity”) especially in large cross-sections. Delrin® also gives slightly less chemical resistance than copolymer acetal. As an example, Delrin® is ideal for small diameter, thin-walled bushings that benefit from the additional strength and rigidity of homopolymer acetal. Delrin® is available in colors of natural (white) and black. Other advantages over copolymer acetal are:

- Greater stiffness, with higher flexural modulus at room & elevated temperature applications.
- Slightly higher tensile and impact strength at room temperatures and lower.
- Slightly harder, thus giving the homopolymer acetals a lower coefficient of friction.

In most applications, Delrin® and acetal copolymer can be interchanged because many material properties are within approximately 10% of each other. Notably, the most significant difference between Delrin® and copolymer acetal relates to what is commonly known as centerline porosity - an inherent characteristic of Delrin®. It is most prominent in thick slab and large diameter rod stock. Visually, it is clearly evident around the center portion of the rod, which extends down the entire length. In sheet, porosity appears as a line along the center of each cut edge. In some cases, the slab may appear to be laminated or glued together. Excessive centerline porosity is undesirable for the following reasons:

- Aesthetic - inconsistent color appearance in finished parts.
- Provides areas which the bacteria can grow in food processing applications.
- Presents potential routes for leakage of gas and liquids.
- Compromises structural integrity.

Acetal, Food Grade

FDA Compliant Blue Acetal



The foremost goal in the food and beverage production and packaging industry is to deliver high quality, healthy and safe products. With that goal in mind, Alro Plastics is stocking FDA compliant Blue Acetal in both sheet and rod stock. The FDA compliance makes it safe to use in the food and beverage industry, while the blue color makes it easier to identify should the part ever chip or break off and fall into the product being made.

Because acetal absorbs minimal amounts of moisture, its physical properties remain constant in a variety of environments. Low moisture absorption results in excellent dimensional stability for close-tolerance machined parts. In high moisture or submerged applications, acetal bearings outperform nylon bearings 4 to 1. Acetal is ideally suited for close tolerance mechanical parts and electrical insulators which require strength and stiffness. It also offers resistance to a wide range of chemicals including many solvents.

Alro Plastics is stocking FDA Compliant Blue Acetal in a select few sizes, please see below for specific sizes in both sheet and round rod.

Typical Features:

- Low moisture absorption
- High strength and stiffness
- Excellent dimensional stability
- No centerline porosity
- Easy to machine
- FDA compliant



FDA Compliant Blue Acetal

Stock Thickness (inches) :	3/4" 1" 1-1/2"
Stock Sheet Size (inches) :	24" x 48"
Stock Diameter (inches) :	2" and 3"
Stock Rod Length :	8 foot

Please inquire on other sizes as stock levels can change over time

Acetal

PLASTICS GUIDE



Acetal, Detectables

Tecaform® UD Blue - Ultra Detectable Grade

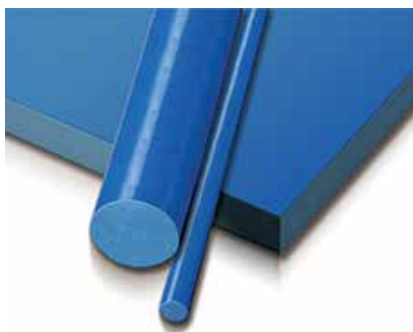
With new regulations in place, the FDA now mandates that all food processors have comprehensive preventive controls and safety programs in place. They have the complete authority to recall food due to contamination, and it is well known to food processors that a recall can kill a brand.

Tecaform® UD Blue is the revolutionary new Ultra Detectable acetal copolymer designed specifically for applications in the food industry. High speed food production lines detect particulate matter in the food product one of three ways; Using optical scanners, metal detection equipment, or X-ray equipment Tecaform® UD Blue is the first engineering thermoplastic that will show up regardless of the scanning method used.

Tecaform® UD Blue can detect chunks as small as 3mm thick and plastic shavings down to 1 mm in thickness. Tecaform® UD Blue is perfect for a great number of applications in the food industry. Whether you are looking at food processing, packaging or conveying, Tecaform® UD Blue can be an important tool in avoiding costly food product contamination.

Typical Features:

- Detectable by X-ray or metal detection equipment
- Plastic chunks as small as 3mm detected
- Plastic shavings to 1mm thick detected
- Food contact Blue in color
- High visibility of filler
- Easily machined



Product Applications:

- Filler valve and pump parts
- Forming plates
- Scraper blades
- Bushings and bearings
- Cam followers

Ensinger

Tecaform® UD Blue

Standard Thickness (inches)	1/2" 3/4" 1" 1-1/2" 2" thick
Standard Sheet Size (inches) :	Please inquire, non-stock item
Standard Diameter (inches) :	1" 1-1/4" 1-1/2" 1-3/4" 2" 3" 5" dia.
Standard Rod Length (inches) :	Please inquire, non-stock item
Standard Color :	Food Contact Blue

Acetal, Detectables

Sustarin® C MDT - Metal Detectable Grade

Finally, an engineering plastic is available that provides all of the physical properties of acetal, can be sensed by metal detectors and best of all it is FDA compliant.

Röchling Engineering Plastics offers Sustarin® C MDT as a solution to many food processing and packaging applications. Most of the food products that we consume every day come into contact with different machines during the manufacturing and packaging processes. If just a small part or component from any one of those machines finds its way into the food there can be serious health risks.

Sustarin® C MDT has special additives that allow it to be traced by standard metal detectors and removed before causing further contamination. Quality assurance engineers at some of the largest food processing manufacturers in the country have already tested this product and found it to be highly effective. The important mechanical, thermal and chemical resistance properties remain unchanged in comparison to standard acetal. This engineering plastic is easily machined and has excellent dimensional stability for close tolerance parts.

Typical Features:

- Can be sensed by standard metal detectors
- Excellent dimensional stability
- FDA Compliant
- Food contact Blue in color
- High visibility of filler
- Easily machined

Product Applications:

- Filler valve and pump parts
- Piston and pocket fillers
- Scraper blades
- Mixer Components
- Cups and sleeves
- Volumetric fillers



Sustarin® C MDT

Standard Thickness (inches)	3/8" up to 4" thick
Standard Sheet Size (inches) :	Please inquire, non-stock item
Standard Diameter (inches) :	1/4" up to 8" diameter
Standard Rod Length (inches) :	Please inquire, non-stock item
Standard Color :	Blue

Acetal, Detectables

Sustarin® C XDT - X-Ray Detectable

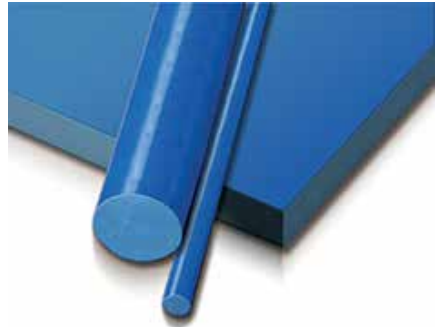
Röchling Engineering Plastics is the first manufacturer to offer extruded X-ray detectable Acetal Copolymer sheets and rods for machined parts and components in the food processing industry.

Repeated handling, cleaning and normal wear and tear of plastic component parts on processing machinery increases the risk of a fragment breaking off and contaminating the product, especially with the ongoing pressure to increase production line speeds. Quality checks are performed at process control points typically with either metal or X-ray detection systems. In many cases, X-ray systems are required or preferred due to the food (such as meat products) and the fact that the system can effectively detect contamination post-packaging.

Röchling Engineering Plastics is the first manufacturer to offer extruded X-ray detectable acetal copolymer sheets and rod for machined parts and components in the food processing industry. Sustarin® C XDT has been proven to be detected in a particle as small as 3mm cube on production lines running as fast as 250 feet-per-minute.

Typical Features:

- Can be sensed by standard metal detectors
- Excellent dimensional stability
- Plastic chunks as small as 3mm detected
- FDA compliant, blue in color
- High visibility of filler
- Easily machined



Product Applications:

- Filler valve and pump parts
- Piston and pocket fillers
- Scraper blades
- Mixer Components
- Cups and sleeves
- Volumetric fillers



Sustarin® C XDT

Standard Thickness (inches)	3/8" up to 4" thick
Standard Sheet Size (inches) :	Please inquire, non-stock item
Standard Diameter (inches) :	1/4" up to 6" diameter
Standard Rod Length (inches) :	Please inquire, non-stock item
Standard Color :	Blue

Acetal, Detectables

Acetron® VMX Food Grade

Acetron® VMX Food Grade is a metal and x-ray detectable material offered in bright blue for easy visual detection. This material is ideal for use in the food processing and packaging industries. It can be easily traced by detection systems to detect foreign materials and contaminations.

Acetron® VMX FG is FDA 21 CFR and EU 10/2011 compliant

Typical Features:

- Three way detectability: visual, metal & x-ray
- Good mechanical strength
- Good mechanical stiffness
- Impact resistant
- Continuous use temperature up to 221°F



Product Applications:

- Gears
- Scrapers
- Grippers
- Funnels
- Extrusion dies
- Cutting blade



Acetron® VMX FG

Standard Thickness (inches)	0.79", 1.57" and 3.15" thick
Standard Sheet Size (inches) :	24" x 39-1/2" and 24" x 120"
Standard Diameter (inches) :	1.18", 1.97", 3.15" and 4.92" diameter
Standard Rod Length (inches) :	39-1/2" and 120"
Standard Color :	Blue

Acetal, Medical

Sustarin® C MG - Medical Grade

As a semi-crystalline material, acetal is characterized by a low coefficient of friction and good wear properties—especially in wet environments. Because acetal absorbs minimal amounts of moisture, its physical properties remain constant in a variety of environments. Low moisture absorption gives excellent dimensional stability for close tolerance machining.

Sustarin® C MG comes in 8 different colors, Natural, Gray, Black, Brown, Blue, Red, Yellow and Green.

Typical Features:

- Excellent dimensional stability
- Excellent electrical properties
- Easy to machine to tight tolerances
- Continuous use temperature of 180°F
- Resistant to steam autoclaving
- Very low moisture absorption
- Can be sterilized multiple times by using hot steam
- Porosity free



Product Applications:

- Sizing trials for joint implants
- Instrument handles and grips
- Medical device components
- Bushings and bearings
- Valves and manifolds

Material Certifications:

- USP Class VI & ISO 10993-5 certified
- FDA21 CFR 177.2470
- ASTM D6100

Sustarin® C MG

Standard Thickness (inches) :	1/4" up to 4" thick (standard increments)
Standard Sheet Size (inches) :	24 x 48 (standard) and 48 x 120 (limited)
Standard Diameter (inches) :	1/4" up to 8" diameter
Standard Rod Lengths :	Varies by diameter, please inquire

All registered tradenames listed are the property of their respective owners.