



PLASTICS REFERENCE HANDBOOK

REGAL PLASTIC SUPPLY COMPANY

PLASTICS REFERENCE HANDBOOK

regal

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Regal Plastic Supply Company,
a division of Regal Supply Company

Established in 1954, Regal Plastic Supply Company is considered one of the foremost pioneers in the plastic distribution industry. Throughout the years, the innovative “customer-oriented plan for success” thinking has become a credible trademark our customers rely on. Fortifying that philosophy, Regal introduced its Plastic Materials Reference Guide in 1984. As products and industries continue to evolve, so does this compilation of technical data. We view providing our customers with tools for effective planning and purchasing as important as meeting product “supply and demand”. You will find this guide an invaluable reference source for researching or finding the answer pertaining to your plastic application. The product information contained herein covers the most commonly used materials; it does not reflect our total capacity.

True customer service is a thought process not developed overnight. Our experience and stability in the industry gives Regal the opportunity to assist you in your plastics endeavors as you utilize staff who are accessible, knowledgeable and resourceful with regard to all inquiries.

We invite you to visit the Regal Plastic Supply Company location in your vicinity. All locations maintain generous inventories of plastic sheet, rod, tube, film, and numerous finished products.

Regal Plastic Supply Company thanks all of our customers for their patronage over the years. We will continue in our efforts to provide the best in JIT inventory and personal service. Plastic is in your future and Regal Plastic Supply Company is your best source.

Sincerely yours,

Regal Plastic Supply Company

National Association

Administrative Offices and Distribution Centers

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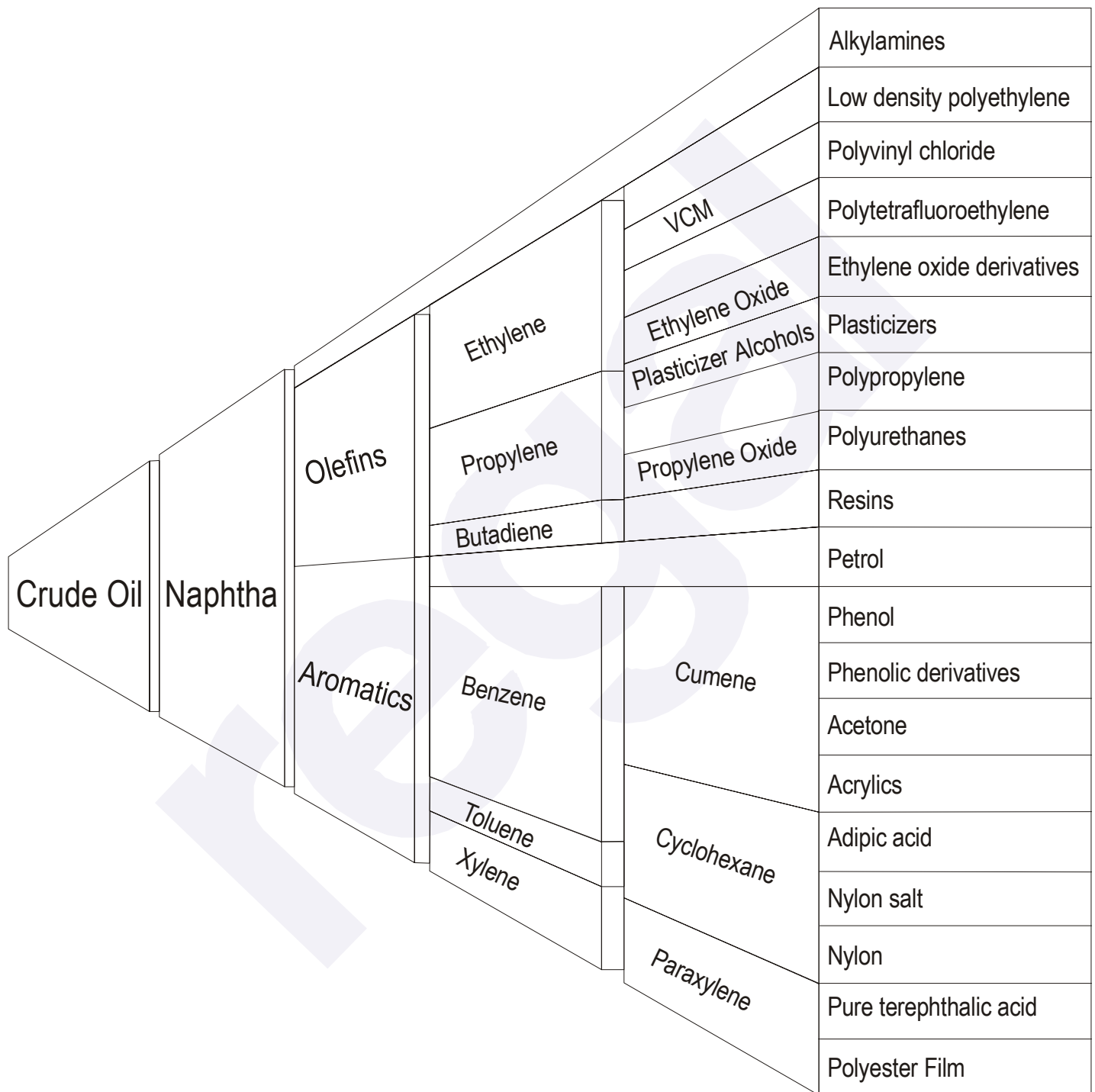
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INTRODUCTION

The Origins of Plastic Materials



INTRODUCTION

Preface

Introduction

PLASTIC-(per Webster)- “Any numerous organic, synthetic, or processed materials that are high molecular weight polymers.”

Polymers are a tribute to man’s creativity and inventiveness. They are truly man-made materials. Like any other material, they have their origins in nature, in such basic chemical elements as carbon, oxygen, hydrogen, nitrogen, chlorine, and sulfur. These elements in turn are extracted from the air, water, gas, oil, coal, or even plant life.

It was man’s inspiration to take these elements and combine them, via various chemical reactions, in an almost unending series of combinations, to produce the rich variety of materials we know today as plastics.

The possibilities of combining chemical elements to create plastics with different properties are almost endless. It is this diversity that has made plastics so applicable to such a broad range of end uses and products today.

In the Beginning

Given this kind of versatility and the role that plastics play in modern living, it’s surprising to realize that a little over a century ago there was no such thing as commercial plastic in the United States. During the 1850's and 60's, developmental work was going on with hard rubbers and cellulose materials, but the U.S. plastics industry officially dates its beginnings back to 1868, when a product called Celluloid was created as the first commercial plastic in the U.S. The development was in response to a competition sponsored by a manufacturer of billiard balls. It came about when a shortage developed in ivory from which the billiard balls were made, and the manufacturer sought another production method. Celluloid was one of the materials considered, and the U.S. plastics industry was born.

As has been typical of new plastic materials ever since, Celluloid quickly moved into other markets. The first photographic film used by Eastman was made of celluloid: producing the first motion picture film in 1882. The material is still in use today under its chemical name Cellulose nitrate, for making products like eyeglass frames.

Forty years were to pass before the plastics industry took its second major step forward. In 1909, Dr. Leo Hendrik Baekeland introduced Phenol formaldehyde plastics (or Phenolics as they are more popularly known), the first plastic to achieve world wide acceptance.

The third big thrust in plastics development took place in the 1920's with the introduction of Cellulose acetate, ureaformaldehyde, polyvinyl chloride, or Vinyl, and Nylon.

Evolution

In the World War II years of the 1940's, the demand for plastics accelerated, as did research into new plastics that could aid in the defense effort.

By the start of the 1950's plastics were on their way to being accepted by designers and engineers as basic materials, along with the more conventional ones.

Nylon, Teflon, Acetal, and Polycarbonate became the nucleus of a group in the plastics family known as the engineering thermoplastics. Their outstanding impact strength and thermal and dimensional stability enabled them to compete directly with metals. This group has grown since then to include a number of new plastics, as well as improved variations of older plastics that could similarly qualify for inclusion.

The Monomers & Polymers

Many plastics are derived from fractions of petroleum or gases that are recovered during the refining process. For example: ethylene monomer, one of the more important feedstocks, or starting materials for plastics, is derived in a gaseous form from petroleum refinery gas, liquefied petroleum gases, or liquid hydrocarbons. Although petroleum gas derivatives are not the only basic source used in making feedstocks for plastics, they are among the most popular and economical in use today. Coal is another excellent source in the manufacturing of feedstocks for plastics.

From these basic sources come the feedstocks we call monomers. The monomer is subjected to a chemical reaction known as polymerization; it causes the small molecules to link together into ever increasingly long molecules. Chemically, the polymerization reaction gas turns the monomer into a polymer, and thus a given type of plastic resin.

The Product as We See It

The polymer or plastic resin must next be prepared for use by the processor, who will turn it into a finished product. In some instances, it is possible to use the plastic resin as it comes out of the polymerization reaction. More often, however, it goes through other steps which turn it into a form that can be more easily handled by the processor and processing equipment. The more popular forms of resin for processing are pellet, granule, flake, and powder.

In the hands of the processor, these solids are generally subjected to heat and pressure. They are melted, forced into the desired shape (sheets, rods, and tubes) and then allowed to cure into a finished product. Resins are most readily available in their natural color, but by adding coloring agents, most any color can be achieved during the processing.

Plastics are a family of materials, not a single material. Each has its own distinct and special advantages.

Each day brings new plastic compounds, and new uses for the old compounds.

INTRODUCTION

Chronology of Plastic

| DATE | MATERIAL | ORIGINAL TYPICAL USE |
|------|---------------------------------|-------------------------------|
| 1868 | Cellulose Nitrate | Eye Glass Frames |
| 1909 | Phenol-Formaldehyde | Telephone Handsets |
| 1926 | Alkyd | Electrical Bases |
| 1926 | Analine-Formaldehyde | Terminal Boards |
| 1927 | Cellulose Acetate | Tooth Brushes, Packaging |
| 1927 | Polyvinyl Chloride | Raincoats |
| 1929 | Urea-Formaldehyde | Lighting Fixtures |
| 1935 | Ethyl Cellulose | Flashlight Cases |
| 1936 | Acrylic | Brush Backs, Displays |
| 1936 | Polyvinyl Acetate | Flash Bulb Lining |
| 1938 | Cellulose Acetate Butyrate | Irrigation Pipe |
| 1938 | Polystyrene or Styrene | Kitchen Housewares |
| 1938 | Nylon (Polyamide) | Gears |
| 1938 | Polyvinyl Acetal | Safety Glass Interlayer |
| 1939 | Polyvinylidene Chloride | Auto Seat Covers |
| 1939 | Melamine-Formaldehyde | Tableware |
| 1942 | Polyester | Boat Hulls |
| 1942 | Polyethylene | Squeezable Bottles |
| 1943 | Fluorocarbon | Industrial Gaskets |
| 1943 | Silicone | Motor Insulation |
| 1945 | Cellulose Propionate | Automatic Pens and Pencils |
| 1947 | Epoxy | Tools and Jigs |
| 1948 | Acrylonitrile-Butadiene-Styrene | Luggage |
| 1949 | Allylic | Electrical Connectors |
| 1954 | Polyurethane or Urethane | Foam Cushions |
| 1956 | Acetal | Automotive Parts |
| 1957 | Polypropylene | Safety Helmets |
| 1957 | Polycarbonate | Appliance Parts |
| 1959 | Chlorinated Polyether | Valves and Fittings |
| 1962 | Phenoxy | Bottles |
| 1962 | Polyallomer | Typewriter Cases |
| 1964 | Ionomer | Skin Packages |
| 1964 | Polyphenylene Oxide | Battery Cases |
| 1964 | Polymide | Bearings |
| 1964 | Ethylene-Vinyl Acetate | Heavy Gauge Flexible Sheeting |
| 1965 | Parylene | Insulating Coatings |
| 1965 | Polysulfone | Electrical/Electronic Parts |
| 1970 | Thermoplastic Polyester | Electrical/Electronic Parts |
| 1973 | Polybutylene | Piping |
| 1975 | Nitrile Barrier Resins | Containers |

The information contained herein provides product data, suggestions, and guidelines we believe to be reliable. They are offered in good faith but without any guarantee, as conditions, type of product, and methods of product use are beyond our control.

Regal Plastic Supply Company makes no warranties either expressed or implied and expressly disclaims any implied warranty of fitness for a particular purpose or procedure.

Sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein, is strongly recommended.

ENGINEERED PLASTICS

ABS Basic Information ■ ABS Products

An amorphous terpolymer, ABS is manufactured by combining three different compounds; acrylonitrile, butadiene and styrene. A product that provides good tensile strength, dimensional stability, surface hardness, rigidity, electrical characteristics, with heat, chemical and abrasion resistance; specific grades of ABS exhibit good impact strength at temperatures as low as -40°F. Typically translucent to opaque, ABS can be produced in transparent grades and colors.

Numerous formulations of ABS allow this product to be used for applications requiring injection molding, extrusion, blow molding, foam molding, and thermoforming.

Using conventional fabrication methods, ABS can be sawed, drilled, routed, punched and die-cut, joined by adhesive or solvent bonding, and mechanically fastened. Easily bonded, ABS is frequently the product of choice in prototyping applications.

Typical Applications:

- Camper tops
- Housings for small appliances
- Communications equipment
- Business machines
- Automotive instrument panels
- Pipes and fittings
- Home security devices
- Refrigerator liners
- Luggage shells
- Tote trays
- Mower shrouds
- Boat hulls
- Large components for recreational vehicles

CHEMICAL RESISTANCE

| CHEMICAL / VALUE (%) | RATING | CHEMICAL / VALUE (%) | RATING | CHEMICAL / VALUE (%) | RATING |
|------------------------|--------|--------------------------------|--------|----------------------|--------|
| Acetic Acid / 80 | P | Heptane | F | Sodium Sulphate / 90 | E |
| Acetic Acid / 10 | G | Hexane | G | Sulfur | E |
| Acetone | P | Hydrochloric Acid / 2 | E | Sulphuric Acid / 90 | P |
| Aluminum Chloride / 10 | E | Hydrochloric Acid / 10 | E | Tar | — |
| Ammonia / 10 | E | Hydrogen Peroxide / 0.5 | — | Tartaric Acid / 90 | — |
| Ammonium Chloride / 10 | E | Hydrofluoric Acid | — | Tetrachlorethylene | P |
| Amyl Acetate | P | Hydrogen Sulfide | — | Toluene | P |
| Barium Sulphide / 10 | E | Iodine | P | Trichlorethylene | P |
| Benzene | P | Isopropyl Alcohol | F | Turpentine | P |
| Boric Acid / 10 | — | Isopropyl Ether | — | Urea | P |
| Bleach / 10 | E | Lactic Acid / 10 | E | Vaseline | E |
| Bromine / 30 | P | Linseed Oil | E | Vinegar | E |
| Butyl Acetate | P | Magnesium Chloride / 10 | G | Water | E |
| Butylene Glycol | — | Methanol | P | Wax Molten | E |
| Butyric Acid Conc. | P | Methyl Acetate | P | Wine | G |
| Calcium Chloride | E | Methyl Ethyl Ketone | P | Xylene | P |
| Camphor | G | Methyl Chloride | P | Zinc Chloride / 10 | E |
| Carbon Disulfide | P | Milk | G | | |
| Carbon Tetrachloride | P | Mineral Oil | E | | |
| Chlorine Gas / 100 | P | Nitric Acid / 90 | P | | |
| Chloroform | P | Nitric Acid / 10 | P | | |
| Cyclohexane | P | nitro Benzene | P | | |
| Cyclohexanol | E | Oxalic Acid / 10 | — | | |
| Chromic Acid / 20 | G | Paraffin | — | | |
| Cotton Seed Oil | E | Perchlorethylene | P | | |
| Dimethylformamide | P | Phenol AQ. | P | | |
| Diesel Fuel | — | Phosphoric Acid / 90 | — | | |
| Diethyl Phthalate | P | Potassium Bromide / 10 | — | | |
| Dioxane | P | Potassium Carbonate / 60 | — | | |
| Edible Oils | — | Potassium Hydroxide / 90 | E | | |
| Ethanol / 90 | F | Potassium Nitrate / 90 | E | | |
| Ether | — | Potassium Permanganate AQ. / 1 | E | | |
| Ethyl Acetate | P | Propanol | E | | |
| Ethylene Chloride | G | Salicylic Acid | E | | |
| Flourine | P | Silicone Oils | E | | |
| Freon / 12 | P | Soap Solutions | E | | |
| Formaldehyde / 30 | F | Sodium Bicarbonate AQ. / 50 | E | | |
| Formaldehyde / 40 | P | Sodium Bisulfite | E | | |
| Formic Acid / 10 | G | Sodium Carbonate / Saturated | E | | |
| Fruit Juices | E | Sodium Chloride / Saturated | E | | |
| Gasoline | E | Sodium Hydroxide / 10 | E | | |
| Gasohol W / 10 Ethanol | — | Sodium Hydroxide / 90 | E | | |
| Gasohol W / 20 Ethanol | — | Sodium Nitrate / 90 | E | | |
| Glycerine | E | Sodium Phosphate / 90 | G | | |

All concentrations shown above are 100% unless otherwise noted. All ratings are for room temperature only. Ratings do not take into consideration in-service stress.

E = EXCELLENT G = GOOD F = FAIR P = POOR

RATINGS LEGEND:

EXCELLENT: The material appeared to be unaffected by the chemical during the test.

GOOD: The material appeared to be only very slightly affected by the chemical

FAIR: The material was substantially affected by the chemical.

POOR: The material was severely attacked by the chemical.

PRODUCT AVAILABILITIES

With the wide range of formulations on the market, the following is strictly a general range of product availability. Customized sizes are available. For specific needs, please contact your nearest Regal Plastic Supply distribution center.

PLATE: Natural, Beige, Black, Flame Retardant, Machining Grade

Thicknesses: 1/32" to 4"

Sizes: 12" x 48", 24" x 48"

ROD: Natural, Beige, Black, Flame Retardant, Anti-Static, Conductive

Diameters: 3/16" to 8"

Lengths: 2' to 10'

EXT. TUBE: Natural, Black, Flame Retardant

Diameters: 1.5" - 11.84" O.D. and 1" to 7.87" I.D.

Lengths: 10'

SHEET: Natural, Flame Retardant, Anti-Static, Conductive. Available in a wide variety of standard and custom colors, grain textures, gauges, and blank sizes.

Maximum Widths: 58", 63" capped, 88", 96" uncapped

Thicknesses: 0.040" to 2.000"

Std. Sizes: 48" x 96" & 120"; 54" x 94"

Acetal polymers, referred to chemically as polyoxymethylene, are semi-crystalline engineering thermoplastics made by the polymerization of formaldehyde. They have physical properties that are not available with metals or most other plastics; high mechanical strength and rigidity, low coefficients of friction, low moisture absorption, excellent dimensional stability, fatigue endurance, and resistance to abrasion and creep. These materials are also resistant to a wide range of solvents and have good electrical properties, which make them good for electrical applications.

There are two types of acetals, homopolymer and copolymer. Acetal copolymers remain tough through broad temperature ranges and are more resistant to hot water, hot air, and creep than the homopolymers. Although homopolymers should not be used with strong caustics, they generally have higher mechanical and thermal properties than copolymers.

Both types of acetals are available in several viscosity ranges, in PTFE-filled or silicone grades, and many have met FDA requirements for food contact applications. Homopolymer acetal is available in chemically lubricated low-friction formulas for self-lubricating applications. Homopolymer and co-polymer acetals are available in unreinforced and glass fiber-reinforced extrusion and injection molding grades. The higher viscosity grades are normally used for extrusions such as extruded rod and slab, and for molded parts that require maximum toughness.

Typical Applications:

Industrial and Automotive

- Gears
- Cams
- Bushings
- Clips
- Lugs
- Door handles
- Housings
- Fuel-system
- Seat-belt components
- Steering columns
- Window-support brackets
- Cranks
- Handles

Plumbing Products

- Valves
- Valve stems

- Pumps
- Faucets
- Impellers
- Shower heads
- Faucet-cartridges

Consumer Items

- Toys
- Garden sprayers
- Audio and video cassette parts
- Butane lighter bodies
- Zippers
- Telephone components

Mechanical Components

- Watch gears
- Conveyor links
- Aerosols
- Mechanical pen and pencil parts

FDA Approved Items

- Milk pumps
- Coffee spigots
- Filter housings
- Food conveyors

Ensinger Engineering Plastics

Ensinger Engineering Plastics manufactures a variety of homopolymer and copolymer acetal grades from the Delrin®, Celcon®, and Ultraform® resins.

Delrin®

Ensinger's line of Delrin® homopolymer acetal products includes FDA, NSF, and USDA approved Natural, Black, 20% Glass-filled, and AF Blend (PTFE-filled) grades.

Ensital®

Ensinger's line of copolymer acetal products include grades of Black, Static Dissipative, and FDA, NSF, USDA, and 3A Dairy approved Natural, produced from Celcon® or Ultraform® resins. The Ensital, 13% PTFE-filled grade, is an acetal homopolymer made from the Delrin® resin.

ENGINEERED PLASTICS

Acetal

PRODUCT AVAILABILITY

| Extruded Rod | | |
|---|---|---------------------------------------|
| PRODUCT | DIAMETERS (in) | LENGTH (ft) |
| Delrin® Natural & Black Ensital® Natural & Black | 3/16, 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/8, 2 1/4, 2 3/8, 2 1/2, 2 5/8, 2 3/4, 2 7/8, 3, 3 1/4, 3 1/2, 3 3/4, 4, 4 1/4, 4 1/2, 4 3/4, 5, 5 1/2, 6, 6 1/2, 7, 7 1/2, 8 | 10 |
| Delrin® 570 - 20% Glass-filled | 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2 1/2, 3, 3 1/2, 4, 4 1/2, 5, 6 | 10 |
| Delrin® AF Blend (PTFE-filled) | 3/16 to 8 - Custom Order | 10 |
| Ensital® Static Dissipative | 1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3 | 10 |
| Ensital® HPV 13 (PTFE-filled) | 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2, 2 3/4, 3, 4, 5, 6 | 10 |
| Extruded Plate | | |
| PRODUCT | THICKNESS (in) | SIZE |
| Delrin® Natural & Black Ensital® Natural & Black | 1/32, 1/16, 3/32, 1/8, 3/16, 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/4, 2 1/2, 2 3/4, 3 3 1/4, 3 1/2, 3 3/4, 4 | 24" x 48" 12" x 48" |
| Delrin® 570 - 20% Glass-filled | 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2 | 24" x 48" |
| Delrin® AF Blend (PTFE-filled) | 1/32 to 3 - Custom Order 3 1/4 to 4 - Custom Order | 24" x 48" 12" x 48" |
| Ensital® Static Dissipative | 1/4, 1/2, 3/4, 1, 1 1/2, 2 | 24" x 48" |
| Ensital® HPV 13 (PTFE-filled) | 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2 | 24" x 48" |
| Extruded Tube All Gauges 10 Ft. Lengths | | |
| PRODUCT | ID (in) | OD (in) |
| *Delrin® Natural & Black *Ensital® Natural & Black | 1.00 | 1.50 |
| Delrin® 570 - 20% Glass-filled | 1.00, 1.25 | 1.75 |
| Delrin® AF Blend (PTFE-filled) | 1.00, 1.25, 1.50 | 2.00 |
| Delrin® AF Blend (PTFE-filled) | 1.00, 1.25, 1.50, 2.00 | 2.50 |
| Ensital® Static Dissipative | 1.00, 1.25, 1.50, 2.00, 2.30, 2.50 | 2.90 |
| Ensital® HPV 13 (PTFE-filled) | 1.00, 1.25, 1.50, 2.00, 2.30, 2.50 | 3.00 |
| | 1.00, 1.25, 1.50, 2.00, 2.30, 2.50 3.00 | 3.50, 4.00, 4.50, 5.00 5.50 |
| * - 500 lb. Minimums apply | 1.00, 1.25, 1.50, 2.00, 2.50, 3.00 4.92 5.91 7.87 7.87 | 6.00 7.09 7.87 9.84 11.84 |

A. L. Hyde Company

A.L. Hyde Company manufactures a variety of acetal homopolymer and copolymer grades from the Delrin® (Dupont) and Ultraform® (BASF) resins.

Delrin® 150 SA Natural

This general purpose, unfilled acetal, has the best impact and toughness properties of all the unfilled Delrin products.

Delrin® 100 Black

This is the black, UV stabilized, version of Delrin® 150 SA.

Delrin® 550 SA Natural

A general purpose grade, unfilled acetal, this Delrin® product provides excellent machinability requiring little to no deburring during machining and exhibiting no build up of silk.

Delrin 507® Black

This is the black, UV stabilized, version of Delrin® 550 SA.

Delrin® 570

Glass-filled acetal typically provides higher mechanical properties and better dimensional stability than the unfilled products. Delrin® 570 is available in 15% to 20% glass-filled grades.

Delrin® AF Blend

This acetal product is filled with 13% teflon fiber. It has better lubricity, lower coefficients of friction, and better wear characteristics than unfilled acetal. Two grades are available, Delrin 500 AF and Delrin 100 AF.

Delrin® 500 CL

A lubricated acetal, this grade has a lower coefficient of friction than unfilled Delrin®.

ENGINEERED PLASTICS

Acetal

DSM Engineering Plastics Products

DSM Engineering Plastics Products (formerly the Polymer Corporation) manufactures and offers the following formulations of acetal products.

Acetron® GP Acetal

As DSM's general purpose copolymer acetal, this product is deemed porosity free and has FDA, USDA, NSF, Canada AG and 3A-Dairy compliance.

Delrin® Acetal

This homopolymer acetal product is manufactured and stocked in rod and plate. Exhibiting slightly higher mechanical properties and less chemical resistance than Acetron® GP Acetal, this acetal material may contain a low-density center in larger cross-sections. It is particularly recommended for small diameter, thin-walled bushings.

Delrin® AF Blend

This PTFE/ acetal blend product is recommended for use in moving parts where low friction and long wear life are required. This acetal blend retains 90% of the inherent strength of unmodified Delrin® acetal.

Delrin® AF 100

This unblended acetal material exhibits a slightly higher limiting PV, lower coefficient of friction, and decreased wear resistance and impact strength due to the added PTFE content.

Acetron® NS Acetal

This internally lubricated acetal grade provides high PV capabilities, low coefficient of friction and excellent wear resistance. Stable in both wet and dry environments, it is recommended for precise, close tolerances.

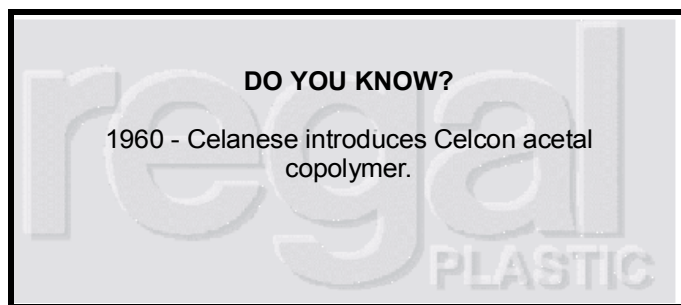
Semitron® ESd 225

Designed for the semiconductor industry, this is a static dissipative acetal exhibiting surface resistivity of 10^{10} - 10^{12} ohms/sq., thermal performance to 225°F (107°C), broad chemical resistance, good wear resistance, and dissipative rate of 5 KV in less than 2 seconds per Mil-B-8170C.

PRODUCT AVAILABILITY

| PRODUCTS | ROD | PLATE | TUBULAR BAR | OTHER |
|--------------------|----------------------|----------------------|-------------|--------------------|
| Acetron® GP Acetal | 1/32" - 6" diameters | 1/32" - 3" thickness | ◆ | hex & square rod ◆ |
| Delrin® Acetal | 1/32" - 6" diameters | 1/32" - 3" thickness | ◆ | hex & square rod |
| Delrin® AF Blend | 1/16" - 6" diameters | 1/4" - 2" thickness | ◆ | hex & square rod ◆ |
| Delrin® AF 100 | ◆ | ◆ | ◆ | ◆ |
| Acetron® NS Acetal | 1/4" - 6" diameters | 1/4" - 2" thickness | ◆ | hex & square rod ◆ |
| Semitron® ESd 225 | 1/32" - 6" diameters | 1/32" - 3" thickness | ◆ | hex & square rod ◆ |

◆ Custom sizes available



Kydex® thermoplastic sheets for vacuum and pressure forming applications are products of the Kleerdex Company.

Based on proprietary acrylic/PVC formulations, all Kydex® thermoplastic sheet grades deliver an unmatched combination of performance and cost advantages.

All grades of Kydex® sheet offer the following characteristics:

Physical Properties

- **Modulus of Elasticity**

Kydex® thermoplastic is among the most rigid of thermoforming materials, resulting in parts that deform less when loaded, which is particularly important in deep formed parts with thin wall sections.

- **Abrasion Resistance**

Kydex® sheet performs very well in abrasion resistance tests. Parts made from it invariably last a long time and maintain their high quality surface finish.

- **Dimensional Stability**

Very low water absorption and a relatively low coefficient of thermal expansion give parts formed from Kydex® high dimensional stability.

- **Chemical Resistance**

From sulfuric acid to hydrocarbons, Kydex® acrylic/PVC alloy is more resistant to a wider range of concentrated chemicals than any other thermoplastic.

Fabrication

- **Wide Forming Range at Low Forming Temperatures**

Kydex® sheet can be thermoformed at temperatures between 320°F and 390°F. Tooling can range from wood for quick turnarounds and prototyping to epoxy or aluminum for longer runs.

- **Superior Extensibility**

Forms to deeper draws than competitive materials when heated to the proper thermoforming temperature for its thickness.

- **Excellent Hot Tear Strength**

Unlike many thermoformable sheets, Kydex® has unusual resistance to hot-tearing.

- **Uniform Wall Thickness**

Special forming techniques and selective heating are seldom necessary to achieve uniform wall thicknesses. Because of its high hot tear strength, thermoforming with Kydex® sheet generally results in more uniform wall thicknesses than competitive materials. This frequently allows for down-gauging the sheet thickness while retaining minimum wall thicknesses in the formed part.

- **Machinability**

Kydex® sheet is extremely easy to work with. It can be formed on standard equipment. It can be die-cut on standard die-cutting machines. All secondary operations are possible, including: machining, sawing, shearing, drilling, punching, brake forming, sanding, and polishing. In addition, Kydex® sheet can be joined to itself or to other materials by cementing or mechanical fastening.

KYDEX® 100

Acrylic/PVC fire retardant sheet which is used for vacuum and pressure forming of high performance components.

Of the three standard formulations of Kydex®, Kydex® 100 offers the highest performance and the highest level of impact resistance, deep formability, and flammability resistance.

KYDEX® T

A proprietary acrylic/PVC fire retardant sheet for general thermoforming. Kydex® T is a cost competitive alternative to fire retardant ABS/PVC (FR-ABS) formulations while providing higher impact strength, rigidity, tensile strength, abrasion resistance, and extensibility. Unlike FR-ABS, Kydex® T normally requires no drying, and offers significantly greater resistance to a broad range of corrosive chemicals and cleaning solutions.

KYDEX® L

Laminating grade, fire rated sheet, used for store fixtures, exhibits, door surfacing and partitions. Unlike most high pressure laminates, color is integral throughout the sheet. Class 1/A rated at (.040" and thinner), this sheet is UL STD 94 V-0 listed by Underwriters Laboratories.

ENGINEERED PLASTICS

Kydex®

Typical Applications for KYDEX® 100 and T:

- Equipment housings (cash registers, photocopy machines, grilles, instrument panels, x-ray machines, computers, keyboards, etc.)
- Internal equipment parts (vending machine chutes, air ducts, partitions, etc.)
- Orthopedic products (braces of all types)
- Consumer products (holsters, medical alert systems, housings for lawn/garden/recreational equipment, etc.)

KYDEX® 6565

A proprietary acrylic/PVC fire retardant sheet for vacuum and pressure forming of aircraft interior components. Kydex® 6565 meets all fire retardancy requirements set forth in Federal Aviation Regulation 25.853 paragraphs (a), (b), and (c) (old [a-1]). It also exhibits a broad range of outstanding physical, mechanical, and thermal properties, and is very easy to form, making it the ideal material from which to form a broad variety of two- and three-dimensional aircraft components.

Typical Applications:

- Air Ducts
- Armrests
- Bulkhead laminates
- Escape slide packboards
- Galley parts
- Instrument panels
- Lavatory floorpans
- Life vest shrouds
- Lighting housings
- Molding strips
- Passenger service units
- Sidewall panels
- Toilet shrouds
- Tray tables
- Window reveals

| Flammability Ratings | Underwriter's Laboratories, Inc. UL Standard 94 | FAR 25.853 a and b Vertical Burn |
|----------------------|---|----------------------------------|
| Kydex 100 | UL Recognized 94 V-0 & 5V - all gauges and colors | Pass all gauges and colors |
| Kydex L | UL Recognized 94 V-0 - .040" and Thinner | |
| Kydex T | UL Recognized 94 V-0 - all gauges and colors | Pass all gauges and colors |

PRODUCT AVAILABILITY

COLOR, SHEET AND ROLL SELECTION

| | | |
|--------------------|---|---|
| COLORS | 33 Standard Colors Custom Colors Available | Amethyst 42111 Angora 72174 Beige 72005 Blue: Buoyant 42112 Cadet 42000 Canyon 42107 Pastel 42031 Peacock 42108 Bordeaux 12036 Cabernet 12038 Calcutta Black 52000 Chocolate 72010 Cocoa 72047 Daybreak 72177 Dusty Rose 72176 Gray: Dark 52002 Pewter 52001 Green: Mystic 32060 Ivory 62015 Misty Mauve 72178 Monterey 62033 Orange 22031 Parchment 72000 Pinstripe 52070 Polar White 62000 Red 12000 Rooster Red 12037 Rouge 72175 Sandy Beach 72179 Snowflake 62029 Thunder 42109 Treasure Chest 32059 Twilight 42110 |
| | TEXTURE(S) | P-1 Haircell P-E Smooth P-3 Velour Matte P-C Level Haircell P-8 Suede P-F Levant (≥.040") P-7 Stipple P-G Contour P-A Smooth (LTD Grades) |
| THICKNESS | .028" (0.7mm) .040" (1.0mm) .060" (1.5mm) .080" (2.0mm) .093" (2.4mm) .125" (3.2mm) .156" (4.0mm) .187" (4.8mm) .250" (6.4mm) .312" (7.9mm) CUSTOM THICKNESSES ALSO AVAILABLE | |
| SHEET SIZES | Standard Widths 36", 48", 60" Standard Lengths 24" to 120" CUSTOM SHEET SIZES ALSO AVAILABLE | |
| ROLLS | 24" x 120' (36.58 m x .61 m) 36" x 120' (36.58 m x .91 m) 48" x 120' (36.58 m x 1.22 m) CUSTOM ROLL SIZES ALSO AVAILABLE (IN .028" and .040" ONLY) | |

The fluoroplastic industry began in 1938 with the invention of polytetrafluoroethylene (PTFE also known as TFE). Since then, seven more fluoroplastics have been added to the fluorocarbon family: FEP, PVDF, PFA, ETFE, PCTFE, ECTFE and PVF. These fluoroplastics offer good weatherability, low friction, a wide working temperature range, electrical and thermal insulation, chemical resistance and anti-stick surfaces.

PTFE

Recognized as the first fluorocarbon, and more prominently referred to by the tradename Teflon®, polytetrafluoroethylene is the most chemically resistant plastic known. It has a working temperature range of -400° to 500°F, excellent thermal and electrical insulation properties and a low coefficient of friction. With a non-stick surface, very few materials will adhere to it, and those that stick can be easily peeled or rubbed off. PTFE's mechanical properties are lower than other engineering plastics, but that can be improved by adding fillers such as glass fiber, carbon, graphite, molybdenum disulfide and bronze. PTFE cannot be processed by conventional methods; it must be condensed and then sintered to produce a useful plastic. Applications include labyrinth seals and shrouds, dishwasher arm beams, transmission and power steering seal rings and valve seats.

FEP

Fluorinated ethylene propylene can be extruded or injection molded. It has the same chemical resistance and mechanical and electrical properties of PTFE, but its temperature range is from -454° to 400°F. It is chemically inert, weather resistant, and flexible with a low coefficient of friction. It is also FDA and USP Class VI approved. Applications include sight gauges, valve and pump linings, pipe liners, release applications, and tubing for strong chemicals.

PVDF

Polyvinylidene fluoride is stiffer and resists cold better than PTFE, FEP, and PFA. However, it has lower chemical resistance, anti-stick properties, lubricity, electrical properties and temperature ranges than the above three. Although a popular material for pipes and fittings, this material is also used in the semi-conductor, pulp and paper, nuclear waste, chemical processing, and food and pharmaceutical processing industries.

PFA

In addition to having the properties of PTFE, perfluoroalkoxy is melt processable with lower permeation and a better flex life. It is also more expensive than both PTFE and FEP, but it meets FDA and USP Class VI regulations. Applications include: coating cables, valve and pump linings, insulating bushings, release applications, and the pharmaceutical and semi-conductor industries.

ETFE

Ethylene tetra fluoro ethylene is a copolymer of ethylene and tetrafluoroethylene. It has greater strength and stiffness than PTFE, FEP, PFA, excellent impact strength, abrasion resistance, and good thermal properties. It has a continuous working temperature of 300°. Applications include valves, fittings, pump housings, electrical components and liquid chromatography.

PCTFE

Chlorotrifluoroethylene has greater tensile and compressive strength than PTFE, FEP, or PFA, and greater radiation resistance within its temperature range. It does not, however, have the solvent resistance of PTFE, FEP, PFA or ETFE, and at high temperatures it is subject to stress cracking. It is FDA approved, oxygen compatible, and has near zero moisture absorption. Applications include: valves, seals, gaskets, bearings, instrumentation, and the aerospace and pharmaceutical industries.

ECTFE

Ethylene-chlorotrifluoroethylene is a copolymer of ethylene and PCTFE. It has a temperature range of -80° to 300°F., with excellent electric insulating properties and impact resistance. At ambient temperatures, its mechanical properties compare to those of nylon 6. Applications include: valve parts, watch parts, lab tubing, containers for corrosive materials, and electrical applications.

PVF

Polyvinyl fluoride has excellent resistance to weathering and good resistance to abrasion and staining. Applications include surfacing film for industrial, architectural, and decorative building materials. Applications include glazing material for solar collectors.

ENGINEERED PLASTICS

Fluorocarbons

Teflon® Shapes

Along with a wide variety of stock shapes and profiles, an endless variety can be extruded to customer specifications.

Typical industry uses of Teflon® (PTFE / TFE) shapes and profiles include:

- Baffles
- Bearings
- Bushings
- Capacitors
- Chemical Equipment
- Coaxial Cable Connectors
- Electronics Equipment
- Food Processing Equipment
- Gaskets
- Mechanical Components
- Medical Equipment
- Pump Components

- Relays
- Rings
- Seals
- Tape-Wrapped Wire
- Terminal Insulators
- Transformers and Coils
- Valve Components
- Washers

Other extruded profiles include:

- U-Channel
- C-Rail
- Snap-On
- Half Round Snap-On
- J-Leg
- Full Round

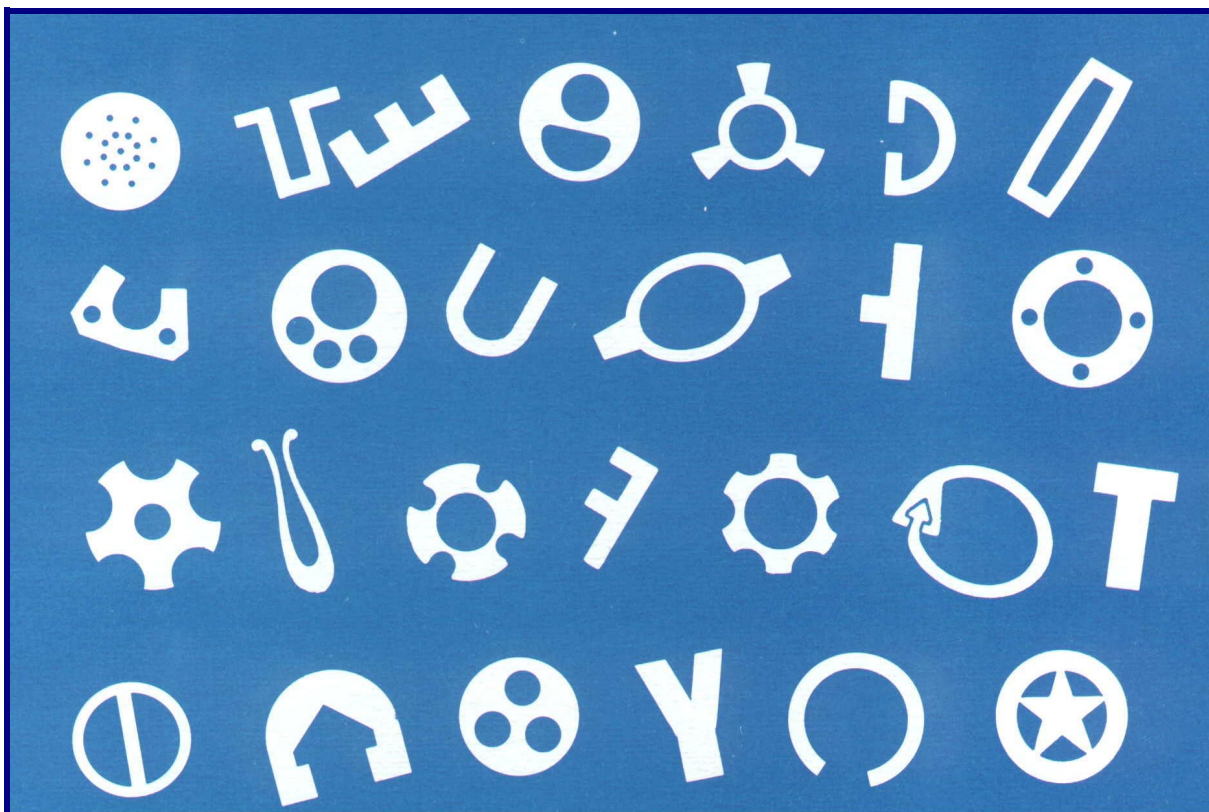


Photo courtesy of Zeus Industrial Products, Inc.

Ensinger Engineering Plastics

Ensinger manufactures the following types of fluorocarbon materials, PVDF and PCTFE.

Ensikem® (PVDF)

Known for its non-toxicity, high purity, high heat deflection temperature, and UV and gamma ray resistance, this material is used in semiconductor and chemical processing and heat exchangers. It is FDA approved and meets ASTM D-3222 Type II regulations.

Ensinger PCTFE

This crystalline polymer is nonflammable, chemical resistant and has a working temperature of -300°F to 300°F. It is designed to have excellent electrical insulating and cryogenic properties with low creep and cold flow. Applications include bearings, bushings, pump parts and ball valve seats.

PRODUCT AVAILABILITY

Ensikem® (PVDF)

Rod

Diameter: 3/8" - 6" (up to 8" is available by request)

Length: 10'

Plate

Thickness: 1/4" - 4"

Size: (1/4" - 3") 24" x 48"

(3 1/4" - 4") 12" x 48"

Tube

From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths

Ensinger PCTFE

Disc

3" - 8" OD

Length

1/2" to 2"

Rod

1" - 2 3/4" OD

Length

3" - 8"

Tube

1 5/8" to 33 OD

Length

3" to 6"

Plate

8" x 8" or 10" x 10" square

Thickness

1/4" - 2"

A. L. Hyde Company

A. L. Hyde produces PVDF material from the Kynar® (Elf Atochem) and Sol-F (Solvay®) resins.

Kynar® type 740 (PVDF)

This general purpose, unfilled extrusion grade of PVDF, was primarily designed for the chemical processing industry. It is chemical, solvent, corrosion, and UV resistant with low flammability and good thermal stability.

PRODUCT AVAILABILITY

Rod

| Diameter | Length |
|-------------|-----------|
| 1/4" - 1" | 5 and 10' |
| 1 1/8" - 2" | 4 and 8' |
| 2 1/8" - 6" | 2 and 4' |

Slab

| Thickness | Size |
|-----------|---------------------------------|
| 3/8" - 4" | 12" x 12", 12" x 24", 12" x 48" |
| 3/8" - 3" | 24" x 24", 24" x 48" |

DO YOU KNOW?

The discovery of Teflon®, April 6, 1938, was pure chance. Involved in a study of refrigeration gases as part of a project totally unrelated to polymers, a group of DuPont researchers headed by Dr. Roy J. Plunkett noticed a white, waxy solid material while cleaning a cylinder which had contained tetrafluoroethylene. That fluorocarbon resin, became known as Teflon®.

ENGINEERED PLASTICS

Fluorocarbons

DSM Engineering Plastic Products

DSM Engineering Plastic Products (formerly Polymer Corporation) manufactures PTFE under the tradenames of Fluorosint® and Semitron® ESd. The Fluorosint® materials are the result of a proprietary process in which synthetically manufactured mica are chemically linked to PTFE, creating a product with low frictional properties and dimensional stability. The Semitron® ESd material is DSMEPP's static dissipative PTFE.

NOTE: The Fluorosint materials' physical strength characteristics are not as high as other advanced engineering plastics.

Fluorosint® 500

With nine times greater resistance to deformation under load than unfilled PTFE, this material is 1/3 harder than PTFE, has better wear characteristics and low frictional properties. Its coefficient of linear thermal expansion approaches the expansion rate of aluminum, and is 1/5 that of PTFE.

Fluorosint® 207

White in color, this product meets FDA regulation 21 CFR 175.3000. It is non-permeable in steam and its relative wear rate is 1/20 the rate of PTFE below 300°F (150°C).

Semitron® ESd 500HR

Designed for the semiconductor industry, this is a static dissipative reinforced PTFE. It has high thermal insulation, a low coefficient of friction, and is thermally stable to 500°F (260°C).

PRODUCT AVAILABILITY

Fluorosint® 207 / 500

Semitron® ESd 500HR

Rod

1/2" - 8 3/4"

Plate

12" x 12" (1/4" - 3" thick)

Tubular Bar

1 1/4" OD x 1/2" ID to 38.75" OD x 32" ID

DO YOU KNOW?

In the 1920s DuPont chemist Wallace Hume Carothers and his team develop nylon, which replaced animal hair in toothbrushes and silk stockings.

PLASTIC

Nylon, as the first engineering resin, was introduced in stock shapes in 1946. Today there are a variety of extruded and cast nylons. Grades include FDA approved, internally lubricated and heat stabilized. There are also a wide range of shapes including rod, hex rod, square rod, bushing stock, strip, tubing, custom profiles, plate, disk, and tubular and rectangular bar. Its excellent wear resistance, low frictional and good temperature properties, along with its chemical and impact resistance, have made it a good replacement for many types of materials from metal to rubber. It has been used in applications ranging from electronic, marine and automotive industries to fibers used to make carpet. Among the many nylons available are the following.

Nylon 6 / 6

This was the first nylon material available in rod, sheet and tube for industrial use. Since its introduction in 1946, it has become the most widely used nylon in the American industry. It is the strongest and stiffest of all nylons, and has the highest melting point of any unmodified nylon processed by conventional extrusion techniques. Its low friction, high strength, toughness and good abrasion resistance allows it to replace steel, bronze, brass, aluminum, laminated phenolics, wood and rubber. Parts can also be easily fabricated from mill shapes using standard metalworking tools.

Typical Applications:

- Bearings
- Bushings
- Valve seats
- Thrust washers
- Seals
- Wear surfaces
- Rollers
- Guides
- Gears
- Insulators
- Cams and cam followers
- Fasteners
- Sleeves
- Liners
- Tooling fixtures
- Forming dies

Nylon 6

This type nylon is produced through a casting process, unlike Nylon 6 / 6 which is extruded. Although the two work well in many of the same applications, Nylon 6 comes in larger sheets and rods and it has slightly better impact resistance than Nylon 6 / 6. It can be cast to-size finished parts, into custom mill shapes, cast blanks and near net shapes. Custom cast nylon parts often replace machined plastic parts, sand cast metal parts, and multipart metal assemblies.

Blue Nylon

This is a type 6 nylon with a heat stabilized blue colorant. It has the same physical properties as natural nylon, but will withstand slightly higher temperatures.

Moly-filled Nylon

Filled with a solid lubricant, parts made from this will operate with little or no additional lubrication.

Oil-Filled Nylon

This material has a lower coefficient of friction than unfilled and molyfilled nylon. It will not dry out even under extreme operating conditions where the nylon may be worn away during machining.

Glass-Filled Nylon

This 6 / 6 nylon is reinforced with glass fibers, making it twice as strong and stiff as unreinforced nylon, with a heat deflection temperature which approaches its melting point.

Ensinger Engineering Plastics

Ensinger produces extruded nylon materials under the tradename Ensilon® and cast nylon under the tradename Vekton®.

Ensilon®

This group of Ensinger's extruded nylon 6 / 6 products are resistant to hydrocarbons, ketone and esters. Applications include bushings, bearings, pulleys, and other wear parts. Available grades are Natural, Black, MDS, and 30% Glass-reinforced.

Nylon

Vekton®

These cast nylons are lightweight, yet tough and strong with good bearing properties. Vekton® cast nylons are produced in a wide range of formulations: Natural, Black, Blue, MDS, Graphite-filled, Oil-filled, and High Heat. A wide variety of stock shapes are available.

A. L. Hyde Company

A.L. Hyde produces a wide range of extruded and cast nylon grades.

Type 6 / 6 Products

Moly-filled Nylon

This type 6 / 6 nylon material is gray-colored with increased surface hardness, lubricity and wear resistance.

ST801 Nylon

A very tough type 6 / 6, this product exhibits more impact resistance and toughness than Zytel 42.

Zytel® 42

A general purpose, type 6 / 6 nylon, it is available in natural and black.

Zytel® 159L

A type 6 / 12 nylon, this material has lower moisture absorption and better dimensional stability than type 6 / 6.

Type 6 Products

Glass-filled 13% Nylon

A type 6 nylon material with increased strength and dimensional stability.

Hyd-Cast Natural

This is Hyde's natural type 6 cast nylon.

Hyd-Cast Moly-filled

This material is a type 6 nylon, colored black, with the same qualities as the extruded moly-filled nylon.

Hyd-Cast Blue

A type 6 nylon, this product has a heat stabilized blue colorant and the same physical properties as Hyd-Cast Natural.

Hyd-Cast Oil-filled

Green colored, this type 6 nylon has a silicone based oil manufactured into the material, giving it more surface lubricity and wear resistance than the unfilled grades.

Hyd-Cast MoS2 Black

This cast nylon has two additives. The first, Molybdenum Disulphide (MoS₂), hardens the surface and enhances lubricity, wear, and compressive strength. The second additive, black pigment, enhances it aesthetically and improves its UV resistance.

Hydlar ZF

A combination of Nylon and Kevlar® Fiber, this material has up to 20 times the wear characteristics of standard nylon and a non-galling mating wear surface. It has good chemical and temperature resistance, high mechanical properties, and is FDA, USDA, and 3A (Dairy) compliant.

Nylawear®

A solid lubricant is added to this cast nylon, giving it an extremely low coefficient of friction and excellent wear resistance. It also has low moisture absorption and can withstand high pressure-velocity conditions, outperforming Hyd-Cast Oil-filled Nylon. FDA approved Nylawear® is available upon request.

DSM Engineering Plastic Products

DSM Engineering Plastic Products (formerly Polymer Corporation) produces the following extruded type 6 / 6 and cast type 6 nylon materials.

TYPE 6 / 6 PRODUCTS

Nylon 101

Unmodified, this is the strongest and most rigid nylon, with one of the highest melting points at 500°F. Designed for general purpose wear and structural parts, it is specified for screw machined electrical insulators and food contact parts. It is FDA, USDA, NSF, and 3-A Dairy compliant.

Nylatron® GS Nylon

This MoS₂ filled nylon is stronger, more rigid and has a lower coefficient of friction than 101. It also maintains better fit and clearances, and has less tendency to seize as bearings.

30% Glass-reinforced Nylon 6/6

This material is for applications which require higher compressive strength and rigidity, improved load capacity or frictional characteristics.

TYPE 6 PRODUCTS

MC® 901 Nylon

This blue-colored nylon offers long-term thermal stability up to 260°F. Applications include wheels, gears, and custom parts.

MC® 907 Nylon

This unmodified, off white nylon offers the highest strength and hardness of the type 6 grades. It is FDA, USDA and 3A-Dairy compliant.

Nylatron® GSM Nylon

This grey-black material has finely divided MoS₂ lubricant added for load bearing capabilities. Applications include gears, sheaves, sprockets and custom parts.

Nylatron® NSM Nylon

In wear applications, this material lasts up to ten times longer than standard type 6 nylon. It has solid lubricant additives for self-lubricating, high pressure/ velocity and superior wear resistance.

Nylatron® GSM Blue Nylon (Oil-filled)

A combination of MoS₂ and oil gives this material 20% lower coefficient of friction, 40% greater limiting PV, and a lower "k" factor than Nylatron® GSM. Applications include slide pads, thrust washers, and trunion bearings.

PRODUCT AVAILABILITY

Extruded Nylon Type 6/6 - General Range Sheet

Size: up to 24"x 120"
Thickness: 1/16" to 4"

Rod

Diameter: 1/16" to 6"
Length: 8 feet

Plate

Thickness: 1/16" to 3"

Tube

From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths

Cast Nylon Type 6 - General Range Sheet

Size: up to 48" x 120"
Thickness: 3/16" up to 4"

Rod

Diameter: 2" up to 38"

Disc

28" to 80"

Plate

Thickness: 3/16" to 4"

Tubular Bar

2" to 38" nominal O.D.
1" to 35" nominal I.D.

Rectangular Block

Thickness: up to 14"

Tube

From 2" - 20" O.D. and 1 1/2" to 18" I.D. - 2' Lengths

ENGINEERED PLASTICS

Phenolics

Phenolic resins are thermoset resins which are commonly filled with organic and inorganic fillers, fibers or fabrics. Fillers include woven glass cloth, random glass mat, glass filaments, woven canvas cotton fabric, woven linen cotton fabric, paper, woven aramid fabric, random mat graphite and others.

The phenolic resins and fillers are then formed into plastic laminates. This is done by laying thin sheets of the resin-impregnated material upon each other, and molding or pressing them into a solid mass which takes on the shape of the molding instrument.

Paper-based phenolics are the most economical while providing significant electrical and mechanical properties. Cotton fabric phenolics have greater impact strength, machinability, and resistance to corrosion. Glass based grades exhibit low moisture absorption, dimensional stability, and the highest mechanical strength, but are not as easily machined as paper or cotton fabrics. Phenolic compounds, overall, are characterized as having good electrical qualities, excellent mold ability and dimensional stability. They are chemical, water, heat and flame resistant with low smoke generation and toxicity.

Special grades are also produced, to provide maximum dimensional stability at high temperatures and in steam, better machining qualities (fine tooth gears), and crack and electrical resistance.

Phenolic laminates are available in rod, sheet and tube.

Typical Applications:

Paper based material

- Thrust washers
- Terminal strips
- Push button sliders
- Jack spacers
- Cams
- Switch backs
- Circuit breaker covers
- Line shields
- Electrical cabinetry

Cotton fabric and synthetic based material

- Gears
- Top sticks
- Gaskets
- Cam followers
- Housings

- Slot wedges
- Slider rails
- Piston rings
- Bushings
- Pulleys
- Bearings
- Valve rings
- Pump and air motor blades

Glass and carbon fiber fabric based

- Gaskets
- Arc chutes
- Scraper boards
- Wear blocks
- Slot wedges

PRODUCT AVAILABILITY

Standard Sheet Sizes:

36"x 48", 48"x 48", 48"x 96"

Sheet Thicknesses:

.010" to 7"

Rod:

1/8" to 6" diameters (23" to 48" long)

Tube:

.010" to 2" Wall Thickness
1/8" to 16" I.D.
23", 39", 48" Length

Colors:

Natural, Black, Chocolate, White, Blue, Tan and Red

Products, sizes and colors vary with manufacturers. Check with your plastics distributor for current availabilities.

NEMA Grade Descriptions and End Use Applications

Grade X —

A high strength paper phenolic material primarily intended for general purpose mechanical applications. It has the highest impact strength of the paper base grades and fair electrical properties. In areas where moisture or high humid conditions are encountered, the material should be used with discretion. It fabricates very well, but punching should be limited to under 3/64" as the low resin content of a mechanical grade does not give the punchability of an XP grade.

Grade XP —

A paper base phenolic material for hot punching applications. The material is more flexible but does not have the flexural strength of "X" grade. It is the grade used for general purpose work for insulating materials.

Grade XPC —

A paper phenolic material intended for punching and shearing at room temperature of 23°C. The material has good mechanical and electrical properties with higher cold flow and lower in flexural strength than XP.

Grade XX —

A paper base phenolic material for general purpose electrical application. The material has good mechanical properties and excellent moisture resistance, machines well and may be punched cold up to 3/64" and hot punched up to 3/32".

Grade XXP —

A paper phenolic material suitable for hot punch applications and with more cold flow than XX grade. This material has good electrical properties under humid conditions due to its low moisture absorption.

Grade XXX —

A refined paper base phenolic material providing good electric properties, low moisture absorption and very low cold flow. This material is suitable for radio frequency and high humidity applications. The material produces excellent appearing parts from machining operations and will hot punch up to 1/16" in thickness.

Grade XXXPC —

These laminates are paper phenolic compounded to punch at room temperatures or slightly above. They are softer than XXX or XXP grades and have excellent electrical properties under humid conditions. Their use is found in the radio frequency range.

Grade L

A cotton phenolic laminate similar in construction to "LE", but intended primarily for mechanical applications where fine appearance on machined parts is essential.

Grade LE —

A cotton fabric phenolic material suitable for electrical applications where toughness and good machining properties are needed. This material is superior in moisture absorption and electrical properties to CE grade and is available in thinner thicknesses.

Grade C —

These materials are cotton canvas phenolic laminates intended for applications requiring toughness and high impact strength. They fabricate very well and as added impact is desired heavier fabrics are used.

Grade CE —

These grades use a purified cloth similar to C grade, but material has controlled electrical properties. This material does not have the toughness of C grade, but has better moisture resistance and better electrical properties and is superior to C grade in machinability.

Grade CF —

Cotton phenolic grades similar to C and L grades with flame retardance. They can be post-formed into simple shapes when heated. This material is not recommended for high voltage electrical applications or in areas of excessive heat.

Grade N-1 —

A nylon fabric phenolic material and has good mechanical and excellent electrical properties under high humidity conditions, but has high cold flow under ambient temperatures. This material machines and fabricates readily.

Grade G-5 —

These grades are continuous filament glass cloth — melamine laminates. They have good flame retardance, arc resistance and high heat resistance and low deformation under load, with good electrical properties in dry conditions.

Phenolics

NEMA Grade Descriptions and End Use Applications

Grade G-7 —

A continuous filament glass cloth silicone resin laminate that has excellent electrical properties and may be utilized in applications up to 200°C. Care must be taken in fabrication due to the low internal bond strengths inherent in silicone resins. The arc resistance of this laminate is outstanding and it is self-extinguishing.

Grade G-9 —

A continuous filament glass cloth melamine laminate similar to G-5, but designed for use in high humidity applications where G-5 is not satisfactory. It has excellent mechanical and electrical properties and arc resistance is outstanding.

Grade G-10 —

A continuous filament glass cloth epoxy resin with excellent electrical and mechanical properties at room temperature or under humid or moist conditions. The superior interlamianr bond allows material to be machind with excellent results.

Grade G-11 —

A continuous filament glass cloth epoxy resin so formulated that a high degree of the room temperatuer flexural strength is retained when the material is tested at 150 C. This material should be used in applications where temperatures in excess of 125 C are encountered.

Self-Extinguishing Grades

Grade FR-2 —

Paper base laminate witha phenolic resin so modified as to be self-extinguishing after the source of ignition is removed. Similar in all other properties to Grade XXXPC.

Grade FR-3 —

Paper base laminate with epoxy resin having higher flexural strength than Grade XXXPC and so formulated as to be self-extinguishing after the source of ignition is removed. Has low dielectric loss properties with good stability of electrical properties under conditions of high humidity. With good punching practice, sheets up to and including 1/16" in thickness may be punched at temperatures not less than 27° C (80°F) and, in thickness over 1/16" up to and including 1/8", when warmed to a temperature not exceeding 65.6°C (150°F).

Grade FR-4 —

Continuous filament type glass cloth with an epoxy resin, similar to G-10 but self-extinguishing after the source of ignition is removed. Similar in all other properties to Grade G-10.

Grade FR-5 —

Continuous filament type glass cloth with an epoxy resin, sim ilar to G-11 but self-extinguishing after the source is removed. Sililar in all other properties to Grade G-11.

DO YOU KNOW?

1948 - Admiral uses molded phenolic thermosetting plastic to produce a 35 pound TV cabinet.

Polyamide-imide is an amorphous engineering thermoplastic characterized by high strength and good impact resistance. It is resistant to chemicals including aliphatic and aromatic hydrocarbons, halogenated solvents, and most acid and base solutions. It is not, however, resistant to high-temperature caustic materials, saturated steam, and some acids.

Withstanding temperatures up to 500°F, it is creep, radiation, and heat resistant. Room temperature tensile strength is about 27,000 psi and compressive strength is 30,000 psi. At 450°F, tensile strength is about 9500 psi, and continued exposure at 500°F for 8,000 hours produces no significant decline in tensile strength. Tensile strength drops only about 5% after exposure to 10⁹ rads of gamma radiation.

Polyimide-imide is available in several grades including:

- A general-purpose, injection-moldable grade
- 3 PTFE / graphite compounds
- A 30% graphite-fiber-reinforced grade
- 30% and 40% glass-fiber-reinforced grades

Flexural modulus of 730,000 psi of the general-purpose grade is increased, with graphite fiber reinforcement to 2.7 million psi.

Typical Applications

- Electrical / electronic gear
- Business machines
- Aircraft aerospace devices
- Components for transmissions
- Universal joints
- Electric motors
- Power-assist devices
- Bearings
- Compressors
- Pumps
- Valves
- Seals

Ensinger Engineering Plastics

Ensinger's grades of polyamide-imide material are manufactured under the tradename of Sintimid T.

Sintimid T

Two grades of this material are available, unfilled and 15% graphite-filled. Both products meet ASTM D-5204 standards.

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBE |
|---------------------------|----------------------------------|---|----------------------------------|
| Sintimid T | | | |
| Unfilled Polyamide-imide | 1/4" - 2" diameter 15" length | 1/4" - 2" thickness 15" x 15" size 15" x 30" size | 1 1/2" O.D. to 58" O.D. |
| Bearing Grade | 1" - 2" diameter 6" length | | 3" min. length 6" max. length |
| Compression Molded | | | |
| Same as above | Up to 3" diameter | Up to 2" thick | Up to 14" thick |

Contact your nearest Regal Plastic Supply distribution center for current availabilities.

DSM Engineering Plastic Products

DSMEPP (formerly Polymer Corporation) produces polyamide-imide products under the Torlon® and Semitron® tradenames. A high performance amorphous (non-crystalline) engineering thermoplastic, Torlon® is considered to be the highest performing melt processable plastic available. With superior resistance to elevated temperatures, it is capable of performing under severe stress conditions at continuous temperatures to 500°F (260°C).

Parts machined from Torlon® stock shapes provide greater compressive strength and higher impact resistance than most advanced engineering plastics. Its extremely low coefficient of linear thermal expansion and high creep resistance deliver excellent dimensional stability over its entire use range. Torlon® is an amorphous material with a T_g (glass transition temperature) of 537°F (280°C).

NOTE: As Torlon® PAI has a relatively high moisture absorption rate, parts used in high temperature service or made to tight tolerances should be kept dry prior to installation. Thermal shock resulting in deformation can occur if moisture laden parts are rapidly exposed to temperatures above 400°F (205°C).

Semitron® ESd 520HR

This product is a reinforced polyamide-imide designed for high temperature, dimensionally stable applications such as nests, sockets, and contactors.

ENGINEERED PLASTICS

Polyamide-imide

Torlon® 4203/4203L (Extruded)

This product is designed for electrical and high strength applications, or those involving impact loading and abrasive wear. It has the highest elongation of the Torlon® grades, high dielectric strength, excellent compressive and impact strength, and good insulation characteristics.

Torlon® 4503 (Compression Molded)

Similar to Torlon® 4203 PAI, this material is recommended for dies and patterns of formed metal parts or as thermal insulators and isolators.

Torlon® 4301 (Extruded)

Used for general wear and friction parts, this product has a low coefficient of friction, very low expansion rate, and little or no slip-stick in use. Recommended applications include non-lubricated bearings, seals, bearing cages and reciprocating compressor parts.

Torlon® 4501 (Compression Molded)

Similar to 4301 in composition, this material is used when larger shapes are required. It has a higher compressive strength than Torlon® 4540, and can carry more load.

Torlon® 4540 (Compression Molded)

This seal and bearing grade was designed for rotating equipment. It has the same composition as the former 4340, and is used when larger (especially tubular) shapes are needed.

Torlon® 5030

A 30% glass-reinforced product, this material has high rigidity, retention of stiffness, low expansion rate and improved load carrying capabilities. Applications include the electrical / electronic, business equipment, aircraft and aerospace industries.

Torlon® 5530 (Compression Molded)

Similar in composition to 5030, this 30% glass-reinforced material has improved load capacity and is used when larger shapes or greater dimensional control is required.

Torlon® 7130

30% carbon-reinforced, this material is for non-abrasive wear performance. Designed to have exceptional stiffness, this product has the lowest coefficient of friction of all the Torlon® products.

PRODUCT AVAILABILITY

| PRODUCT | ROD | DISC | PLATE | TUBULAR BAR | OTHER |
|-------------------------------------|---|--------------------------------|--|--|-------|
| Semitron® ESd 520HR | Consult with your nearest Regal Plastic Supply distribution center for current product availability | | | | |
| Torlon® 5030 PAI Injection Molded | * | — | * | * | * |
| Torlon® 7130 PAI | * | — | * | * | * |
| Torlon® 4503 PAI Compression Molded | 2 1/4"-15" | — | — | — | — |
| Torlon® 4501 PAI Compression Molded | 2 1/4"-15" | 6"-9" dia. 3/8" to 2" thick | 12" x 12" 13 1/4" x 14 1/4" 14" x 28" (3/8"-2" thick) | From 1 1/2" O.D. x 3/4" I.D. To 36" O.D. x 29" I.D. | — |
| Torlon® 4540 PAI Compression Molded | 1"-15" | 6"-9" dia. 3/8" to 2" thick | 12" x 12" 13 1/4" x 14 1/4" 14" x 28" (3/8"-2" thick) | From 1 1/2" O.D. x 3/4" I.D. To 36" O.D. x 29" I.D. | — |
| Torlon® 5530 PAI Compression Molded | 1"-15" | 6"-9" dia. 3/8" to 2" thick | * | From 1 1/2" O.D. x 3/4" I.D. To 36" O.D. x 29" I.D. | — |
| Torlon® 4203 PAI Extruded | 1/32" - 2" dia. | — | 3/16" - 2" (12" wide) | * | — |
| Torlon® 4301 PAI Extruded | 1/32" - 2" dia. | — | 3/16" - 2" (12" wide) | * | — |

* = custom sizes available

ENGINEERED PLASTICS

Polybenzimidazole (PBI)

DSM Engineering Plastic Products manufactures Polybenzimidazole (PBI) under the tradename of Celazole®. Considered to be the highest performance engineering plastic available, PBI exhibits:

- highest mechanical properties of any plastic over 400°F (205°C)
- highest heat deflection temperature of any plastic at 800°F (425°C), with a continuous service capability of 750°F (400°C) in inert environments, or 650°F (345°C) in air with short-term exposure potential to 1,000°F (540°C)
- lowest coefficient of thermal expansion and highest compressive strength of all unfilled plastics

As an unreinforced material, Celazole® PBI has a very high level of ionic purity, outgassing water only. With better wear resistance and load carrying capabilities at extreme temperatures than all other reinforced or unreinforced advanced engineering plastics, Celazole® PBI also has excellent ultrasonic transparency and thermal properties.

NOTE: Celazole® PBI is an extremely hard product providing a fabricating challenge. Polycrystalline diamond tools are recommended if fabricating production quantities. This product tends to be notch sensitive. It is recommended that all corners should be radiused (0.040" min.) and edges chamfered to maximize part toughness. High tolerance fabricated components should be stored in sealed containers (preferably with desiccant) to avoid dimensional changes due to moisture absorption. Components rapidly exposed to temperatures above 400°F (205°C) should be "dried" prior to use or kept dry to avoid deformation from thermal shock.

Typical Applications:

- High heat insulator bushings
- Electrical connectors
- Ball valve seats
- Clamp rings
- Vacuum chamber application
- Probe tip lenses in ultrasonic measuring equipment

PRODUCT AVAILABILITY

Rod

Diameter: 3/8" to 4 3/4"

Disc

Diameter: 6 3/4" to 8 3/4"

Thickness: 3/8" to 2" thick

Plate

Size: 12" x 12", 12" x 24", 13 1/4"x141/4"

Thickness: 1/2" to 2"

Tubular bar

From: 2 1/2" O.D. x 1 1/4" I.D.

To: 15" O.D x 12 3/4" I.D

DO YOU KNOW?

The word Polymer comes from Greek: poly meaning 'many' and mer from merous which roughly means 'parts'. Our word polymeric comes directly from the Greek polumeres which simply means 'having many parts'.

ENGINEERED PLASTICS

Polycarbonate

Polycarbonates are engineering thermoplastics with high molecular weight and impact strength, and good electrical and insulating characteristics. Tough, transparent, heat and flame resistant, these materials are normally not affected by greases, oils or acids. In unreinforced states, polycarbonates can withstand temperatures as low as -65°F, and once molded, be exposed to boiling water without dimensional changes of more than 0.0001 in. / in. after being returned to room temperature.

Polycarbonate resins are available in a variety of formulas including those for molding, extruding and blow molding. Grades with improved chemical resistance and those with special coatings are available, as well as structural-foam, glass-reinforced, flame-retardant, and FDA, NSF, Canada AG, USP Class VI, and ASTM 3935 approved grades. A machine grade comes in natural (translucent) and black.

Typical Applications:

- Connectors
- Face plates
- Terminal block
- Telephone finger wheels
- Meter covers
- Business machine housings
- Computer disk packs
- Storage modules
- Power-tool housings
- Vacuum-cleaner impellers and housings
- Grills for fans and air conditioners
- Bowls and cutting wheels for food processors
- Automotive instrument panels
- Indoor and outdoor lighting diffusers
- Skylights and outdoor signs
- Safety helmets
- Microwave wear
- Food-service wear
- Safety and prescription eyewear
- Kidney dialysers
- Solar cell covers
- Boat hatch covers
- Door and window hardware
- Windscreens
- Milk and baby bottles

- Patio door thresholds
- Safety and vandal-resistant windows for schools, banks, public buildings, gas stations, trains, and armored cars.

Ensinger Engineering Plastics

Ensinger's polycarbonate materials are manufactured under the tradename of Ensicar®.

Ensicar®

Available in black, natural, and 20% glass reinforced, all grades of Ensinger's polycarbonate materials meet ASTM requirements. The black and natural grades also meet FDA and USP requirements.

PRODUCT AVAILABILITY

Natural, Black and 20% Glass Filled ROD

| Diameter | Lengths |
|--|---------|
| 3/16" - 8" | 10ft |
| Custom diameters available upon request. | |

SLAB

| Thickness | Sizes |
|------------|-------------------------|
| 1/32" - 4" | (Up to 3") 24" x 48" |
| | (3 1/4" - 4") 12" x 48" |

Not all sizes stocked.

Some sizes available on custom ordered, minimum runs.

TUBE

From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths

A. L. Hyde Company

Machine grade polycarbonate materials are manufactured by A. L. Hyde under the tradename Hydex®.

Hydex® 4301

Hydex® 4301 is Hyde's general purpose machine grade polycarbonate that comes in natural and black.

Hydex® 4320

Hydex® 4320 is a 20% glass filled polycarbonate material increasing its mechanical strength and rigidity.

PRODUCT AVAILABILITY

Hydex 4301 Natural Rod

| Diameters | Lengths |
|------------|--|
| 1/4" - 12" | (Up to 1") 5 and 10 ft. (1 1/8" to 2") 4 and 8 ft. (2 1/8" to 12") 2 and 4 ft. |

Some sizes also available in black.
Not all sizes in stock, but custom sizes available.

Hydex 4301 Natural Slab

| Thicknesses | Sizes |
|-------------|--|
| 3/8" - 4" | (3/8" - 4") 12" x 12", 12" x 24", 12" x 48" (3/18" - 3") 24" x 24", 24" x 48" |

Some sizes also stocked in black.
Custom sizes available.

Hydex 4320BK 20% Glass Filled Black Rod and Slab ROD

| Diameter | Sizes |
|-----------|---|
| 1/2" - 3" | (Up to 1") 5 and 10 ft. (1 1/8" - 2") 4 and 8 ft. (2 1/8" - 8") 2 and 4 ft. |

Custom diameters and lengths available.

SLAB

| Thicknesses | Sizes |
|--------------------|---------------------------------|
| 3/8", 1/2", 1", 2" | 12" x 12", 12" x 24", 12" x 48" |

Slab offered as extruded only — not finished.

GE Structured Products

The Structured Products Division of the General Electric Company manufactures several grades of industrial polycarbonates under their registered tradename LEXAN®.

LEXAN® 9030 Sheet

This polycarbonate material is recommended for machine guards and lenses. It can be colored, tinted, painted, or printed. Formable by vacuum, pressure, twin sheet or drape methods.

LEXAN® 9440 Sheet

FDA and USDA approved, this polycarbonate product was designed specifically for food contact applications including food trays and bins. It has high impact strength, and is vacuum, pressure, twin sheet, and drape formable. Available in clear, it is both paintable and printable.

LEXAN® FMR Sheet

Designed for windscreens and lenses, this material is available in clear and tinted grades. It is drape formable and exhibits high impact strength and abrasion resistance.

PRODUCT AVAILABILITY

Contact your nearest Regal Plastic Supply Company distribution center for current ordering information.

DSM Engineering Plastic Products

DSMEPP (formerly Polymer Corporation) produces a machine grade polycarbonate product.

PC 1000 Polycarbonate

PC 1000 is Polymer's machine grade polycarbonate. It is transparent with excellent impact resistance, toughness, good dielectric and elongation properties and good thermal performance. This material has a 290°F (145°C) heat deflection temperature at 264 psi, absorbs very little moisture and resists acidic solutions.

A food grade that is compliant with FDA, NSF, Canada AG and USP Class VI regulations is available upon request.

NOTE: PC 1000 polycarbonate is machine grade, not optically clear. It can be both mechanically and vapor polished to improve optical clarity. **Caution:** During machining, never use coolants with an aromatic base.

PRODUCT AVAILABILITY

| Rod | Disc | Plate | Tubular Bar | Other |
|-----------|-------------------|-----------|-------------------|---------------------------|
| Diameter | | Thickness | | |
| 1/8" - 4" | Custom sizes only | 1/4" - 3" | Custom sizes only | Custom hex and square rod |

ENGINEERED PLASTICS

Polycarbonate

Hyzod® is a registered trademark of Sheffield Plastics, Inc., a wholly owned subsidiary of Bayer. Sheffield, the second largest polycarbonate sheet producer in the world, is a recognized leader in high performance plastics.

For the demanding aerospace industry, the Hyzod® product line produces the following sheets.

HYZOD® AC1000 Aircraft Sheet

An opaque flame inhibiting polycarbonate formulation featuring low flame spread, low smoke generation and low toxicity. AC1000 offers superior impact strength, high heat resistance and dimensional stability for interior aircraft applications.

Typical applications are:

- seat parts
- tray tables
- lavatories
- cargo liners
- window reveals
- partitions
- moldings

Typical Physical Properties

| Property | AC1000 | Units | Test Method |
|--------------------------------------|-------------------------|-----------------------|-------------|
| General | | | |
| Specific Gravity | 1.2 | lbs/ft ³ | ASTM D-792 |
| Mechanical | | | |
| Tensile Strength Yield .125" | 9,000 | psi | ASTM D-638 |
| Tensile Strength, Ultimate | 8,500 | psi | ASTM D-638 |
| Tensile Modulus | 325,000 | psi | ASTM D-638 |
| Compressive Strength | 10,400 | psi | ASTM D-635 |
| Flexural Strength at 5% Strain | 13,200 | psi | ASTM D-790 |
| Flexural Strength at Break | | psi | |
| Flexural Modulus .125" | 345,000 | psi | ASTM D-790 |
| Izod Impact Notched .125" | 12 | ft lb/in | ASTM D-256 |
| Gardner Impact .125" | | psi | |
| Rockwell Hardness .250" | M70 | MScale | ASTM D-785 |
| Thermal | | | |
| Heat Deflection Temp. 264 psi | 270 | °F | ASTM D-648 |
| Heat Deflection Temp. 66 psi | - | °F | ASTM D-648 |
| Vicat Softening Rate B | - | °F | ASTM D-1525 |
| Coefficient of Thermal Expansion | 3.75 X 10 ⁻⁵ | in/in/°F | ASTM D-696 |
| Physical | | | |
| Specific Gravity | | lbs/ft ³ | ASTM D-792 |
| Water Absorption Equilibrium 24 hrs. | | % | ASTM D-570 |
| Flammability | | | |
| Ignition Temperature Self | 1077 | °F | ASTM D-1929 |
| Ignition Temperature Flash | 872 | °F | ASTM D-1929 |
| OSU Heat Release 2 Min. | | KW-Min/M ² | OSU |
| OSU Heat Release Peak | | KW-Min/M ² | OSU |
| NBS Smoke Density ≤ 4 min. | Pass | KW-Min/M ² | ASTM E-662 |
| Vertical Burn FAA Flammability | Pass | KW-Min/M ² | FAR 25.853 |
| ATS 1000 Airbus | Pass | KW-Min/M ² | ATS 1000 |

PRODUCT AVAILABILITY

For current product sheet sizes, gauges, and general availability information, please contact your closest Regal Plastic Supply Distribution Center.

DO YOU KNOW?

On the list of top 100 "Stories of the Century" released by the Newseum, a journalism museum based in Arlington, VA, plastic ranks number 46 -- higher than the first jet airplane flight, the Watergate scandal and the establishment of the United Nations.

ENGINEERED PLASTICS

Polyetheretherketone (PEEK)

Polyetheretherketone (PEEK), is a semi-crystalline thermoplastic with a high operating temperature that is used for injection molding, film, and advanced structural composites. It is tough, strong, rigid, and resistant to steam, creep, solvents, and UV rays. Exhibiting excellent hydrolysis resistance, very low flammability and smoke generation, and excellent mechanical properties, it can be used continuously to 480°F (250°C) and in hot water or steam without permanent loss in physical properties. Unreinforced PEEK offers good wear resistance, while carbon reinforced PEEK has excellent wear capabilities, and both meet USP class VI requirements.

NOTE: The stiffness of PEEK drops off significantly and expansion rate increases above its glass transition temperature (Tg) of 300°F (150°C). Therefore, this product is not recommended for close tolerance bearings or seals operating at temperatures higher than 300°F (150°C).

PEEK is used in the nuclear, electronics, aerospace, petroleum and analytical as well medical equipment industries, among others.

Typical Applications:

- Pump wear rings
- Electrical housing
- Bushings, bearings, seals, back up rings
- Wire and cable coatings
- Automotive engine parts
- Woven monofilaments
- Film
- Liquid chromatography parts

Ensinger Engineering Plastics

Ensinger offers PEEK materials with the above described mechanical, electrical and thermal properties, in the following grades:

- Natural
- Black
- 30% Glass-reinforced
- 30% Carbon fiber-reinforced

NOTE: Ensinger is authorized by Victrex (manufacturers of PEEK resin) to extrude PEEK™.

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBE |
|--------------------------------------|---|---------------------------------------|---|
| Extruded Natural | 3/16" - 6" - dia. 10' - length | 1/4" - 4" 24" x 48" and 12"x48" | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths |
| Extruded 30% Glass -reinforced | 3/16" - 4" - dia. 10' - length | 1/32" - 2" Custom order | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths |
| Extruded 30% Carbon Fiber-reinforced | 3/16" - 4" dia. 10' - length Custom order | 1/32" - 2" Custom order | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. - 10' Lengths |
| Compression Molded unfilled Peek | up to 6" | Up to 3" thick | Up to 33" O.D. |
| Compression Molded Filled Peek | up to 6" | Up to 3" thick | Up to 33" O.D. |

A. L. Hyde Company

PEEK is offered in both unfilled and filled grades by A. L. Hyde Company.

PEEK (450G) Natural & Black

PEEK 450G is Hyde's general purpose unfilled grade, providing chemical resistance, hydrolytic stability, wear resistance and the ability to withstand high levels of gamma radiation.

PEEK (Bearing Grade)

PEEK Bearing Grade is a heavily filled material which works well in high load, high PV wear environments.

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBE |
|---------------|-------------------------------------|-------|------|
| Victrex PEEK | 1/4" - 3" dia. 2' - 10' - length | — | — |
| Black Victrex | Custom order only | — | — |
| Bearing Grade | Custom order only | — | — |

ENGINEERED PLASTICS

Polyetheretherketone (PEEK)

DSM Engineering Plastic Products

DSM Engineering Plastic Products (formerly the Polymer Corporation) offers PEEK under its tradename of Ketron® in standard and two reinforced grades.

Ketron® PEEK

This is DSMEPP's unreinforced, general purpose PEEK, which offers the highest elongation and toughness of all PEEK grades.

30% Glass-reinforced Ketron® PEEK

The added glass fibers to this material, reduces its expansion rate while increasing its stiffness and compressive strength. It is recommended for structural applications which require improved strength, stiffness or stability.

30% Carbon fiber-reinforced Ketron® PEEK

This grade PEEK has more compressive strength, higher stiffness, and 3 1/2 times more thermal conductivity than the unreinforced material. It also has excellent wear resistance and load carrying ability.

PRODUCT AVAILABILITY

| PRODUCT | ROD | DISC | PLATE | TUBULAR BAR | OTHER |
|--|--------------------|-------------------------------------|----------------------------|--|------------------------------|
| Extruded Ketron® | 1/4" - 3" dia. | — | 3/8" - 2" dia. 24" wide | * | * Hex and square rod, tubing |
| Extruded Ketron® 30% Glass - reinforced | 1/2" - 1 1/2" dia. | — | — | * | Hex and square rod |
| Compression Molded Ketron® | * | 3" and 4" dia. 3/8" - 2" thick | — | From: 1 1/2" O.D. x 3/4" I.D. To: 12 1/4" O.D. x 10 1/2" I.D. | — |
| Compression Molded 30% Glass-reinforced Ketron® | 1" - 2 1/4" dia. | 3" and 4" dia. 3/8" - 2" thick | — | From: 1 1/2" O.D. x 3/4" I.D. To: 12 1/4" O.D. x 10 1/2" I.D. | — |
| Compression Molded 30% Carbon-reinforced Ketron® | 1" - 3" dia. | 3" - 9 7/8" dia. 3/8" - 2" thick | — | From: 1/2" O.D. x 3/4" I.D. To: 36" O.D. x 29" I.D. | — |

* = Available by custom order

Ketron® PEEK Physical Properties

| | |
|--|---------------|
| Overall Chemical Resistance | Very Good |
| Moisture Absorption | Very Good |
| Steam Resistance | Good |
| Wear Resistance (dry) | Very Good |
| Continuous Service Temperature | 480°F (250°C) |
| Heat Deflection Temperature | 320°F (160°C) |
| % Flexural Strength Maintained at: 300°F (150°C) | 84% |
| at: 500°F (260°C) | 10% |

DO YOU KNOW?

In 1933, organic chemists E. W. Fawcett and R. O. Gibson, working for Imperial Chemical Industries Research Laboratory discover polyethylene when a test container springs a leak during testing under highly pressurized conditions.

ENGINEERED PLASTICS

Polyetherimide (PEI)

Polyetherimide (PEI) was introduced in 1982 as an amorphous engineering thermoplastic. It has high heat resistance with a continuous work range to 340°F (170° C). Resistant to acidic solutions, hydrolysis and flames, it carries a UL 94-V-0 rating with low smoke evolution. PEI exhibits high strength and modulus, has excellent electrical properties and thermal stability, and withstands repeated autoclaving cycles. Using ultrasonic, adhesive, or solvent methods, PEI can be bonded to itself or to dissimilar materials.

NOTE: Care must be used in selecting adhesives and designing press fit components to avoid stress cracking.

A variety of grades are available; unreinforced, glass fiber-reinforced, and FDA, USDA and Class VI compliant. Unreinforced grades, in standard or custom colors, are recommended for general-purpose injection, extrusion, blow, and foam molding. The glass fiber-reinforced formulations provide added rigidity and dimensional strength. Molded and extruded parts can be machined using either conventional or laser techniques, and solvent-casting techniques can be used to produce film with thicknesses down to 0.25. Other extruded PEI products are coated wire, sheet and profiles.

Typical Applications:

- Reusable medical devices like trays and surgical handles and probes
- High intensity lighting
- Manifolds for the pharmaceutical business
- Insulators for microwave equipment
- Clamps for connecting printed circuit boards to video display units in planes, tanks and ships.

Ensinger Engineering Plastics

Ensinger manufactures the following PEI products from General Electric's Ultem® resin.

Ultem®

Stocked in natural and 30% glass-reinforced grade, both meet ASTM specifications, and the natural grade complies with FDA, NSF, and USP Class VI standards. 10% and 20% glass-reinforced grades are available by custom order.

PRODUCT AVAILABILITY

| Product | Rod | | Plate | | Tube |
|---------|------------|--------|-----------|-----------|-----------------------------|
| | Diameter | Length | Gauge | Size | |
| Natural | 3/16" - | 10' | 3/8" - 4" | 24" x 48" | From 1.5" - 11.84" O.D. and |
| Natural | Custom | Custom | Custom | Custom | From 1.5" - 11.84" O.D. and |
| Natural | Custom | Custom | Custom | Custom | From 1.5" - 11.84" O.D. and |
| Natural | 3/16" - 8" | 10' | 3/8" - 4" | 24" x 48" | From 1.5" - 11.84" O.D. and |

A. L. Hyde Company

A. L. Hyde manufactures the following PEI products from General Electric's Ultem® resin.

Ultem®

FDA, USDA, and USP Class VI compliant, Ultem® 1000; Ultem® 1000-7101 FDA Black; Ultem® 2100 (10% glass filled); Ultem® 2200 (20% glass filled); and Ultem® 2300 (30% glass filled).

PRODUCT AVAILABILITY

| Rod Diameter | Rod Length |
|--|-------------|
| 1/4", 3/8", 1/2", 5/8", 3/4", 7/8", 1" | 5 and 10 ft |
| 1 1/4", 1 1/2" and 1 3/4", 2" | 4 and 8 ft |
| 2 1/2", 3", 4", 5", 6" | 2 and 4 ft |

Rods may be ground to any intermediate diameter. Ultem® 2100, 2200, and 2300 available as custom order.

DSM Engineering Plastic Products

DSMEPP Manufactures several grades of PEI from General Electric's Ultem® resin and a static dissipative PEI under the tradename Semitron®.

Ultem® 1000

FDA and USP Class VI compliant, this material is available in FDA compliant colors upon request.

ENGINEERED PLASTICS

Polyetherimide (PEI)

Ultem® 2100, 2200, and 2300

These are the glass reinforced (10, 20 and 30%) versions of Ultem® 1000. They exhibit a higher level of rigidity and dimensional stability than the Ultem® 1000.

NOTE: Ultem® 1000 and 2300 are standard products. DSMEPP will custom quote Ultem® 2100, 2200 and specialty grades of Ultem®.

Semitron® ESd 410C

Designed for the semiconductor industry, this is a static dissipative polyetherimide. It has low stress for tighter tolerances during machining and is thermally stable to 410°F (210°C).

PRODUCT AVAILABILITY

| Product | Rod (diameter) | Plate (Thickness) | Tubular Bar | Other |
|-----------------------|-------------------|----------------------|----------------|--------------------------|
| Ultem® 1000 PEI | 1/4" - 6" | 1/4" - 2" | * | bushing stock, tubing |
| Ultem® 2300 PEI | 1/2" - 4" | 1/2" - 2" | * | _____ |
| Semitron® ESd 410C | | 3/8" - 1 3/4" | * | |

Sheffield Plastics, Inc.

Hyzod® is a registered trademark of Sheffield Plastics, Inc., a wholly owned subsidiary of Bayer.

For the demanding aerospace industry, the Hyzod® product line produces the following sheets.

HYZOD® AC2000 Aircraft Sheet

A patterned opaque, extruded thermoplastic sheet (PEI), Hyzod AC2000 is designed for use in aircraft interior applications.

This PEI sheet is used for flat or thermoformed aircraft parts. AC2000 lends itself well to pressure and twin-sheet thermoforming techniques as well as standard vacuum forming processes. AC2000 meets existing commercial aircraft requirements for smoke, toxicity and heat release, including OSU 100/100 and FAA NBS.

HYZOD® AC3000 Aircraft Sheet

Produced specifically for aircraft interior applications, Hyzod® AC3000 is a patterned opaque, advanced formulation extruded thermoplastic sheet (PEI).

AC3000 as with AC2000 is used for flat or thermoformed aircraft parts and lends itself well to pressure and twin-sheet thermoforming techniques and standard vacuum forming processes. AC3000 meets commercial aircraft requirements for smoke, toxicity and heat release, including OSU below 65/65 and FAA NBS.

| Typical Physical Properties | | | | |
|--------------------------------------|-----------|-----------|-----------|-------------|
| Property | AC2000 | AC3000 | Units | Test Method |
| General | | | | |
| Specific Gravity | | | lbs/ft³ | ASTM D-792 |
| Mechanical | | | | |
| Tensile Strength Yield .125" | 9,000 | 9,000 | psi | ASTM D-638 |
| Tensile Strength, Ultimate | | | psi | ASTM D-638 |
| Tensile Modulus | 340,000 | 340,000 | psi | ASTM D-638 |
| Compressive Strength | | | psi | ASTM D-635 |
| Flexural Strength at 5% Strain | | | psi | ASTM D-790 |
| Flexural Strength at Break | 13,500 | 13,500 | psi | |
| Flexural Modulus .125" | 345,000 | 345,000 | psi | ASTM D-790 |
| Izod Impact Notched .125" | | | ft lb/in | ASTM D-256 |
| Gardner Impact .125" | >320 | >320 | psi | |
| Rockwell Hardness .250" | | | MScale | ASTM D-785 |
| Thermal | | | | |
| Heat Deflection Temp. 264 psi | | | °F | ASTM D-648 |
| Heat Deflection Temp. 66 psi | | | °F | ASTM D-648 |
| Vicat Softening Rate B | | | °F | ASTM D-1525 |
| Coefficient of Thermal Expansion | | | in/in/°F | ASTM D-696 |
| Physical | | | | |
| Specific Gravity | 1.26-1.32 | 1.26-1.33 | lbs/ft³ | ASTM D-792 |
| Water Absorption Equilibrium 24 hrs. | .70 | .70 | % | ASTM D-570 |
| Flammability | | | | |
| Ignition Temperature Self | | | °F | ASTM D-1929 |
| Ignition Temperature Flash | | | °F | ASTM D-1929 |
| OSU Heat Release 2 Min. | <100 | <50 | KW-Min/M² | OSU |
| OSU Heat Release Peak | <100 | <50 | KW-Min/M² | OSU |
| NBS Smoke Density ≤ 4 min. | Pass | <100 | KW-Min/M² | ASTM E-662 |
| Vertical Burn FAA Flammability | Pass | Pass | KW-Min/M² | FAR 25.853 |
| ATS 1000 Airbus | Pass | Pass | KW-Min/M² | ATS 1000 |

PRODUCT AVAILABILITY

For current product sheet sizes, gauges, and general availability information, please contact your closest Regal Plastic Supply Distribution Center.

Polyolefins consist of Polyethylene, Polypropylene, Ethylene-Vinyl Acetate, Ionomer, Polyallomer, Polybutylene, and Polymethyl Pentene. All olefins have similar properties, and often compete for the same applications. They all have very good chemical, corrosion, and abrasion resistance, good electrical properties, and are easy to fabricate. They vary, however, in tensile, flexural and impact strength, stress crack resistance and working temperature ranges.

Polyethylene

Polyethylene is the most widely used polymer. It is characterized as easily processable, economical, tough and light weight with excellent chemical and gamma ray resistance. It also has low moisture absorption, good impact strength, a low coefficient of friction, and excellent low temperature and electrical properties. It is available in several different grades with a variety of properties. Some are flexible, others are rigid; some have more impact strength, and while some have good clarity, others are opaque. Working temperature ranges can also range from -40° to +200°F.

Polyethylene is classified into three categories: low, medium and high molecular weight. A fourth type, ultra-high-molecular weight (UHMW-PE), falls into the high density category. A special grade, crosslinked polyethylene, is also available. Through chemical or irradiation treatment producing a crosslinked reaction, polyethylene can be made to adopt similar properties to those of thermoset properties, such as increased heat resistance and strength.

Low Density Polyethylene

This was the first of the polyethylenes to be developed. It is the least expensive, most flexible and has good clarity in film form. However, it has low temperature impact resistance and the least heat resistance with a maximum service temperature of 160° to 180°F. Although it is chemically resistant, it can be attacked by strong oxidizing acids. It is also susceptible to stress cracking, especially by detergents, but some copolymers of LDPE are available with stress cracking resistance.

Linear low-density PE (LLDPE) has better impact, tear, heat-seal strengths and environmental stress crack resistance than either LDPE or HDPE. While LLDPE is used mainly for film applications, it can be injected rotational, or blow molded.

LDPE Applications:

- Industrial bags
- Shrink bulking
- Produce and garment bags
- Blow molded bottles
- Large industrial containers
- Toys
- Hot-melt adhesives
- Injection molded housewares
- Paper-board coatings
- Wire insulation
- Large agricultural tanks
- Chemical shipping containers
- Tote boxes
- Battery jars
- Prosthetic appliances (braces)
- Medical equipment

LLDPE Applications:

- Film products
- Industrial trash bags
- Liners
- Heavy duty shipping bags

High Density Polyethylene

This is much more rigid with nearly four times the tensile strength and three times the compressive strength of Low Density PE. Two categories of high density polyethylene are high-molecular weight polyethylene (HMW-HDPE), and ultra-high-molecular-weight polyethylene (UHMW-PE).

HDPE Applications:

- Blow molded bottles for milk, juice, water, etc.
- Injection molded housewares
- Industrial pails, food containers and tote boxes
- Extruded water and gas distribution pipe
- Wire insulation
- Structural-foam housing
- Trash containers
- Dump carts
- Pallets
- Agricultural tanks
- Highway barriers
- Water and wastewater tanks for RVs

Polyethylene

HMW-PE

High molecular weight polyethylene, also known as pipe grade PE, has a higher molecular weight than standard HDPE, with excellent toughness and durability.

Typical Applications:

- Film applications
- Flanges
- Stub ends
- Manhole covers for industrial piping systems
- T-shirt-type grocery sacks

Ultra-High-Molecular-Weight-Polyethylene

UHMW-PE has excellent abrasion and chemical resistance, a low coefficient of friction and high impact strength. It has a crystalline melting point of 267°F., with a maximum working temperature of 200°F. This material cannot be processed by conventional molding and extrusion processes. Methods used are compression molding, ram extrusion, and warm forging of extruded slugs.

Typical Applications:

- Conveyor wear strips
- Snowmobile track sprockets
- Guide rails
- Bearings
- Paper machine suction box covers
- Parts of textile looms
- Chute linings and truck bed linings
- Pipe for distribution of slurry materials
- Any applications requiring abrasion resistance, high impact strength a low friction coefficient.

Poly Hi Solidur

Poly Hi Solidur manufactures products in all of the polyethylene grades and in numerous availabilities.

Low Density Polyethylene (LDPE)

The least expensive and most flexible of the polyethylenes, this grade has a maximum service temperature of 160°F to 180°F., and meets FDA 21CLR Section 177.1520 requirements.

High Density Polyethylene (HDPE)

This meets the same FDA requirements of LDPE, and is USDA approved for use in federally inspected meat and poultry packing facilities. With a maximum service temperature of 180°F., it is resistant to mild acids, alkalies and solvents.

Pipe Grade Polyethylene (HMW HDPE)

This polyethylene material is designed for applications requiring higher performance characteristics than standard HDPE. UV resistant with a maximum working temperature of 180°F, this material is classified by ASTM and Plastic Pipe Institute as PE3408, and meets NSF Standard 14 for use in potable water piping systems. Applications include manhole covers for industrial piping systems and flanges.

Sanalite® Cutting Board

Produced with a pebbled, self-healing surface that is designed to help keep knives sharp, Sanalite® Cutting Board is acid resistant, tasteless, odorless, and Agriculture Canada accepted. It is NSF certified under Standard 02, and meets FDA Reg. 21CFR177.1520 Item 2.1.

TIVAR®

The tradename for Poly Hi Solidur's UHMW polyethylene line of products, TIVAR® is designed for applications typically found in food processing, textile, agriculture, packaging, seaports and wastewater treatment industries. This material has a low-friction, self-lubricating surface that approaches that of Teflon®. It is also wear and corrosion resistant and has high impact strength. Highly used in conveyor applications.

TIVAR® 88 and TIVAR® 88-2

Designed as premium liner for bulk material, TIVAR® 88 promotes the flow of cohesive or non-free flowing materials. TIVAR® 88-2 has all of the characteristics of the former, and is weldable.

TIVAR® 1000

This material meets FDA guidelines for pharmaceutical processing and food contact applications. It is non-toxic, chemical resistant, absorbs no water, has no taste or odor, and creates no discoloration.

Typical Applications:

Agriculture

- Wear strips
- Chain guides
- Diverters
- Flights
- Chain tensioners
- Spreaders
- Grain strippers

Food processing

- Augers
- Bearings
- Guide rails, rollers
- Chute, hopper liners
- Deboning tables

Wastewater / Sewage treatment

- Scraper blades
- Filter press plates
- Wear strips
- Plow blades
- Chain sprockets

TIVAR® 1000 Recycled

This is designed for less demanding, non-FDA applications. Made of virgin and reclaimed TIVAR®, it is available in a multicolored Marble grade and in a Uniblend grade. It comes in sheet, rod and board, and is available in green or black.

Typical Applications:

- Drag conveyor flights
- Conveyor chain wear plates
- Belt conveyor wipers, skirts

TIVAR® AntiStatic

This was developed for applications in potentially volatile environments, such as munitions plants or grain elevators, where a spark can cause an explosion. It also protects robotics and products sensitive to build-up of an electrical charge and dust accumulation.

Typical Applications:

Grain handling

- Discharge spout liners
- Flights
- Trough liners

Electronics

- Robotics plants
- Assembly parts

Chemicals -Explosives, Munitions

- Conveyor components
- Table surfaces

Package handling

- Chute liners
- Transfer plates

TIVAR® Ceram P

Comprised of virgin UHMW-PE and performance enhancing additives, TIVAR® Ceram P is a patented, strength enhanced, material. A shatter resistant alternative to sintered ceramics, this material has higher tensile strength, greater dimensional stability and wear resistance than other grades of UHMW-PE. Available in lime green and standard sheet size of 48" x 120", this product has a lower coefficient of thermal contraction and expansion making it a recommended choice for the following applications:

- Suction Box Covers
- Forming Boards in Paper Machines
- Pump Impellers
- Foil Blades in Paper Machines

Custom sizes are available by request. Contact your plastics' distributor for current availabilities and ordering information.

TIVAR® CleanStat®

TIVAR® CleanStat™ are static-resistant, seamless, FDA approved custom liners and components. These products are specifically manufactured to replace stainless steel and aluminum components and offer the following advantages:

- Meets FDA guidelines for food handling
- Static-reduced—guards against fines build-up
- Welded, seamless liners and components
- Long-wearing surface with lower coefficient of friction than stainless steel or aluminum
- Reduced noise levels
- Convenient and less frequent cleaning

ENGINEERED PLASTICS

Polyethylene

Typical applications include:

- Vibratory feeder pans and conveyors
- Coating drums
- Hoppers
- Drag chain conveyors
- Scale buckets, doors, and inserts
- Diverters
- Chutes
- Auger housings
- Metal detector sleeves and tubing

TIVAR® DrySlide

Designed for parcel handling, distribution centers and conveying equipment, this material has enhanced coefficient of friction and anti-static properties. The dry self-lubricant will not attract dust or dirt in dusty environments, and will not stain products or packaging that come into contact with it. This material does not meet FDA specifications for food handling.

Typical Applications

- Chute liners
- Transfer plates
- Chain guides
- Guide rails, curves
- Bearings
- Belt guides
- Guide rollers
- Roller covers

TIVAR® Oil Filled

Designed for roller chains, this has an enhanced coefficient of friction formula which exudes an oil additive to lubricate mating bearing surfaces, and help chains run easily. It meets FDA guidelines for food contact operations.

Typical Applications:

Agriculture

- Roll-end bearings
- Chain tensioners

Food processing / handling

- Sprockets
- Roller chains
- Chain weather strips
- Spur gears

Packaging / Bottling

- Chain radius guide
- Bow curves

- Timing screws
- Underchain wear strips
- Entry / exit tables

TIVAR® UV Resistant

Designed for the harshest elements, this material will retain its low-friction surface, impact strength, and resistance to wear and corrosion longer than non-UV resistant formulas. It can withstand the friction, pressure and impact of moving ships and ferries, and will not freeze in sub-zero temperatures.

Typical Applications:

- Dock fender facings
- Boat rubrails
- Airboat bottoms
- Snowmobile ski skins
- Snowmobile belly pan liners
- Water slides
- Ice rinks
- Rink kick plates
- Amusement park wear components
- Snowplow blades
- Salt spinners
- Sand / salt boxes

Agriculture

- Trough liners
- Plow board liners
- Shank protectors
- Wear strips
- Sprockets
- Combine skid plates
- Spreaders

PRODUCT AVAILABILITY

| Product | Standard Sizes | Thickness | Standard Colors |
|--------------------------|--|--|---|
| LPDE* | 4' x 8' 4' x 10' | 1/16" - 2" 1/16" - 2" | Natural |
| HDPE* | 4' x 8' 4' x 10' 47" x 95" 5' x 10' | 1/16" - 2" 1/16" - 2" 2 1/4" - 4" 1/8" - 1" | Natural and Black |
| Sanalite® HDPE* | 4' x 8' 4' x 10' 5' x 10' | 1/2" - 1" 1/2" - 1" 1/2" - 1" | Natural |
| Pipe™ grade HMW HDPE* | 4' x 8' 4' x 10' 5' x 10' | 1/4" - 4" 1/4" - 2" 1/4" - 1 1/4" | Black UV Stabilized with carbon black additive Custom: Natural |

*custom widths, lengths, gauges and colors available in small runs

| TIVAR® | Sheet Sizes | Sheet Thickness | Extruded Rod | Extruded Tube | Extruded Board | Extruded Profiles | Molded Parts | Colors |
|-------------------------|--|---|--------------|--------------------------------|---------------------------|---|--------------|--|
| TIVAR® 1000* | 1/16" - 6" 1/16" - 6" 3/8", 1/2", 3/4", 1" 3/4" - 3" 1/4" - 8" | 48" x 96" 48" x 120" 60" x 120" 48" x 240" Spec. order 39 3/8" x 78" 3/4" | 1/4" - 10" | 7/8" x 1/4" 8 5/8" x 7 7/8" | .100 - 2.5" 1-26" wide | U-Channels, right- angles, dogbone, half and full rounds, snap-ons J-legs | Yes | Natural Custom colors in minimum runs |
| TIVAR® 1000 Recycled | 1/16" - 6" 1/4" - 1" Press load quantities: 3/4" - 3" Special order: 1/4" - 8" | 48" x 120" 60"x120" Press load: 48" x 240" Spec. order: 39 3/8" x 78 3/4" | ☐ | | ☐ | | Yes | Marble green Marble black Uniblend green Uniblend black |
| TIVAR® Antistatic* | 1/16" - 6" | 48" x 120" Spec.Order: 39 3/8" x 78 3/4" | ☐ | Special Order | ☐ | Selected | Yes | Black |
| TIVAR® UV Resistant* | 1/16" - 6" | 48" x 120" Spec.Order: 39 3/8 x 78 3/4 | ☐ | Special Order | ☐ | Selected | Yes | Black Custom colors in minimum runs |
| TIVAR® Oil Filled | 1/8" - 2" | 48" x 120" | ☐ | Special Order | ☐ | Selected | Yes | Brown Custom colors in minimum runs: gray |
| TIVAR® DrySlide | 1/4" - 2" | 48" x 120" | | | ☐ | Selected | | Black |

☐ Same as TIVAR® 1000

* Oversized welded sheet available. Sizes and colors vary internationally
Custom colors available in minimum runs

Sheet Billet Runs For Custom Colors

| Sheet Thickness | 1/16" | 1/8" | 3/16" | 1/4" | 3/8" | 1/2" |
|--------------------|-------|------|-------|------|------|------|
| Minimum No. Sheets | 20 | 11 | 10 | 8 | 5 | 4 |

TIVAR® Wear Components

Custom and standard wear components are available manufactured from the TIVAR® line of products.

Conveying Components

For Bottling, Canning & Packaging Plants

- Sprockets
- Wearstrips
- Chain Guides
- Bearings
- Gears
- Pulleys
- Guide Rails
- Shaft Collars



ENGINEERED PLASTICS

Polyethylene

SolidTrack Modular Systems

SolidTrack units are available in straights and corners in tab, bevel, and combination designs. Corner designs can include straight extensions for smooth transitions. Available in the following TIVAR® products:

- TIVAR® 1000
- TIVAR® Oil Filled
- TIVAR® DrySlide
- TIVAR® Ceram P
- TIVAR® AntiStatic
- TIVAR® Recycled

- J-Leg
- Snap-Ons
- C-Channels
- Full Rounds
- Half Rounds
- U-Channels
- Right Angles
- Dogbones

[For complete product availabilities and design options, contact your closest Regal Plastic Supply Distribution Center.](#)

Radius Curve Wearstrips for Flat Top Chains

Provided in sets as 90° sections, the tab chain uses a rectangular design and the non-tab chain uses a bevel design.

Industrial Chain Guides for Roller Chains

For use with plastic or metal chain, single and double strand chain, these guides are available in standard 10 ft. lengths and natural color. Custom colors and triple strand designs are available by request.

UltraTrac Chain Guides for Roller Chains

UltraTrac Chain Guides are available with or without steel profiles.

UltraTrac Belt Guides

These products provide a low-friction surface for rubber and urethane belts or cables. Metric sizes are available to accommodate round and v-belts. Belt guides are available with or without steel profiles.

UltraTrac Steel Profiles

Designed specifically to handle TIVAR® UltraTrac chain and belt guides, the standard profile lengths are 120". UltraTrac profiles are available in both stainless steel (for food handling) and galvanized steel.

TIVAR® Guide Rails and Wearstrips

Weighing 1/8 as much as steel, TIVAR guide rails and wearstrips can reduce noise levels up to 50% and last three times longer in most conveyor applications. Available in the following designs:

TIVAR® Hanger Bearings

Designed for use in screw conveyors, hanger bearings are water, acid, and alkali resistant.

Measuring Operating PV

The load capacity of plastic bearings can be expressed as a pressure/velocity (PV) factor.

P = Pounds per square inch on the projected bearing area

V = Velocity in feet per minute on the shaft surface

$$PV = P \times V$$

Example:

Shaft OD = 3/4"
Bearing Length = 1"
Bearing Load = 20 lbs.
Shaft RPM = 250

V (FPM) = .262 x (Shaft Dia.) x Shaft (RPM)
= .262 x .750 x 250 RPM
= 49 FPM

P (PSI) = Bearing Load (Bearing Dia.) x
(Bearing Length)

Bearing Material PV Chart

| Material | Max PV | Max P (PSI) | Max V (FPM) | Max Temp °F |
|---------------------|--------|-------------|-------------|-------------|
| TIVAR® 1000 | 2300 | 1400 | 100 | 180 |
| Nyloil | 16000 | 2000 | 400 | 230 |
| Nylon Type 6 | 3600 | 2000 | 400 | 225 |
| Nylon Type 6/6 | 2700 | 2000 | 400 | 200 |
| Delrin® | 3000 | 1000 | 100 | 200 |
| PTFE (Teflon®) | 1000 | 500 | 400 | 500 |
| PTFE (Glass-Filled) | 1000 | 500 | 400 | 500 |

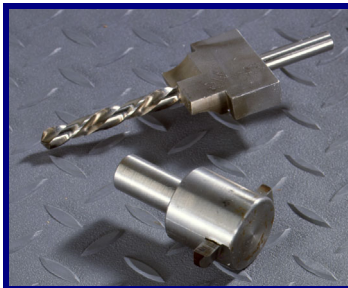
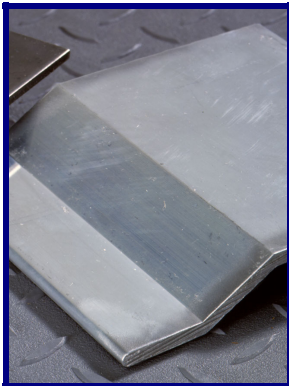
TIVAR® Fastening

Fastening options for TIVAR® include:

- TIVAR® capped elevator bolts
- TIVAR® washers
- Steel washers
- Locknuts
- Regular Nuts
- Aluminum, mild steel, and stainless steel weld washers and matching plugs



Capped elevator bolt and weld washer systems



Leading edge protectors and counterbore tools

[For product availability and complete information regarding the various installation methods and techniques, please contact your closest Regal Plastic Supply distribution center.](#)

ChampLine™

ChampLine™ is Poly Hi Solidur's textured, UV, moisture, and graffiti resistant polyethylene product for use in the building of customized play systems.

Stocked in oversize sheet, 48 1/4" x 96 1/4", gauges of .4" to .75", and five standard colors (red, green, blue, yellow, and tan), custom compound colors are available by request.



ENGINEERED PLASTICS

Polyimide

Polyimides are some of the most heat and fire resistant polymers known, and are formulated as both thermosets and thermoplastics. They are available as laminates and shapes, molded parts, stock shapes, film, adhesives, coatings and enamel.

This material has good wear resistance and low coefficients of friction, both of which are further improved by PTFE fillers. Self-lubricating parts containing graphite powders have flexural strengths above 10,000 psi. It is resistant to chemicals including dilute acids, aromatic and aliphatic hydrocarbons, esters, ethers, alcohols, freons, hydrolic fluids, JP-4 fuel and kerosene. It is not resistant, however, to dilute alkalis and concentrated inorganic acids.

Polyimide parts are fabricated by techniques that range from powder-metallurgy to conventional injection, extrusion, transfer and compression molding methods. The extruded product, however, offers better mechanical properties without sacrificing thermal properties.

Polyimide parts and laminates can operate continuously in air at 500°F, and intermittently from cryogenic temperatures to 900°F. Glass fiber reinforced versions retain over 70% of their flexural strength and modulus at 480°F. Creep is nearly nonexistent, even at high temperatures, and deformation under load (4000 psi) is less than 0.05% at room temperature for 24 hours. Other grades available include high purity, low outgassing and self-lubricating formulas.

Polyimide is used in the semiconductor, aerospace, nuclear, heat transfer, electrical / electronics, and off-road vehicle industries, just to name a few.

Typical Applications:

- Jet engine vane bushings
- High temperature electrical connects
- High speed, high load bearings for business machines and print-out terminals.
- Gear pump gaskets
- Hydraulic valve seals
- Automotive- distributor blocks
- Seal rings for air compressors
- Automotive transmissions
- Severe service bushings
- Critical service bearings
- Wand tips and wafer boat handling tools

Ensinger Engineering Plastics

Ensinger manufactures the following polyimide products under the tradename Sintimid.

Sintimid V

Ensinger's family of polyimides include the following grades:

- Unfilled Polyimide
- 15% Graphite-filled Polyimide
- 40% Graphite-filled Polyimide
- High-Purity Polyimide
- High Purity, High-Temperature Polyimide

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBE |
|----------------------------------|--------------------|---------------------|-----------------|
| Sintimid V | | | |
| Unfilled Polyimide | 1/4" - 2" diameter | 1/4" - 2" thickness | 1/2" O.D. |
| 15% Graphite filled | 15" length | | to 58" O.D. |
| 40% Graphite filled | | 15" x 15" size | |
| High Purity | 1" - 2" diameter | 15" x 30" size | 3" min. length |
| High Purity and High Temperature | 30" length | | 6" max. length |
| Compression Molded | | | |
| Same as above | Up to 3" diameter | Up to 2" thick | Up to 14" thick |

[Contact your nearest Regal Plastic Supply distribution center for current availabilities.](#)

DO YOU KNOW?

1962 - DuPont introduces space-age polyimide.

regal
PLASTIC

DSM Engineering Plastic Products

DSMEPP (formerly Polymer Corporation) manufactures fully imidized* thermoset polyimide under the tradename Duratron®. The full imidization and encapsulation of graphite lubricants in the following wear grades are designed to make Duratron® PI stronger and more chemical resistant than other polyimides, with 1/3 lower thermal expansion and a wear resistance to 575°F (300°C).

Note: Fully imidized products like Duratron® polyimide are harder (making them more challenging to fabricate), and tend to have lower impact strength.

*imidized - a material's polymer chains (molecules) undergo a chemical change forming a 3-dimensional network by crosslinking during processing or annealing cycles.

Duratron® XP

This unreinforced material has very low ionic impurities and outgassing. It is recommended for applications where maintaining purity or electrical insulation is critical.

Duratron® 150

This material contains 15% graphite lubricant. It has the best combination of physical properties and toughness among DSMEPP's lubricated polyimide products.

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBULAR BAR |
|--|-------------|--|--|
| Duratron® XP PI Compression molded | 3/8" - 3" | 12" x 12"; 3/8" - 2" thick | |
| Duratron® 150 PI Compression molded | 1" - 3 3/8" | 12" x 12" 13 1/4" x 14 1/4" 14" x 28" 1/2" - 1 1/4" thick | From 1 1/2" O.D. x 3/4" I.D. To 12 1/2" O.D. x 11 1/4" I.D. |

DO YOU KNOW?

1954 - The first large-scale production of high-density polyethylene plastic begins.

roga
PLASTIC

ENGINEERED PLASTICS

Polyphenylene Oxide

Noryl® resins (composed of modified polyphenylene oxide (PPO)) produce a line of engineering plastics which combine polyphenylene oxide and styrene. This material has good creep resistance, excellent hydrolytic stability, low moisture absorption, and good dimensional stability. It has outstanding electrical characteristics and thermal properties, and is stress relieved for easy machinability. It also has high impact strength and keeps its mechanical strength over a range of temperatures from -40°F to 265°F.

Typical Applications:

Water Distribution

- Water softener valves
- Pump components
- Ball cocks and tank trim
- Beverage dispenser components

Automotive and Transportation

- Specialty hardware
- Bezels, housings
- Gauges and instrument parts
- Coil forms and bobbins
- Fender extensions
- Mass transit seat housings

Appliances and Business Machines

- Housings (portable mixers, calculators, computers, electric knives)
- Coffee pots and components
- Attachments (vacuum sweepers and floor polishers)
- Plated and vacuum metalized parts (decorative and functional uses)

Medical

- Surgical instruments
- Vaporizer parts
- Utensils, trays, basins

Electrical components

- Terminal boards
- Relay cases
- Radio and TV components
- Connectors and live guards
- Motor controls and wiring devices

Ensinger Engineering Plastics

Ensinger manufactures two grades of Noryl® PPO materials.

Noryl® EN-265

This PPO material is a black, general purpose grade.

Noryl® SE1-GFN3

This PPO product is a natural, 30% glass-reinforced grade.

PRODUCT AVAILABILITY

| PRODUCT | ROD | PLATE | TUBE |
|-------------------|-------------------------------|--|---|
| *Noryl® EN-265 | 3/16" - 8" dia. 10' length | 1/4" - 4" thickness Up to 3" thickness 24" x 48" size 3 1/4" - 4" thickness 12" x 48" size | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. 10' Lengths |
| **Noryl® SE1-GFN3 | 3/16" - 8" | 1/4" - 4" thickness Up to 3" thickness 24" x 48" size 3 1/4" - 4" thickness 12" x 48" size | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. 10' Lengths |

* Not all sizes stocked. Some available on a minimum run, custom order only.

** Available on custom order, minimum runs only.

A. L. Hyde Company

The A. L. Hyde Company produces a black, Noryl® PPO general purpose grade material.

Noryl® ENG-265 BK701

Hyde's black, general purpose grade, Noryl PPO, available in rod only.

PRODUCT AVAILABILITY

| Diameters | Lengths |
|-----------|--|
| 3/8" - 2" | Up to 1" - 5 and 10 ft. 1 1/8" - 2" - 4 and 8 ft. |

[Check with your nearest Regal Plastic Supply distribution center for other diameter and length availabilities.](#)

ENGINEERED PLASTICS

Polyphenylene Sulfide (PPS)

Polyphenylene sulfide (PPS) is a semi-crystalline engineering thermoplastic. It offers the best resistance to chemicals of any advanced engineering plastic, and is suitable for applications requiring thermal stability to 425° and structural integrity to 225°. Machinable to tight tolerances, it absorbs virtually no moisture, and has superior dimensional stability. With good electrical and mechanical properties, it is flame and creep resistant, and the graphite loaded bearing grades are UV resistant. There are many grades available: unfilled natural, 30% and 40% glass filled, glass / mineral filled, conductive and anti-static grades, internally lubricated, and those which offer low friction, high limiting PVs and wear resistance.

PPS can be injection and blow molded, extruded and compression molded, and machined parts are available. PPS may be bonded to itself or other materials with adhesives or through thermal or ultrasonic welding.

Note: Although this material is highly chemical resistant, it can still be attacked by concentrated nitric acid, chlorosulfonic acid and ethylene diamine. Long-term exposure to temperatures above 425°F. is not recommended. Melting occurs at 540°.

Typical Applications:

- Lantern rings in centrifugal pumps
- Pump housings
- High pressure liquid chromatography components
- Electronic test sockets and fixtures
- Flow meter rotors
- Engine sensors
- Halogen lamp sockets
- Chemical processing
- Medical and diagnostic devices
- Valve and pump components

Ensinger Engineering Plastics

Ensinger manufactures two grades of PPS under the tradename Ensifide®.

Ensifide®

Ensifide® materials are available in a natural grade produced from Fortron® resin; and a black, 40% glass reinforced (GF40) grade from Ryton® or Fortron® resin.

PRODUCT AVAILABILITY

| Product | Rod | | Plate | | Other | Tube |
|--|------------|----------------|--------------------|---|----------------------------|--|
| | Diameter | Length | Thickness | Size | | |
| Ensifide® Natural (extruded) | 3/16" - 6" | 10 ft. | 1/4" - 4" thick | (up to 3") 24" x 48" (3 1/4" - 4") 12" x 48" | | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. 10' Lengths |
| 40% Glass- filled (extruded) | 3/16" - 6" | 10ft. | 1/4" - 4" thick | (up to 3") 24" x 48" (3 1/4" - 4") 12" x 48" | | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. 10' Lengths |
| PPS Filled (various fillers) (compression molded) | Up to 8" | Up to 1 ft. | Up to 3" | — | Tube: Up to 33" O.D. | |

All rod and most plate available on custom order, minimum runs only.

DSM Engineering Plastic Products

DSMEPP (formerly Polymer Corporation) manufactures several grades of PPS under the tradenames of Techtron® PPS and Ryton® PPS.

Note: All DSMEPP's PPS products offer dimensional stability and strength at moderate temperatures. They are rated for continuous service to 425°F (220°C), but strength and stiffness vary based on temperature and grade. Unreinforced Techtron® PPS is usually not used for wear applications. Products like Torlon® (PAI) or Ketron® (PEEK) are better selections for high temperature wear applications. When designing with Ryton®, it is important to note its relatively low elongation and impact strength.

Techtron® PPS

An unfilled PPS product, this material is easily machined and designed for structural applications in corrosive environments.

Techtron® CM PPS

Manufactured from Ryton® PPS resin, this is the compression molded version of the unfilled Techtron® PPS.

ENGINEERED PLASTICS

Polyphenylene Sulfide (PPS)

40% Glass-reinforced Ryton® PPS

Compression molded, this material exhibits better dimensional stability and thermal performance than Techtron® PPS and maintains its strength over 425°F.

Bearing-grade Ryton® PPS

For use in thrust or wear applications, or when an electrically conductive material is required, this material is internally lubricated and carbon fiber -reinforced. It has a low coefficient of thermal expansion and excellent chemical resistance.

PRODUCT AVAILABILITY

| Product | Rod | | Disc | | Plate | | Other |
|---------------------------------|--------------|----------|-----------|------------------------|---------------|--------------------|-------|
| | Diameter | Diameter | Thickness | Diameter | Thickness | | |
| Techtron® PPS | 3/8" to 2" | — | — | | 1/4" - 2" | Hex and square rod | |
| Techtron® CM PPS | 1" to 9 3/4" | 11" | 3/8" - 2" | 12" x 12" 14" x 28" | 3/8" - 1 1/4" | Tubular Bar | |
| 40% Glass-reinforced Ryton® PPS | 1" to 9 7/8" | | | 12" x 12" 14" x 28" | 3/8" - 1 3/4" | Tubular Bar | |
| Bearing Grade Ryton® PPS | 1" to 11" | | | 12" x 12" 14" x 28" | 3/8" - 1 3/4" | Tubular Bar | |

DO YOU KNOW?

Since 1976 plastic has become the most widely used material in the United States.

ENGINEERED PLASTICS

Polyphenylsulfone (PPSU)

Polyphenylsulfone (PPSU) is an amorphous high performance thermoplastic exhibiting a higher level of impact and chemical resistance over polysulfone and polyetherimide. Products manufactured with the Amoco produced Radel® R resin exhibit high heat deflection (400°F/ 204°C) and good hydrolytic stability, allowing prolonged exposure to elevated temperatures in air, water, and long-term, repeat autoclave cycles. Not recommended as a wear material, the Radel® properties degrade when exposed to sunlight. Available in transparent, opaque, black, white, and custom colors, Radel® R is USP Class VI compliant.

Note: Radel® R has been approved for use in a variety of medical devices but is not FDA compliant, and therefore, not appropriate for food contact applications.

Typical Applications:

- Electrical / electronics
- Dip switches
- Radomes
- Pump houses
- Bearing cages
- Site glasses
- Medical applications

Hydex® 5500

Manufactured by the A. L. Hyde Company, from the Radel® R Resin, this product performs with good impact strength, chemical resistance and withstands repeated autoclaving. Recommended for use in the medical and electronic industries, this product is available in black, in the following sizes and gauges:

| Rod | | Sheet |
|----------------------|-------------|---------------|
| Diameter | Length | Thickness |
| 3/8", 1/2", 3/4", 1" | 5 and 10 ft | 3/8", 1/2" |
| 1 1/2" and 2" | 4 and 8 ft | 3/4" 1" |
| 3" | 2 and 4 ft | 1 1/2" and 2" |

Sizes not in stock can be custom quoted.
Rods may be ground to any intermediate diameter.

Radel® R PPSU

Manufactured by DSM Engineering Plastic Products (formerly Polymer Corporation), this Radel® R product has excellent impact resistance, steam resistance to 400°F (205°C), is USP Class VI compliant, and exhibits a high modulus of elasticity and heat resistance. Available in transparent, natural (bone white) and custom colors, it is commonly used in sterilization trays, dental and surgical instrument handles, orthopedic implant trials and in fluid handling coupling and fitting applications.

| Steam Autoclave Resistance | |
|---------------------------------------|--------------------|
| Flexural Stress 1400 Psi (9.7 MPa) | Cycles to Cracking |
| Radel® R | >2000 |
| Polyetherimide | 900 |
| Polysulfone | 50 |
| Polyethersulfone | 45 |

PRODUCT AVAILABILITY

| Rod Diameter | Plate Thickness |
|--------------|-------------------|
| 1/2" to 2" | 1/32" to 3" thick |

DO YOU KNOW?

Salvagers who recovered the riches aboard the Titanic in 1987 were struck by the absence of "plastic".

PLASTIC

ENGINEERED PLASTICS

Polypropylene

Polypropylene, created through the polymerization of propylene gas, is a light density (.91-.92 gm/cm³) thermoplastic with a hard, high gloss surface and moderate strength. Polypropylene exhibits excellent track, arc resistance, dielectric strength, low permeability to water vapor and gases, and resistance to chemicals and solvents including aqueous, salts, acids and alkaline solutions. It is attacked, however, by aromatic and chlorinated hydrocarbons at high temperatures, halogens, fuming nitric acid and other active oxidizing agents. Extensively used in the semiconductor industry, this product performs well in the presence of DI water. Homopolymers have a working temperature range of 30° to 210°F., while copolymers can handle -20° to 180°F.

Copolymerization with an additional resin can enhance physical properties, and the addition of fibers can increase mechanical or thermal stability. It can be modified to be conductive or antistatic, have improved flame retardancy, and to withstand prolonged use in elevated temperatures and ultra violet light.

This material is fabricated utilizing standard woodworking tools, and can be butt, extrusion, fusion, and spun welded. Processing can be done by extrusion, injection, blow, compression, and rotational molding, as well as pressure, thermo, or vacuum forming.

Typical Applications

- Plating barrels and tanks
- Tank covers
- Scrub stations
- Piping
- Semi-conductor processing
- Electrical switch gear
- Glove boxes
- Fan shrouds
- Orthopedic appliances
- Battery cases
- Cutting boards
- Bottling machines
- Insulations components
- Animal feeders
- Acid tanks
- Tank linings
- Playground equipment
- Food wraps
- Packaging
- Irrigation

Ensinger Engineering Plastics

Ensinger manufactures polypropylene under the tradename Ensipro®.

Ensipro®

This material meets ASTM D-4101 PP0112 specifications and FDA requirements. Recommended applications include liners, labware, medical devices, valve components and fittings.

PRODUCT AVAILABILITY ROD

1/4" to 8" diameter in up to 10' lengths.

A. L. Hyde Company

The A. L. Hyde Company produces polypropylene material under the tradename Polypro.

Polypro

This polypropylene material has a low coefficient of friction, good thermal properties, low moisture absorption and is chemical resistant. It is widely used for electrical components and in fluid handling and containment applications.

PRODUCT AVAILABILITY ROD

1/4" to 16" in 2' to 8' lengths

Colors, blends and other grades quoted upon request

Poly Hi Solidur

Poly Hi Solidur manufactures several grades of homopolymer and copolymer polypropylene products under the tradename Proteus®.

Proteus® Homopolymer

Designed for applications to 180°F, this material is resistant to chemicals including most acids, alkalis, and solvents. It meets FDA 21CFR Section 177.1520 and is USDA approved for use in federally inspected meat and poultry packing facilities.

Proteus® White Homopolymer

This white homopolymer polypropylene material is film masked one side, and is available with both sides masked for the semiconductor industry.

Proteus® 18G Flame Retardant

A white polypropylene, this material has a UL 94 flammability rating of V-0 and 5VA.

Proteus® Copolymer

A blend of polypropylene and ethylene, Proteus® Copolymer has a temperature range of -34°F to 170°F and exhibits a higher impact strength than the Proteus® Homopolymer.

PRODUCT AVAILABILITY

| Poly Hi Solidur | Standard Sizes | Thickness | Standard Colors |
|---|--|--|--|
| Proteus® Homopolymer* | 4' x 8' 4' x 10' 47" x 95" 5' x 10' | 1/16" - 2" 1/16" - 2" 2 1/4" - 3" 1/8" - 1" | Natural. Custom: Industrial Grey UV Stabilized RAL 7032 |
| Proteus® Homopolymer* | 4' x 8' 4' x 10' 5' x 10' | 1/8" - 1" 1/8" - 1" 1/8" - 1" | White / film masked 1 side |
| Proteus® Homopolymer* | 4' x 8' | 1/8" - 1" | Black / film masked 1 side |
| Proteus® 18G Flame Retardant Homopolymer* | 4' x 8' | 1/8" - 1" | White / film masked 2 sides |
| Proteus® Copolymer* | 4' x 8' 4' x 10' 5' x 10' | 1/8" - 2" 1/8" - 2" 1/8" - 1" | Natural. Custom: Industrial Grey UV Stabilized |

Custom widths, lengths, gauges and colors available in minimum runs.

DO YOU KNOW?

1957 - The 'House of Tomorrow' opens at Disneyland. Created by Monsanto, its walls, roof, floors, rugs and furniture are all made of plastic. (It's so strong that the wrecking crew has trouble demolishing it years later.)

PLASTIC

ENGINEERED PLASTICS

Polysulfone

Polysulfone is a transparent, amorphous, high performance engineering thermoplastic. It has good thermal and insulation characteristics and low ionic impurity levels. It is also heat and hydrolysis resistant in hot water and steam to 300°F, and has a continuous use temperature down to -150° F. It has excellent radiation stability, and mechanical and electrical properties. It has low flammability and smoke emission, and is resistant to chemicals including acidic and salt solutions, as well as detergents. It often replaces polycarbonates when higher temperatures, improved chemical resistance or autoclavability is required. It can be processed on conventional equipment and can be compounded with fillers like glass beads, glass fiber or TFE. It is available in stock shapes, sheet and film. Grades which are FDA, NSF, 3A-Dairy and USP Class VI compliant are also available.

Typical Applications:

- Manifolds
- Distributor valves
- Medical equipment components
- Steam cleaning equipment inserts
- Pharmaceutical equipment
- Semiconductor processing
- Milking machines
- Steam table pans
- Microwave oven cookware
- Coffee makers
- Coil bobbins
- Television components
- Pumps
- Filter modules
- Camera components
- Watch components
- Aerospace components
- Analytical instrumentation

Ensinger Engineering Plastics

Ensinger offers polysulfone under the tradename Ensifone®.

Ensifone®

A natural grade of polysulfone which meets FDA and NSF standards.

A. L. Hyde Company

Hyde offers a general purpose grade polysulfone material produced from the Amoco resin, Udel®.

Udel P-1700

As Hyde's general purpose, extrusion grade polysulfone, this transparent amber colored material complies with FDA, USDA, 3-A, NSF 14, NSF 61, and USP VI (1) regulations.

DSM Engineering Plastic Products

DSMEPP offers polysulfone manufactured by the Amoco resin, Udel®.

Note: Polysulfone is not a wear material and may stress craze under high pressures in certain chemical environments.

PSU 1000 Polysulfone

Semi-transparent, this material has a flame resistance of UL94-V-O at 1/4" thickness and UL94-HB at 1/8". Food grade and custom colors can be special ordered.

Note: Only the food grade is FDA, NSF, 3A-Dairy, and USP Class VI compliant.

PRODUCT AVAILABILITY

| Rod | Plate | Tube |
|--------------------------|----------------------------|---|
| 3/16" to 8" Diameters | 1/32" to 4" Thicknesses | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. |
| Up to 10' Lengths | | 10' Lengths |

Sizes as well as availability vary with the manufacturers listed here, DSMEPP, Ensinger, and A. L. Hyde Company.

Custom colors and sizes often available. [Check with your nearest Regal Plastic Supply Company distribution center for the most current product information.](#)

Urethane is available in a variety of forms including thermoplastic, thermoset, coatings and foams (flexible, semi-rigid, rigid and integral skin). Thermoset and some foam types are available in sheet, rod, bar and tube as well as custom molded parts. Processes to produce parts include injection molding, extrusion, RIM, spray and casting.

Polyurethanes are versatile engineering materials which provide properties unavailable in conventional rubbers, metals, and plastics. They have greater oil, solvent, abrasion and tear resistance, as well as good impact strength, low compression set and excellent bearing capacity.

Typical Applications:

- Fluid Handling
- Filter Bowls
- Manifolds
- Valves
- Site Glasses
- Junction Boxes

A. L. Hyde Company

The following two grades of solid polyurethane, produced out of the Dow Chemical resin, Isoplast® under the tradename Hydex®, have excellent impact and temperature resistance with very good mechanical properties. Both have a resistance to a wide range of chemicals including: alcohols, aliphatic hydrocarbons, aromatic hydrocarbons, bases, inorganic acid, organic acids and oxidizers.

Hydex® 301

This unfilled, light yellow, machine grade product has nearly 90% light transmission and can be mechanically buffed or flame polished to achieve excellent clarity. Unlike acrylic and polycarbonate, this material can be used for applications which require clarity as well as chemical resistance and toughness. Applications include medical diagnostic equipment; filter bowls, manifolds and valves; and, petrochemical processing plants; site glasses and junction boxes.

Hydex® 202

This opaque, unfilled polyurethane grade was designed for mechanical applications that have significant machining but require close tolerances. It has better impact strength than 301, can outwear many metals, and is durable and tough in highly corrosive environments. This material can withstand chemicals with a PH range from 2 to 14.

PRODUCT AVAILABILITY

| PRODUCT | ROD | SLAB |
|------------|--------------------|----------------------|
| Hydex® 301 | 1/4" - 6" Diameter | 1/4" to 4" thickness |
| Hydex® 202 | | |

DO YOU KNOW?

1959 - Over 5 billion pounds of plastic are produced in the U.S. this year, compared with 2.2 billion pounds in 1950.

regal
PLASTIC

ENGINEERED PLASTICS

Polyvinyl Chloride (PVC)

Polyvinyl Chloride (PVC) or "vinyl" is the second largest selling thermoplastic resin behind polyethylene. Rigid PVC is the most common type of PVC used for pipes, fittings, valves, machining shapes, sheet, and duct. It has excellent chemical resistance and dielectric properties, good tensile, flexural and mechanical strength, low moisture absorption, excellent dimensional stability, and low flammability. The maximum working temperature for PVC is 140°F. Properties, however, can be altered with the addition of certain additives, such as UV stabilizers.

Typical Applications:

- Chemical processing
- High purity applications
- Water and wastewater treatment
- Irrigation
- Agriculture
- Corrosive fume handling (duct)
- Food contact applications
- DWV / plumbing
- Corrosive resistant tanks and vessels
- Corrosive resistant workstations and equipment
- Nuts, bolts, fasteners
- Pump and valve components
- Spacers, hangers, stiffeners, hubs
- Siding
- Flooring
- Windows
- Face shields
- Phonograph records
- Gutters and downspouts

Chlorinated PVC (CPVC)

This material has high tensile, flexural, and impact strength. It is chemically inert, corrosion resistant, a good thermal and electrical insulator, and has a temperature range up to 200°F.

Typical Applications:

- Self-supporting tanks and tank linings
- Valve and pump parts
- Fume exhaust hoods
- Spacers and flanges

A.L. Hyde Company

A.L. Hyde Company produces PVC under the tradename Hydcor®.

Hydcor® PVC Rod

This Type 1 PVC material machines well and has excellent chemical and impact resistance.

PRODUCT AVAILABILITY

| ROD | |
|------------|----------------------|
| Diameter: | Standard Lengths: |
| 1/4" - 12" | 1/4" - 5" 10' |
| | 5 1/2" - 10" 5' |
| | 12" 20" |

Poly Hi Solidur

Poly Hi Solidur produces PVC and CPVC grade products through extrusion and compression molding methods.

Poly Hi Solidur PVC

Typically used for pipe and fittings, this PVC Type I, Grade I Gray, per ASTM D1784, resists mild acids, alkalies and solvents, and has a UL94 V-0 flammability rating.

Poly Hi Solidur Corzan™ CPVC Sheet

This chlorinated PVC material is produced primarily for corrosive or high-temperature environments. This product performs in temperatures up to 200°F., and is impact, weather, acid, alkali and solvent resistant. It has a UL94 V-0 flammability rating and meets NSF Standard 14 for use in plastic piping components and related materials.

DO YOU KNOW?

In 1929, a B. F. Goodrich organic chemist, Waldo Sermon, was trying to bind rubber to metal when he stumbled upon a polymer called polyvinyl chloride.

ENGINEERED PLASTICS

Polyvinyl Chloride (PVC)

PHYSICAL PROPERTIES

| Test Name | ASTM Test Method ISO Equivalent | Corzan™ CPVC | PVC |
|---|------------------------------------|------------------------|------------------------|
| Density—g/cm ³ | D792 1183: 1987 | 1.55 | 1.41 |
| Tensile Strength at Yield PSI—MPa | D638 527—1 & 2: 1993 | 8000 55.0 | N.A. N.A. |
| Tensile Elongation at Yield—% | D638 527—1 & 2: 1993 | N.A. | N.A. |
| Tensile Modulus PSI—MPa | D638 527—1 & 2: 1993 | 360,000 2500 | 435,000 3000 |
| Flexural Strength PSI—MPa | D790 178: 1993 | 15,000 103.5 | N.A. N.A. |
| Flexural Modulus PSI—MPa | D790 178: 1993 | 415,000 2860 | N.A. N.A. |
| Izod Impact—Notched Ft. lb./in. @ 73°F kJ/m ² @ 23°C | D256 180: 1993 | 1.5 3.15 | 0.8 1.7 |
| Heat Deflection Temp. °F @ 66 PSI °C @ 0.45 MPa | D648 75—1 & 2: 1993 | 230 110 | 167 75 |
| Mean Coefficient of Linear Thermal Expansion In./In./°F | D696 | 3.4 x 10 ⁻⁵ | 6.1 x 10 ⁻⁵ |
| Hardness—Rockwell R or Shore D where noted | D785 | 119 | 82 Shore D |
| Water Absorption—% | D570 62: 1980 | 0.03 | 0 |
| Flammability Rating | UL—94 | V-0 | V-0 |
| Maximum Operating Temperature | °F °C | 200 92 | 140 60 |

The information listed above contains averages based on testing under laboratory conditions and does not necessarily indicate end product performance or suitability for a particular application.

PRODUCT AVAILABILITY

| PRODUCT | THICKNESS | SIZE | COLOR |
|------------------------|---------------------------|----------------------|-------|
| Poly Hi Solidur PVC | 1/16" - 2" 2 1/4" - 3" | 4' x 8' 47" x 95" | Gray |
| Corzan™ CPVC | 3/4" - 2" 2 1/4" - 3" | 4' x 8' 47" x 95" | Gray |

DO YOU KNOW?

1952 - B. F. Goodrich develops high-impact rigid PVC for plastic pipe.

ENGINEERED PLASTICS

Thermoplastic Elastomer (TPE)

A thermoplastic elastomer (TPE) is a synthetic compound that combines the properties of vulcanized rubber with materials such as polypropylene. Parts made from TPE can be fabricated using the same methods and machinery that conventional thermoplastics do. Soft and flexible in nature, these are normally used where a rubber-like material is required.

Typical Applications:

Automotive

- Convoluted boot for steering system
- Convoluted CVJ boot
- Weatherstripping
- Air duct intakes
- Safety air bag cover
- Fuel line cover
- Gear shift knob
- Brake cable cover
- Fascia, trim

Building construction

- Expansion joints
- Pipe connectors
- Household / industrial plumbing
- Weather seals
- Roofing
- Window glazing

Household appliances

- Water sumps
- Water conduit hose
- Door seals
- Handle seals
- Handle grips
- Gaskets

Food and medical

- Syringe stoppers
- Tubing
- Catheters
- Container caps
- Valves
- Bladders

A. L. Hyde Company

The A. L. Hyde Company produces two grades of TPE from a DuPont elastomer, Hytrel.

Hytrel® 5556 and Hytrel® 7246

These TPE materials are flexible with excellent memory, wear well, have superior impact and outstanding chemical resistance. Hytrel® 5556 has a 55 durometer and Hytrel® 7246 has a 72 durometer.

PRODUCT AVAILABILITY

Rod

Diameters: 1/4", 1/2", 3/4", and 1"

Plate

Thicknesses: 1/4", 1/2", and 1"

[For current availability and sizes, contact your closest Regal Plastic Supply Distribution Center.](#)

DO YOU KNOW?

In the 1950s Swiss engineer George de Maestral devises a vinyl product that replicates the natural ability of a cocklebur to cling to anything it comes in contact with. The result is Velcro®.

Thermoplastic Polyesters (PBT) - (PET)

Thermoplastic polyesters are high-performance engineering resins known as polybutylene terephthalate (PBT), or polythramethylene terephthalate (PTMT), and polyethylene terephthalate (PET / PETE). They are known for their toughness, creep resistance, high dimensional stability and low moisture absorption. Equilibrium water absorption, after prolonged immersion at 73°F., ranges from 0.25 to 0.40% and 0.52 to 0.60% at 150°F.

They are resistant, at room temperature, to a wide range of chemicals including: aliphatic hydrocarbons, gasoline, carbon tetrachloride, perchloroethylene, oils, fats, alcohols, glycols, esters, ethers and dilute acids and bases. They are not, however, resistant to strong acids and bases.

These thermoplastic polyesters are available in unreinforced, high-molecular molding resins and in glass-reinforced grades. Both the unreinforced and glass-filled grades are available with UL flammability ratings of 94 HB and 5V.

Although the polyesters without glass fillings are unreinforced, unnotched specimens are rated "no break" both at room temperature and down to -40°F. They are also capable, in falling dart tests, of handling more than 40 ft. / lb. Although they have high impact strength, they are notched-sensitive, and care must be used when designing parts.

Stiffness and creep resistance can be increased by the addition of glass to the polyesters. Recently, tougher grades of 30%, 45%, and 55% glass-filled thermoplastic polyesters have arrived on the market, as well as a new, low warpage grade with 35% glass / mica.

Glass-reinforced polyesters have excellent electrical properties even after prolonged exposure to a wide range of temperatures and other conditions, including humidity. However, for continuous exposure, the maximum water temperature recommended is 125°F.

Typical Applications:

- Pump housings
- Gears
- Cams
- Rollers
- Bearings
- Electrical and electrical components
- Automotive distributor caps
- Painted exterior automobile components
- Coil forms

PBT

Polybutylene terephthalate (PBT), is a semi-crystalline thermoplastic polyester. It has a hard, durable surface and superior chemical resistance, especially to chlorine. It has better impact resistance and elongation than PET, and is less brittle. It has low moisture absorption, good dimensional stability, low coefficient of friction, good ductility, noise dampening qualities, no centerline porosity, and excellent wear resistance in wet or dry conditions. FDA, USDA and 3A compliant, it is recommended for use primarily in food processing.

Typical Applications:

- Bearings
- Bushings
- Food contact parts
- Guides
- Insulators
- Pump components
- Seals
- Spacers
- Thrust washers

A. L. Hyde Company

Hyde produces PBT materials under the tradename Hydex® out of resins by General Electric (Valox*); BASF (Ultradur*); and Celanese (Celanex*).

Hydex® 4101

This PBT material is wear and chemical resistant with low moisture absorption and good dimensional stability. It can withstand repeated "CIP" chemical washdowns, and meets FDA, USDA and 3A requirements.

Hydex® 4101L (Lubricated)

This enhanced version of 4101 is lubricated with improved wear and PV range.

PRODUCT AVAILABILITY

| SLAB | | ROD | |
|------------------------|---|-----------|---|
| Thickness | Sizes | Diameter | Lengths |
| 3/8" - 4" 3/8" - 3" | 12"x 24", 12"x 48" 24"x 24", 24" x 48" | 1/4" - 6" | (1/4" - 1") 5 and 10 feet (1 1/4" - 2") 4 and 8 feet (2 1/2" - 6") 2 and 4 feet |

ENGINEERED PLASTICS

Thermoplastic Polyesters (PBT) - (PET)

PET

PET (Polyethylene Terephthalate also known as PETE), is a thermoplastic polyester that can be either amorphous or crystalline (or a mixture of both) depending on how it is processed. It is also known as APET (Amorphous Polyethylene Terephthalate). In its crystalline state for oven trays, it is known as CPET, and when used for oriented film, it is called OPET.

PET is a durable, tough plastic with good chemical, high-energy radiation, weather, wear and abrasion resistance. It is a good electrical insulator with excellent dimensional stability and high strength and stiffness. It has a low coefficient of friction, low creep, a high modulus, and meets FDA regulations. It has a continuous use temperature of approximately 10% higher than acetal, and a melting point of almost 150° higher. It has 1/2 the moisture absorption of acetal and 10 times less than nylon. Because it has no centerline porosity, moisture absorption and leakage is virtually eliminated.

Typical Applications:

- Carbonated soft drink and water bottles
- "Freezer to oven" food packaging trays
- Water purification systems
- Printing equipment
- Textile components
- Food-handling equipment
- Valves
- Bearings
- Bushings
- Guides
- Insulators
- Pump components
- Seals
- Spacers
- Thrust washers
- Exterior body parts
- Electrical components

Ensinger Engineering Plastics

Ensinger manufactures PET material from Arnite® and Crystar® resins under the tradename Ensitemp®.

Ensitemp®

This PET material is FDA approved and meets ASTM D-4507 TPES211B55130. It is available in black and natural.

PRODUCT AVAILABILITY

| ROD | PLATE | TUBE |
|---------------------------|-------------------------------------|---|
| 1/2" - 6" 10 feet long | 24" x 48" 1/4" - 4" thickness | From 1.5" - 11.84" O.D. and 1" to 7.87" I.D. 10' Lengths |

DSM Engineering Plastic Products

DSM Engineering Plastic Products (formerly Polymer Corporation) produces PET material under the tradename of Ertalyte® by proprietary resin grades made by DSM. Only DSM can offer Ertalyte®.

Note: Because it is more rigid and offers greater thermal performance than nylon and acetal, Ertalyte machines differently. For best results, please request a copy of DSM's design and fabrication guideline for Ertalyte PET-P from your plastics distributor. Ertalyte and other polyesters have less resistance to hot water than Acetron® GP acetal.

Ertalyte® PET-P

This material is stain, arc and gamma ray resistant and good in both wet and dry conditions. While the natural and black grades are both FDA approved, the natural is also USDA, 3A-Dairy and Canada AG compliant.

PRODUCT AVAILABILITY

| ROD | PLATE |
|--------------------|-----------------|
| 1/2" - 7" diameter | 1/4" - 4" thick |

Trademarks

Click on trademark name to locate within document

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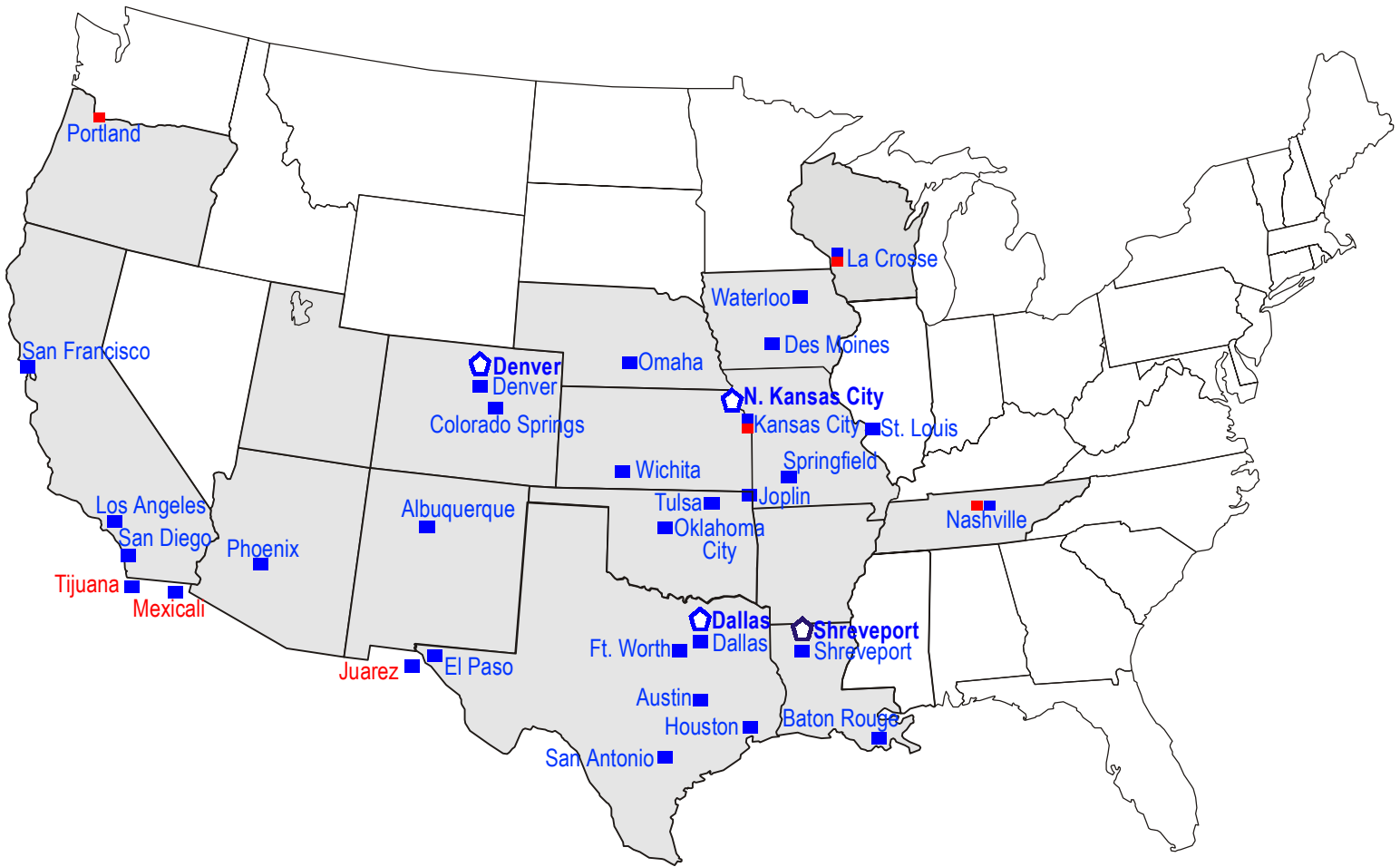
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