Alro Plastics

Your Source for Performance Plastics

Sheet • Plate • Rod • Tube • Film • Profiles • Grating • Custom Parts

PLASTICS GUIDE

Online Version

Since 1987

Introduction

1 **Introduction**
Alro Plastics Product Offerings and Services
Section 1, Pages 1-1 to 1-16

Acetal

2 **Acetal**
Acetal Copolymer & Delrin Homopolymer items
Section 2, Pages 2-1 to 2-16

Nylon

3 **Nylon**
Cast, Extruded, Oil-Filled, MoS2 and more
Section 3, Pages 3-1 to 3-20

Polyolefin

4 **Polyolefin**
HDPE, LDPE, UHMW, Polypro and more
Section 4, Pages 4-1 to 4-62

Thermoset Composites

5 **Thermoset Composites**
Phenolics, Laminated products and GPO-3
Section 5, Pages 5-1 to 5-18

Polycarbonate

6 **Polycarbonate**
Sheet, Plate, Rod, Tube, Film and more
Section 6, Pages 6-1 to 6-20

Acrylic

7 **Acrylic**
Sheet, Plate, Rod, Tube and more
Section 7, Pages 7-1 to 7-14

Chemical & Corrosion 8

PVC, CPVC, PVDF - Chemical & Corrosion Resistant
Section 8, Pages 8-1 to 8-14

High Performance 9

Specialty plastics for demanding applications
Section 9, Pages 9-1 to 9-66

Other Plastics 10

ABS, PETG, Urethane, Tooling Board & more
Section 10, Pages 10-1 to 10-32

Fiberglass 11

Grating, Structurals, Sheets and more
Section 11, Pages 11-1 to 11-16

Plastics Processing 12

Value-Added Alro Processing Offerings
Section 12, Pages 12-1 to 12-18

Reference 13

Plastics Product Information, Data & Tolerances
Section 13, Pages 13-1 to 13-30

Alro Metals 14

More Products & Services from Alro Steel
Section 14, Pages 14-1 to 14-10

Terms and Conditions:

Returned Goods

Orders may not be returned without prior authorization from Alro. If the responsibility is ours or the manufacturer's, we will replace the material promptly. In all other cases, we will attempt to minimize the customer's expense or loss. If we authorize a return, we reserve the right to make reasonable handling charges for returned goods.

Cancellations

Special orders (goods not normally carried in stock) may not be cancelled without our prior authorization. Such authorization will depend on terms we receive from the manufacturers. Orders for stock material that have already been processed may not be cancellable. This determination will be made at Alro's sole discretion.

Claims

Claims for shortages in shipment, defective goods, or errors must be made within 10 days after receipt of order. Claims for shortages or damage caused by delivering carrier should be made directly with them. Claims for defective material may need to be inspected and approved by the manufacturer before credit can be issued.

Responsibility

Alro's liability is limited to replacement of defective material. We are not responsible for and assume no liability for labor, incidental or consequential damages or other expenses. Statistical information contained in this catalog (pertaining to speeds, strength, specifications, proper working load of materials, tools, machines) was derived from manufacturer's tables and reprinted by us for our customer's convenience. We assume no responsibility by this reprint.

The information contained in this catalog has been prepared to the best of our ability, however, there is no guarantee that all of the information is correct and updated. The latest version of this catalog can be found online at www.alro.com.

This catalog has been compiled to provide information on a wide variety of products to assist with selecting the proper materials for your application. All of the information listed in this catalog is for reference only. The information listed should not be the final determination in material selection for your specific application.

Alro Plastics - 2218 Enterprise - Jackson, Michigan

Our Philosophy:

Our business philosophy can best be represented by our Mission Statement and our commitment to continuous improvement.

MISSION STATEMENT

To ensure the long term success of Alro and its people by exceeding our customers' expectations.

SERVICE EXPECTATIONS

Tender Loving Care for all Customers
Everyone is your customer.

Next Day Delivery
Most customers rely on it.

Zero Errors
What good is great delivery if it's wrong?

Heroic Recoveries
Turn a problem into an opportunity. If something goes wrong, fix it now!
Figure out what happened later and learn from it.

FOUNDATIONS

PEOPLE • SAFETY • SYSTEMS • INVENTORY • FACILITIES • EQUIPMENT

We exceed our customers' expectations through vast inventory, superior technology, value-added services and on-time deliveries!

Advantages of Stock Shape Plastics

Plastics can provide many advantages over other materials.
Some benefits include:

Light Weight		Increased Productivity
High Wear Resistance		**Longer Part Life**
High Impact Resistance	LEADS TO	Increased Product Reliability
Noise Reduction		**OSHA Compliance**
Self Lubricating		No Lubrication Required
Easily Machined		**Cost Savings**
Corrosion Resistance		Less Down Time
Aesthetics		**Appearance**

General Selection Criteria

The selection of a material for an application is a very difficult task. Usually one is only able to narrow the selection down to two or three candidates and the final selection is then determined by testing. The first and most important step in selecting a material from the broad spectrum (steel, aluminum, brass, UHMW, Delrin®, nylon, etc.) is to carefully define the properties required and the environment in which the material will need to perform.

It may be necessary to ask some or all of the following questions to define the application. The more completely the application is defined, the better the chance of selecting the best material for the job.

What load will the part have to carry?

Will the design carry high loads? What will the highest load be? What is the maximum stress in the part? What kind of stress is it (tensile, flexural, etc.)? How long will the load be applied? What is the projected life of the part or design?

What temperatures will the part see and for how long?

What is the maximum temperature the material must sustain? What is the minimum temperature the material will sustain? How long will the material be at these temperatures? Will the material have to withstand impact at the low temperature?

Will the material be exposed to chemicals or moisture?

Will the material be exposed to normal relative humidity? Will the material be submerged in water? If so, at what temperature? Will the material be exposed to steam? Will the material be painted? Will the material be submerged or wiped with solvents or other chemicals? If so, which ones? Will the material be exposed to chemical or solvent vapors? If so, which ones? Will the material be exposed to other materials that can outgas or leach detrimental materials, such as plasticizers?

Will the material be used as a bearing or need to resist wear?

Will the material be expected to perform as a bearing? If so, what will the load, shaft diameter, shaft material, shaft finish, and rpm be? What wear or abrasion condition will the material see? Note: Materials with friction reducers added, such as TFE, molybdenum disulfide, or graphite, generally exhibit less wear in rubbing applications.

Does the part have to retain its dimensional shape?

What kind of dimensional stability is required?

Continued on next page

General Selection Criteria

Will the part have to meet any regulatory requirements?
Is an FDA approved material required (taste/odor)? Is this for a Medical application?

Should the material have a special color and/or appearance?
What color material is desired? Does it have to match anything else? Is a textured surface needed?

Will the part be used outdoors?

Is material cost an important factor?

LEAST EXPENSIVE

MOST EXPENSIVE

HDPE (High Density Polyethylene)
Polypropylene
PVC Type 1 (PolyVinyl Chloride)
VHMW (Very High Molecular Weight Polyethylene)
LDPE (Low Density Polyethylene)
Acrylic (Clear sheet, Plexiglas®)
Polycarbonate (1/2" thick and under, Makrolon®)
UHMW-PE (Ultra High Molecular Wgt, TIVAR® 1000)
Phenolic CE (Industrial Laminate Sheet)
Nylon 6 (Cast), **Nylatron® GSM** (Cast)
ABS (Acrylonitrile-Butadiene-Styrene)
Acetal Copolymer (Acetron® GP)
Phenolic G10/FR4
TIVAR® 88 (Specialty UHMW product)
Delrin® (Acetal Homopolymer)
Nylon 6/6 (Extruded), **Nylatron® GS** (Extruded)
Urethane / Polyurethane
CPVC (Chlorinated PolyVinyl Chloride)
PTFE, Virgin (PolyTetra-FluoroEthylene)
Polycarbonate (Machine Grade, 3/4" thick and up)
Noryl® (PPO)
Nylatron® NSM (Cast, Premium Bearing grade)
Ertalyte® PET-P (Polyethylene Terephthalate)
Polycarbonate (Window Grade/optically clear)
Hydex® 202, 301, 4101, 4101L
Ertalyte® TX
Ultem™ 1000 (Duratron® PEI)
Polyethersulfone (PES)
PVDF (Kynar®)
Polysulfone
Delrin® AF (Acetal Homopolymer PTFE blend)
Hydlar® Z (Kevlar® fiber reinforced Nylon 6/6)
PEEK (Polyetheretherketone, Ketron®)
Techtron® PPS & HPV
Torlon® (Polyamide-imide, Duratron® PAI)
Tecasint™

*Note: Comparative pricing based on price per square foot for 1 inch thick slab.

Plastics Selection Chart

S = Sheet, R = Rod, T = Tube, F = Film

MATERIAL GRADE	TYPICAL APPLICATIONS	TYPICAL PROPERTIES	FORMS AVAILABLE S R T F	HARDNESS ROCKWELL	WATER ABSORB. 24 hr 1/8 thk %
ASTM Test				D785	D570
HDPE	Machined prototypes, support blocks, housing covers	Great impact resist., low cost, good machinability, vac form	S R T	70 Shore D	< 0.01
Polypropylene	Bearings, bushings, gears, rollers, timing screws, seals	Low moist. absorp., high strength & stiffness,dimension stable	S R T F	72 Shore D	n/a
PVC Type I	Gears, sprockets, wear shoes, pads, sheaves, pulleys	High impact resist, excellent vibration resist, easy machine	S R T F	89 Shore D	none
VHMW	Conveyors, chutes, punching ops, snow plows, lubricating discs	Resistant to caking/bridging, low co -efficient friction, FDA/USDA compliant	S	65 Shore D	n/a
LDPE	Orthotic & Prosthetic devices, die pads, drape formed parts	Lightweight, good impact resist, very flexible, thermoforming performance	S R T F	45 Shore D	< 0.01
Acrylic	Sneeze guards, shields, museum cases, enclosures, skylights	Dimension stability, clarity, tough & durable, weather and heat resistant	S R T	M90	0.20
Polycarb (thin)	Inudstrial glazing, mach guards, structural parts, fabricated parts	High impact resistance, chemical resistance, lightweight, clarity	S R T	M70 / R118	0.12
UHMW-PE	Guides, wear strip, plate, bushings, rollers, augers, chutes, liners	Self lubricating, chem, corrosion and wear resistant, no moisture absorb.	S R T	66 Shore D	< 0.01
Phenolic CE	Guides, table tops, gears, pulleys, rollers	Good mech properties & toughness, High impact strength, machinability	S R T	M100	2.00
Nylon (Cast)	Bushings, bearings, gears, sprockets, wear pads/rails, feed screws	High impact resist, excellent vibration resist, high heat distortion	S R T	M85 / R115	0.60
Nylatron® GSM	Bushings, bearings, gears, sprockets, wear pads/rails, feed screws	Good mech/electrical prop., ideal balance of strength/toughness	S R T	M80 / R110	0.30
ABS	Mach prototypes, support blocks, housing covers, structural comp.	Excellent impact resist, good strength, stiffness and machinability	S R F	n/a	n/a
Acetal Copolymer	Bearings, bushings, gears, rollers, electrical components, keels	Low moisture absorb, high strength and stiffness, dimensionally stable	S R T	M88 / R120	0.20
Phenolic G10	Terminal boards, washers, sleeves, structural components	Extremely high mech strength, low water absorb, superior electrical char	S R T	M115	0.10
TIVAR® 88	Belt scrapers, bunk & chute liners, dust collection hoppers, truck beds	Abrasion, chem & corrosion resist, promotes reliable, steady bulk flow	S	67 Shore D	< 0.01
Delrin®	Bearings, bushings, gears, rollers, electrical components, keels	Low moisture absorb, high strength & stiffness, dimensionally stable	S R	M94 / R120	0.20
Nylon (Extruded)	Pulleys, sheaves, gears, sprockets, bushings, conveyor & star wheels	Good mech & electrical prop, ideal balance strength & toughness	S R T	M85 / R115	0.30
Urethane	Bumper pads, cutting surfaces, gaskets, wear pads, sorter blocks	Superior cut & abrasion resist, ability to self heal, resist to many oils	S R T	Vary by Duro	0.24
CPVC	Fume scrubbing, metal finishing, chemical processing, pickling	Excellent corrosion resist, good chemical resist, high heat resist.	S R T	84 Shore D	< 0.04
PTFE, virgin	Convey roller, gaskets, seals, coil separators, bushings, bearings	Excellent electrical prop, high impact strength, great chemical resistance	S R T F	M119	0.001
Polycarb (thick)	Site glasses, view windows, impact shields, manifolds, housing, covers	Excellent impact resist & dimension stability, low moisture, easy machine	S	M74 / R118	0.12
Noryl® PPO	Manifolds, pump, valve fittings, electrical components, housing	Excellent dim stability, low moisture, good strength/impact resistance	S R	R115-119	0.10
Nylatron® NSM	Bushings, bearings, rollers, sleeves, wear components, gears	High mech strength, excellent wear resist, good fatigue resistance	S R	M80 / R110	0.30
Ertalyte® PET-P	Linear bearings, wear/slide parts, dynamic seals, valve seals, rollers	Outstanding wear resist, non-stain, great dim stability, FDA compliant	S R T	M101 / R126	0.07
Hydex® 202/301	Gears, ind hardware, level gauges, oil/gas field equip, bearing filter house	Great chem resist, dimension stable, good impact and wear resistance	S R	n/a	0.21 / 0.19
Hydex® 4101	Fixture block piston assembly, valve body, conveyor gears, filler valve	High chemical and wear resistance, dimensionally stable, no porosity	S R	M119/120	0.07
Ultem® 1000	Connectors, valves, electrical fittings, structural probes, manifolds, clamps	High strength & heat resist, broad chem resist, UV stable, 94 V-0	S R	90 Shore D	0.25
PVDF	Fluid handling, chem process/storage, semiconductor equipment	High purity, flame resistant, excellent weatherability, FDA, USDA, USP	S R	80 Shore D	0.01-0.03
Polysulfone	Food processing, solenoid valve body, manifold, distributor valves	Excellent mech & electrical prop, dimension stable, radiation stable	S R	M93	0.30
Delrin® AF	Bearings, bushings, structural keels, gears, rollers, electrical components	Low moisture absorp., high strength and stiffness, easy to machine	S R	M75-90	0.20
Hydlar® Z	Bushings, bearings, rollers, wear strips, gears, pulleys	Excellent wear resist, superior abrasion resist, good dimension stability	S R	R121	0.80
PEEK	Valve seats, pump gears, high purity seals, wafer carriers, wear blades	Excellent chem resist, low moisture, good wear & abrasion resistance	S R	M100 / R126	0.10
PPS	Pump & valve components, HVAC equip, lantern rings, chip nests	Excellent chem resist, excels in corrosive environments up to 425°F	S R	M95 / R125	0.02
Torlon® 4203	Connectors, relays, insulators, piston parts, bearing cages, seals, valves	Superior electrical insulation, resist to wear, high strength, low CoF	S R	M120 / E80	0.40
Tecasint™	Compressor bearing, pump bushing	Excellent electrical values, high temperature usage	S R	M120	0.40

Plastics Selection Chart

MATERIAL GRADE	COMPRESSIVE STRENGTH, PSI	TENSILE STRENGTH, PSI	DIELECTRIC STRENGTH 1/8" THK VPM	FLEXURAL YIELD STRENGTH, PSI	ELONGATION % at BREAK
ASTM Test	D695	D638	D149	D790	D638
HDPE	4,600	4,600	n/a	4,600	400%
Polypropylene	4,800	3,400	n/a	4,800	11%
PVC Type I	12,000	8,350	n/a	8,350	5%
VHMW	n/a	> 4,100	n/a	n/a	210-260%
LDPE	1,400	1,400	n/a	1,500	100%
Acrylic	n/a	10,200	n/a	15,000	n/a
Polycarb (thin)	12,500	9,000-9,500	380 V/mil	13,500	110%
UHMW-PE	3,000	5,800	2,300 kV/in	3,500	300%
Phenolic CE	36,000	10,000	550 V/mil	17,000	n/a
Nylon (Cast)	15,000	12,000	500 kV/in	16,000	20%
Nylatron® GSM	14,000	11,000	400 kV/in	16,000	30%
ABS	7,650	> 6,400	n/a	10,500	24% - 40%
Acetal Copolymer	13,500	9,500	420 kV/in	12,000	30%
Phenolic G10	65,000	38,000/45,000	800	65,000/75,000	n/a
TIVAR® 88	3,000	5,800	2,300 kV/in	3,200	300%
Delrin®	15,000	11,000	450 kV/in	13,000	30%
Nylon (Extruded)	12,500	12,000	400 kV/in	15,000	50%
Urethane	20,000	175/10,000	400/500	700/4,500	100% / 1000%
CPVC	14,000	6,150	n/a	6,700	12%
PTFE, virgin	1,700	2,000/5,000	430	n/a	200% / 400%
Polycarb (thick)	10,500-12,500	8,900-10,500	380	13,500	8-125%
Noryl® PPO	16,000-16,400	7,800 - 9,600	40/550	12,800 - 13,500	50-60%
Nylatron® NSM	14,000	11,000	400 kV/in	16,000	20%
Ertalyte® PET-P	15,000	12,400	385 kV/in	18,000	20%
Hydex® 202/301	n/a	9,000/10,000	n/a	12,000/14,000	90% / 140%
Hydex® 4101	12,800	9,400	n/a	n/a	200% / 300%
Ultem® 1000	21,900	15,200	830	22,000	60%
PVDF	8,680	5,500/7,400	n/a	n/a	50% / 250%
Polysulfone	n/a	10,200	425	15,400	50% - 100%
Delrin® AF	n/a	8,500/11,000	n/a	15,000	2% / 7%
Hydlar® Z	19,300	16,000	n/a	23,000	n/a
PEEK	17,100	12,000	190	12,500	50%
PPS	n/a	12,500	450	15,400	3% - 6%
Torlon® 4203	32,100	16,000-21,500	580	34,000	5% - 18%
Tecasint™	30,000	16,000	395	n/a	9%

Plastics Selection Chart

MATERIAL GRADE	MAXIMUM TEMP CONTINUOUS °F	MACHINABILITY	UL RATING	BURN RATE (IN./ MIN.)	ARC RESISTANCE SEC.	REFER TO PAGE #
ASTM Test	---	---	---	D635	D495	
HDPE	180°	Excellent	94 HB	0.50	n/a	4-06
Polypropylene	225° / 300°	Good	94 HB	n/a	136/185	4-52
PVC Type I	160°	Good	94 V-0	Self Extinguishing	n/a	8-02
VHMW	n/a	Excellent	n/a	n/a	n/a	4-32
LDPE	180°	Very Good	94 HB	n/a	n/a	4-03
Acrylic	170° - 190°	Very Good	n/a	n/a	n/a	7-02
Polycarb (thin)	n/a	Excellent	94 HB	< 1.00	10/120	6-02
UHMW-PE	180°	Excellent	94 HB	0.50	n/a	4-34
Phenolic CE	125°	Very Good	94 HB	n/a	n/a	5-02
Nylon (Cast)	200°	Excellent	94 HB	Self Extinguishing	n/a	3-02
Nylatron® GSM	200°	Excellent	94 HB	Self Extinguishing	n/a	3-14
ABS	n/a	Excellent	94 HB	n/a	n/a	10-08
Acetal Copolymer	180°	Excellent	94 HB	n/a	n/a	2-02
Phenolic G10	180°	Fair - Good	94 HB	n/a	100	5-08
TIVAR® 88	180°	Excellent	94 HB	0.50	n/a	4-44
Delrin®	195°	Excellent	94 HB	n/a	129, 15 mil spec	2-06
Nylon (Extruded)	210°	Excellent	94 V-2	Self Extinguishing	n/a	3-04
Urethane	190° - 225°	Bad	n/a	n/a	1/0.60	10-28
CPVC	200°	Excellent	94 V-0	n/a	n/a	8-06
PTFE, virgin	500°	Excellent	n/a	n/a	300	9-56
Polycarb (thick)	200°	Excellent	94 V-0	< 1	10/120	6-14
Noryl® PPO	175° - 220°	Excellent	94 V-1	Self Extinguishing	75	9-43
Nylatron® NSM	200°	Excellent	94 HB	n/a	n/a	3-16
Ertalyte® PET-P	210°	Very Good	94 HB	n/a	n/a	9-35
Hydex® 202/301	n/a	Fair - Good	n/a	n/a	n/a	---
Hydex® 4101	221°	Excellent	94 HB	n/a	n/a	9-14
Ultem™ 1000	338°	Good	94 V-0	n/a	n/a	9-30
PVDF	300°	Excellent	94 V-0	Self Extinguishing	50/70	8-12
Polysulfone	300°	Good	94 V-2	n/a	122	9-53
Delrin® AF	185° - 220°	Excellent	94 HB	n/a	136	2-06
Hydlar® Z	210°	Excellent	94 HB	Self Extinguishing	n/a	3-20
PEEK	480°	Good	94 V-0	n/a	120/180	9-20
PPS	400°	Good	94 V-0	n/a	124	9-48
Torlon® 4203	450° - 500°	Good	94 V-0	n/a	n/a	9-04
Tecasint™	Up to 572°	Good	n/a	n/a	n/a	9-38

Plastics Selection Chart

MATERIAL GRADE	EFFECT OF WEAK ACIDS	EFFECT OF STRONG ACIDS	EFFECT OF WEAK ALKALIES	EFFECT OF STRONG ALKALIES	EFFECT OF ORGANIC SOLVENTS
ASTM Test	D543	D543	D543	D543	D543
HDPE	Very Resistant	Attacked slowly by oxidizing acids	Very Resistant	Very Resistant	Resistant (below 80°C)
Polypropylene	n/a	n/a	n/a	n/a	n/a
PVC Type I	Excellent	Excellent	Excellent	Excellent	Unacceptable
VHMW	n/a	n/a	n/a	n/a	n/a
LDPE	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Acrylic	n/a	n/a	n/a	n/a	n/a
Polycarb (thin)	Excellent	Excellent	Excellent	Marginal	n/a
UHMW-PE	Fair - Good	Unacceptable	Acceptable	Marginal	Acceptable
Phenolic CE	Acceptable	n/a	n/a	n/a	Marginal
Nylon (Cast)	Limited	Attacked	None	None	Resist common solvents
Nylatron® GSM	Limited	Unacceptable	Limited	Unacceptable	n/a
ABS	n/a	n/a	n/a	n/a	n/a
Acetal Copolymer	Limited	Unacceptable	Acceptable	Unacceptable	Acceptable
Phenolic G10	n/a	n/a	n/a	n/a	n/a
TIVAR® 88	Acceptable	Unacceptable	Acceptable	Marginal	Acceptable
Delrin®	Limited	Attacked	Limited	Unacceptable	Acceptable
Nylon (Extruded)	Limited	Unacceptable	Limited	Unacceptable	Resist common solvents
Urethane	Marginal	n/a	Acceptable	Marginal	Marginal
CPVC	Acceptable	Limited	Acceptable	Acceptable	n/a
PTFE, virgin	None	None	None	None	None
Polycarb (thick)	Excellent	Excellent	Excellent	Marginal	n/a
Noryl® PPO	Excellent	Excellent	Excellent	Excellent	n/a
Nylatron® NSM	Limited	Unacceptable	Limited	Unacceptable	Acceptable
Ertalyte® PET-P	Acceptable	Limited	Acceptable	Unacceptable	Acceptable
Hydex® 202/301	n/a	n/a	n/a	n/a	n/a
Hydex® 4101	Acceptable	Resistant	Excellent	Excellent	Marginal
Ultem® 1000	Excellent	Acceptable	Excellent	n/a	Acceptable
PVDF	None	None	None	None	Limited
Polysulfone	Acceptable	Acceptable	Acceptable	Marginal	Marginal
Delrin® AF	Limited	Attacked	Limited	Unacceptable	Acceptable
Hydlar® Z	Limited	Attacked	None	None	Marginal
PEEK	Resistant	Limited	Limited	Acceptable	Acceptable
PPS	Excellent	Acceptable	Excellent	Acceptable	Excellent
Torlon® 4203	Excellent	Acceptable	Marginal	n/a	Excellent
Tecasint™	Excellent	Acceptable	Marginal	n/a	Excellent

IAPD Thermoplastics Rectangle

High Performance
High Temperature
High Cost

IMIDIZED

Key Characteristics	Materials
Very high cost per pound	Polyimide (PI)
Excellent physical properties above 400°F / 205°C	Polyamide-imide (PAI)
Excellent electrical properties	Polybenzimidazole (PBI)
Excellent dimensional stability	
Low coefficient of friction (bearing grades)	

450°F
230°C

AMORPHOUS HIGH PERFORMANCE THERMOPLASTICS

Key Characteristics	Materials
High cost	Polysulfone (PSU)
High temperature	Polyetherimide (PEI)
High strength and good stiffness	Polyethersulfone (PES)
Hot water and steam resistance	Polyphenylsulfone (PPSU)
	Polyarylate (PAR)

250°F
120°C

AMORPHOUS ENGINEERING THERMOPLASTICS

Key Characteristics	Materials
Moderate cost	Polycarbonate (PC)
Moderate temperature resistance	Polyphenylene Oxide (PPO)
Moderate strength	Thermoplastic Polyurethane (TPU)
Good to excellent impact resistance	
Good dimensional stability	

150°F
65°C

AMORPHOUS COMMODITY THERMOPLASTICS

Key Characteristics	Materials
Low cost	Acrylic/Polymethyl Methacrylate (PMMA)
Low temperature resistance	Polystyrene (PS)
Low strength	Acrylonitrile-Butadiene-Styrene (ABS)
	Polyvinyly Chloride (PVC)
	Polyethylene Terephthalate Glycol Modified (PETG)
	Cellulose Acetate Butyrate (CAB)
	Polyvinyl Chloride & Acrylic Alloy Sheet (PVC/PMMA)

AMORPHOUS KEY CHARACTERISTICS

Soften over a broad range of temperatures
Easy to thermoform
Tend to be translucent or transparent (typically, not always)
Bond well using adhesives and solvents
Prone to stress cracking
Poor fatigue resistance
Structural applications only (not bearing and wear)

= Amorphous Commodity = Amorphous Engineering = Amorphous High Performance = Imidized

IAPD Thermoplastics Rectangle

IMIDIZED

Key Characteristics	Materials
Very high cost per pound	Polyimide (PI)
Excellent physical properties above 400°F / 205°C	Polyamide-imide (PAI)
Excellent electrical properties	Polybenzimidazole (PBI)
Excellent dimensional stability	
Low coefficient of friction (bearing grades)	

SEMI-CRYSTALLINE HIGH PERFORMANCE THERMOPLASTICS

Key Characteristics	Materials
High cost	Polyvinylidene Fluoride (PVDF)
High temperature	Polyetetrafluoroethylene (PTFE)
High strength	Ethylene-Chlorotrifluoroethylene (ECTFE)
Good chemical resistance	Fluorinated Ethylene Propylene (FEP)
Good electrical properties	Polychlorotrifluoroethylene (PCTFE)
Low coefficient of friction (CoF)	Perfluoroalkoxy (PFA)
Good toughness	Polyphenylene Sulfide (PPS)
	Polyetheretherketone (PEEK)

SEMI-CRYSTALLINE ENGINEERING THERMOPLASTICS

Key Characteristics	Materials
Moderate cost	Nylon / Polyamide (PA)
Moderate temperature resistance	Acetal / Polyoxymethylene (POM)
Moderate strength	Polyethylene Terephthalate (PET)
Good chemical resistance	Polybutylene Terephthalate (PBT)
Good bearing and wear properties	Ultra High Molecular Weight
Low coefficient of friction (CoF)	Polyethylene (UHMW-PE)
Difficult to bond	

SEMI-CRYSTALLINE COMMODITY THERMOPLASTICS

Key Characteristics	Materials
Low cost	High-Density Polyethylene (HDPE)
Low temperature resistance, strength	Low-Density Polyethylene (LDPE)
Low coefficient of friction (CoF)	Polypropylene (PP)
Near zero moisture absorption	Polymethylpentene (PMP)
Good electrical properties, toughness	
Difficult to bind	

SEMI-CRYSTALLINE KEY CHARACTERISTICS

Sharp melting point
Difficult to thermoform
Tend to be opaque
Difficult to bond using adhesives and solvents
Good resistance to stress cracking
Good fatigue resistance
Good for bearing and wear and structural applications

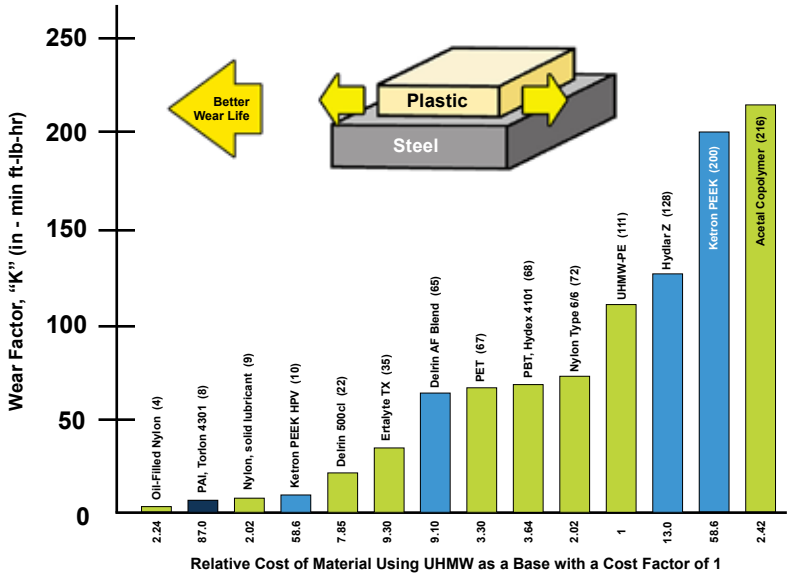
Performance (Chemical Resistance and Thermal Stability)

= Semi-Crystalline Commodity = Semi-Crystalline Engineering = Semi-Crystalline High Performance = Imidized

Property Comparison Charts

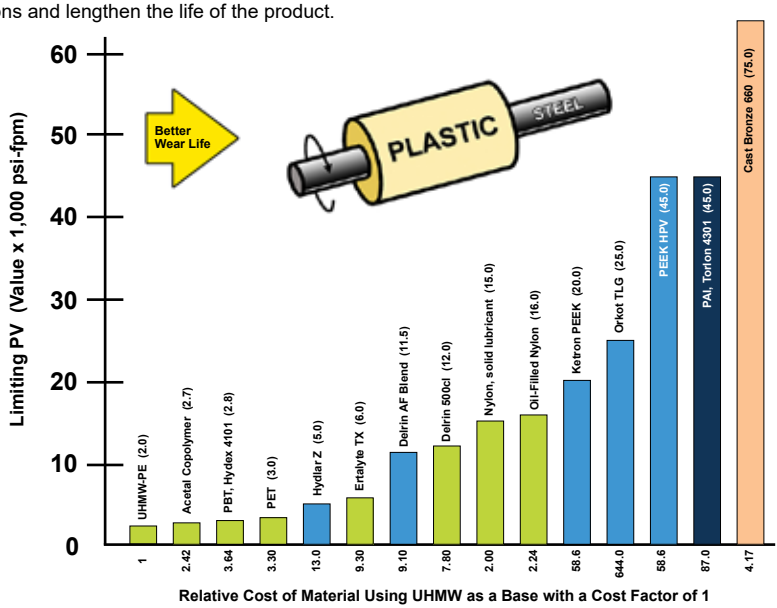
COMPARISON OF SLIDE WEAR AND RELATIVE COST

Slide Wear is the amount of material that is worn away in a controlled test. The lower the amount (or number) the longer the life of the product.



COMPARISON OF ROTATIONAL WEAR AND RELATIVE COST

Rotational Wear is measured as a Limiting PV value. The Limiting PV value is the amount of pressure and velocity a material can experience before melting. The higher the value the greater ability to withstand tougher conditions and lengthen the life of the product.

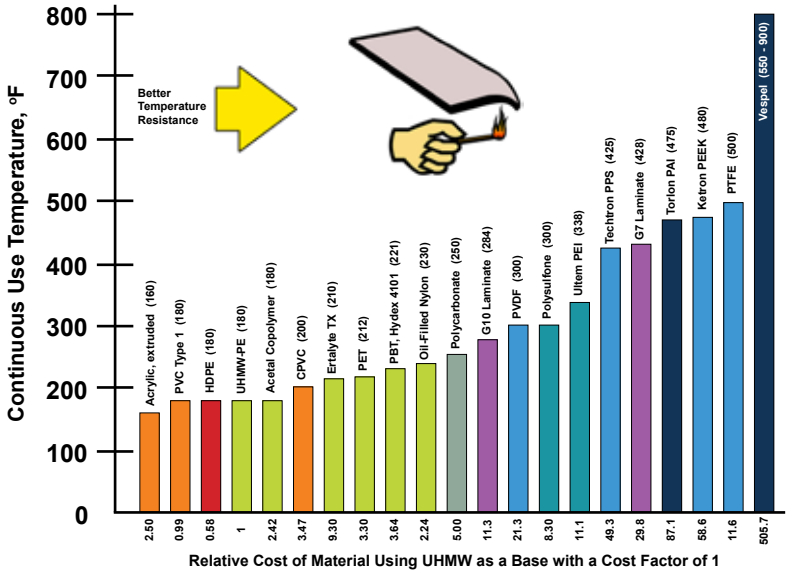


= Amorphous Commodity | = Semi-Crystalline Commodity | = Amorphous Engineering | = Semi-Crystalline Engineering
= Thermoset Plastic Material | = Amorphous High Performance | = Semi-Crystalline High Performance | = Imidized

Property Comparison Charts

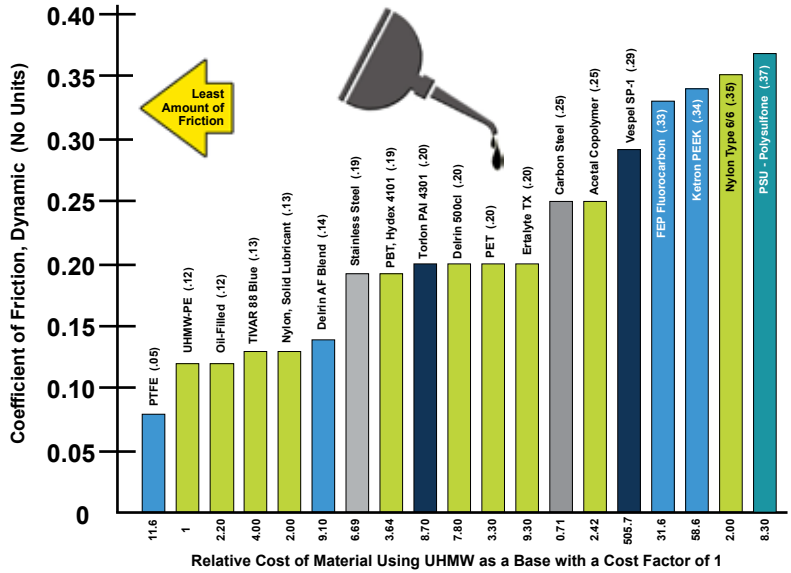
COMPARISON OF TEMPERATURE AND RELATIVE COST

Temperature (Continuous Use) gives an assesment of the maximum temperature at which a product can be considered for continuous use in a given application.



COMPARISON OF FRICTION AND RELATIVE COST

Friction is the resistance of motion on surfaces that touch. The lower the number in this chart, the easier the material will move.

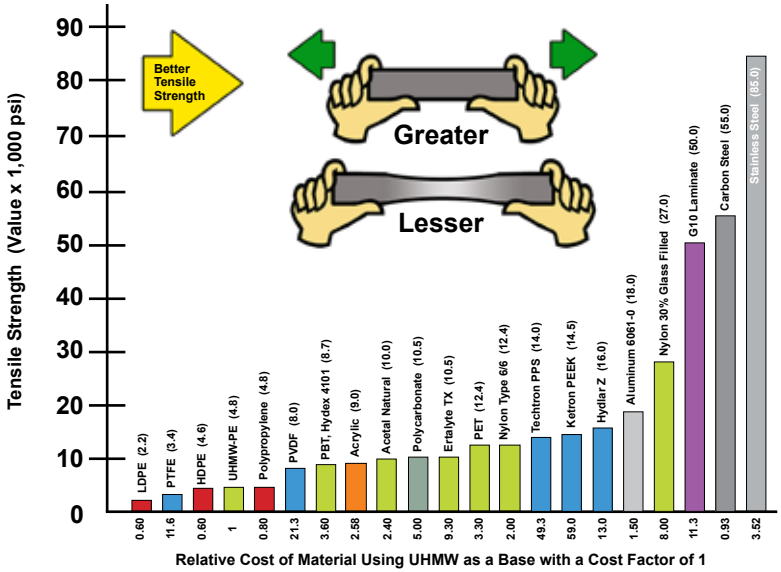


The suggestions and data in these charts are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use of our products are beyond our control. We recommend that the prospective user determine the suitability of materials and suggestions before adopting them on a commercial scale.

Property Comparison Charts

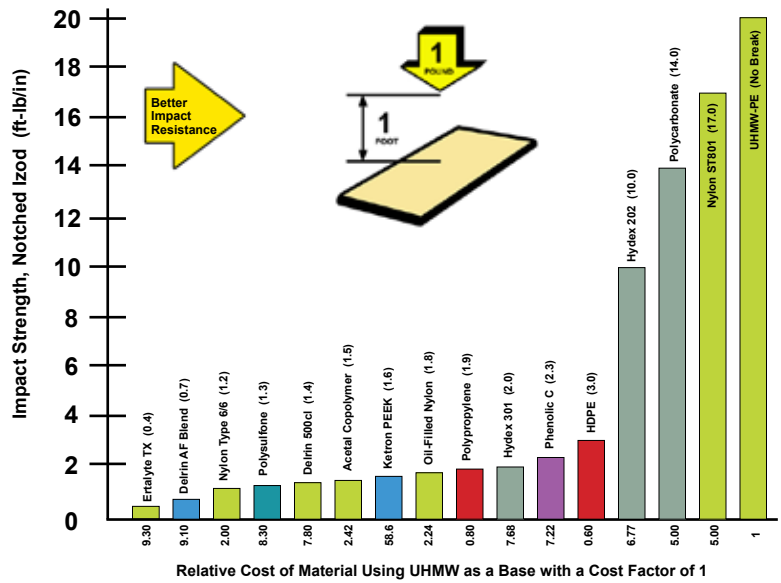
COMPARISON OF TENSILE STRENGTH AND RELATIVE COST

Tensile Strength is related to flexibility. The higher the number the stiffer the material becomes.



COMPARISON OF IMPACT RESISTANCE AND RELATIVE COST

Impact is the amount of force needed to break a material. The higher the number the better the impact resistance.

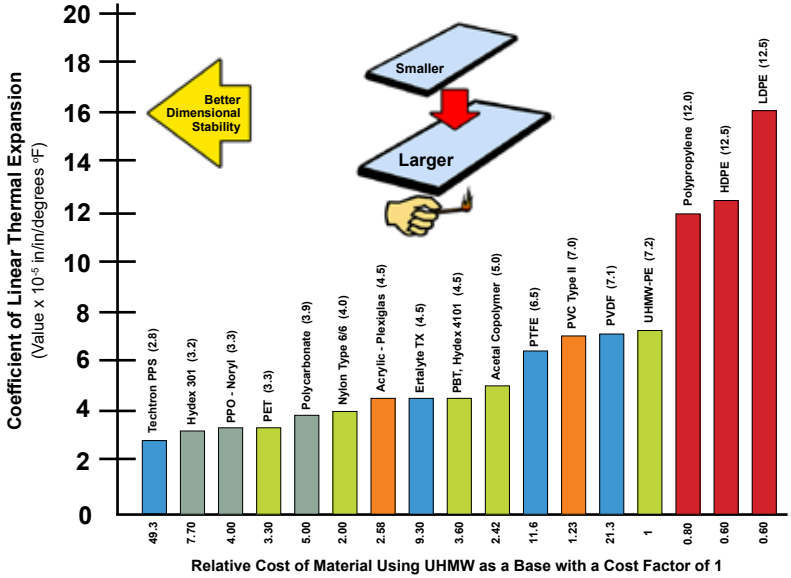


= Amorphous Commodity | = Semi-Crystalline Commodity | = Amorphous Engineering | = Semi-Crystalline Engineering
= Thermoset Plastic Material | = Amorphous High Performance | = Semi-Crystalline High Performance | = Imidized

Property Comparison Charts

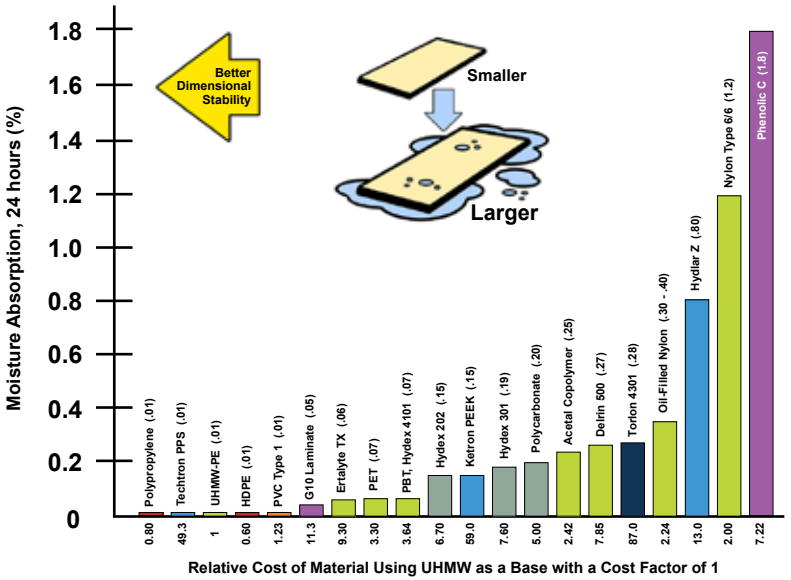
COMPARISON OF THERMAL DIMENSIONAL STABILITY AND RELATIVE COST

Thermal Dimensional Stability is related to the "consistency of size" (dimensions) of a part undergoing a change in temperature. The lower number represents material better thermal dimensional stability.



COMPARISON OF MOISTURE DIMENSIONAL STABILITY AND RELATIVE COST

Moisture Dimensional Stability is related to the "consistency of size" (dimensions) of a part in high moisture applications.The lower number represents better resistance to moisture.



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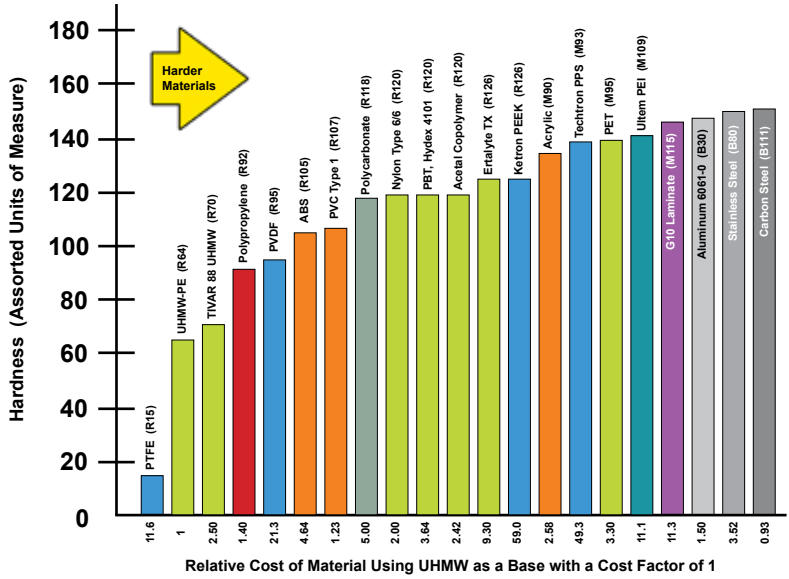
Property Comparison Charts

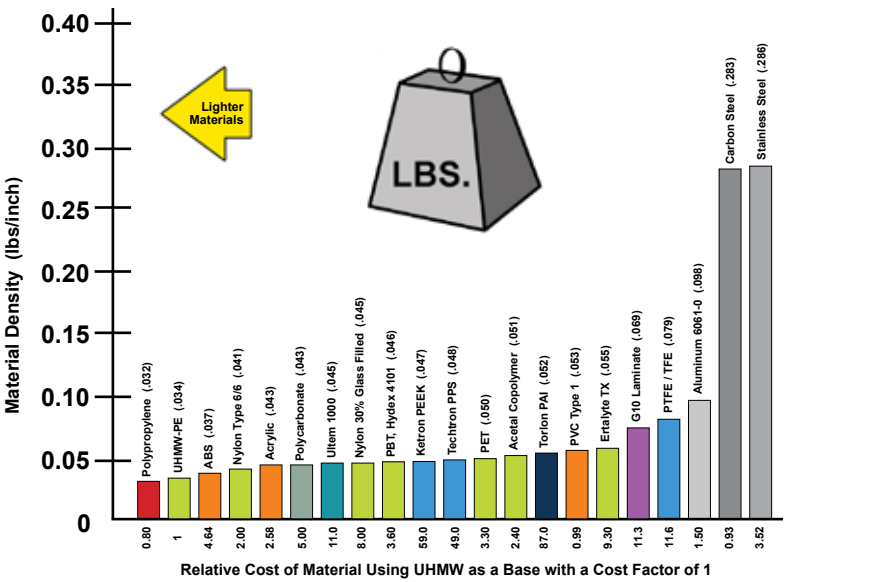
COMPARISON OF HARDNESS AND RELATIVE COST

The values to the right of the chart represent harder materials.



COMPARISON OF WEIGHT AND RELATIVE COST

Weight is measured as a ratio of density (mass/volume). The lower the number the lighter the material.



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= Imidized

Acetal

Acetal Copolymer and Homopolymer

Acetal Copolymer .....2-2 to 2-3

Acetron® GP .....2-4 to 2-5

Delrin® Acetal .....2-6 to 2-7

Compare: Acetals .....2-8 to 2-9

Acetal vs Delrin® 2-10

FDA Blue Acetal 2-11

Detectable Grade Acetal .....2-12 to 2-15

Medical Grade Acetal 2-16

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

Acetal Copolymer

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

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

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

Common Trade Names:

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

Typical Features:

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

Product Applications:

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

Acetal Copolymer

Product Availability

Acetal Copolymer Sheet / Slab

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

Acetal Copolymer Rod / Round

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

Longer and intermediate lengths available on request.

Acetal Copolymer

Acetron® GP - General Purpose

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

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

Typical Features:

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

Product Applications:

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

Engineering Note:

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

MITSUBISHI CHEMICAL GROUP

Acetal Copolymer

Acetron® GP Availability

Sheet / Slab / Plate

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

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

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

Rod / Round Bar

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

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

Acetal Homopolymer

Delrin® - DuPont Acetal

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

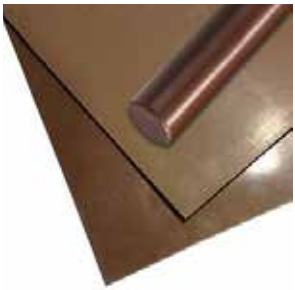
Typical Features:

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

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

Typical Features:

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



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

Typical Features:

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

Acetal Homopolymer

Delrin® Availability

Delrin® Sheet / Slab

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

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

Delrin® Rod / Round

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

Longer and intermediate lengths available by request.

Acetal Comparison

Typical Properties Various Acetals

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

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

Two page chart, continues on the next page

Acetal Comparison

Typical Properties Various Acetals

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

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

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

Two page chart, continued from previous page

Acetal Copolymer

Product Comparison: Acetal vs Delrin®

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

Acetal Copolymer (POM-C)

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

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

Acetal Homopolymer (POM-H)

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

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

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

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

Acetal, Food Grade

FDA Compliant Blue Acetal

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

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

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

Typical Features:

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

FDA Compliant Blue Acetal

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

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

Acetal, Detectables

Tecaform® UD Blue - Ultra Detectable Grade

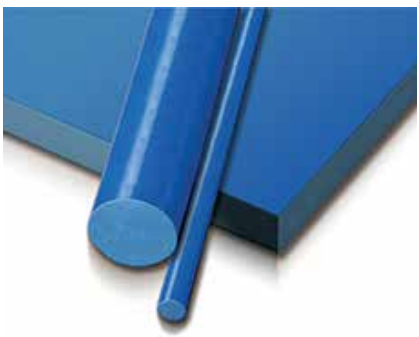
With new regulations in place, the FDA now mandates that all food processors have comprehensive preventive controls and safety programs in place. They have the complete authority to recall food due to contamination, and it is well known to food processors that a recall can kill a brand.

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

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

Typical Features:

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



Product Applications:

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

Ensinger

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

Acetal, Detectables

Sustarin® C MDT - Metal Detectable Grade

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

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

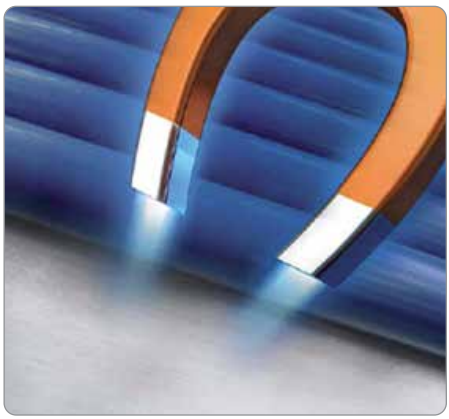
Sustarin® C MDT has special additives that allow it to be traced by standard metal detectors and removed before causing further contamination. Quality assurance engineers at some of the largest food processing manufacturers in the country have already tested this product and found it to be highly effective.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

Typical Features:

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

Product Applications:

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



RÖCHLING Engineered Plastics

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

Acetal, Detectables

Sustarin® C XDT - X-Ray Detectable

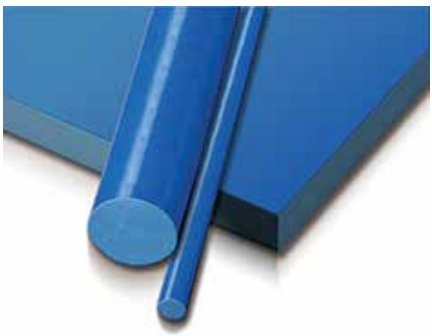
Röchling Engineering Plastics is the first manufacturer to offer extruded X-ray detectable Acetal Copolymer sheets and rods for machined parts and components in the food processing industry.

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

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

Typical Features:

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



Product Applications:

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

RÖCHLING Engineered Plastics

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

Acetal, Detectables

Acetron® VMX Food Grade

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

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

Typical Features:

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

MITSUBISHI CHEMICAL GROUP

Product Applications:

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

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

Acetal, Medical

Sustarin® C MG - Medical Grade

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

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

Typical Features:

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

Product Applications:

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

Material Certifications:

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

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

Nylon

Cast and Extruded Nylon Product Offerings

Cast Nylon .....3-2 to 3-3

Extruded Nylon .....3-4 to 3-5

Heat Stabilized Nylon .....3-6 to 3-7

Molybdenum Disulfide Nylon .....3-8 to 3-9

Oil-Filled Nylon .....3-10 to 3-11

Compare: Cast vs Extruded .....3-12 to 3-13

Nylatron® GSM & GS .....3-14 to 3-15

Nylatron® NSM 3-16

Nylatron® Grades 3-17

Compare: Nylatron® Grades .....3-18 to 3-19

Hydlar® Z 3-20

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

Nylon - Cast

Type 6 / PA 6 / Cast Nylon

Nylon is one of the most widely used and versatile thermoplastic resins. Its combination of physical properties and reasonable price make it a favorite choice for numerous applications. Nylons toughness, wear resistance, tensile strength and lubricity make it a good choice for many mechanical machine parts.

Nylon has a consistent history of replacing other materials including: metal, brass, bronze, aluminum and rubber. In replacing metal gears in machinery, Nylon can be advantageous because of its ability to reduce noise, use less lubrication and increase gear life. It can also be lighter weight as Nylon weighs 1/7 as much as Bronze. Nylon can also be fabricated on most mills with high precision.

Cast Nylon exhibits all the properties which generally make nylon a superior engineering material: high strength, low friction and wear resistance. However, because of the casting process, part size and thickness are almost unlimited without degradation of the materials internal structure. Cast Nylon meets FDA standards.

Common Trade Names:

- MC® 907 (MCG)
- Nycast® 6PA (Cast Nylons LTD)
- Nylatron® (MCG)
- Sustamid® G (Rochling Sustaplast)
- TECAST PA6 C (Ensinger)
- ZL® 1100 (ZL Engineering)

Typical Features:

- Broadest size range availability
- Good mechanical and electrical properties
- Ideal balance of strength and toughness
- Many grade options: FDA compliant, internally lubricated, heat stabilized
- Natural is FDA, USDA, NSF and 3A-Dairy compliant

Product Applications:

- Bushings and bearings
- Gears and sprockets
- Wear rails, pads and strips
- Sheaves and pulleys
- Feed screws
- Conveyor wheels and rollers

Engineering Note:

Nylons can absorb up to 7% (by weight) water under high humidity or submerged in water. This can result in dimensional changes up to 2% and a corresponding reduction of physical properties. Proper design techniques can frequently compensate for this factor.

Nylon - Cast

Type 6 / PA 6 / Cast Nylon

Cast Nylon Sheet / Plate

Standard Thickness (inches) :	1/4" up to 8" thick
Standard Sheet Size (inches) :	24 x 48 and 48 x 120
Standard Sheet Color :	Natural and Black

Cast Nylon Rod

Standard Diameter (inches) :	1" up to 25" diameter
Standard Rod Length (feet) :	5 ft, 4 ft, 2 ft and 1 ft Varies by rod diameter
Standard Rod Color :	Natural and Black

Cast Nylon Tubular Bar

Standard Outside Diameter :	2" up to 40" diameter
Standard Wall Thickness :	1/4" up to 4" thick
Standard Tube Length (inches) :	39", 26" and 13" Varies by tube diameter
Standard Tube Color :	Natural and Black

Please inquire about large diameter discs (12-1/2" up to 60" dia), rings (up to 60" diameter) and rectangular square bar (over 4" thick). Custom castings are available upon request. Minimums may apply and lead times to be determined at time of quote and or order.

Nylon - Extruded

Type 6/6 / PA 66 / Extruded Nylon

Nylon is one of the most widely used and versatile thermoplastic resins. Its combination of physical properties and reasonable price make it a favorite choice for numerous applications. Nylons toughness, wear resistance, tensile strength and lubricity make it a good choice for many mechanical machine parts.

Extruded nylon type 6/6 is characterized as having an excellent combination of physical properties including: a high melting point, resistant to repeated impact, low coefficient of friction and a resistance to abrasion. It has good resistance to fuels, lubricants and most chemicals, but is attacked by phenols, strong acids and oxidizing agents. It is also light in weight, Nylon is 1/7 the weight of Bronze.

Of all the unmodified nylons, Nylon type 6/6 is the strongest, most rigid and has one of the highest melting points. It is commonly specified for screw machined electrical insulators and food contact parts. It is stocked in both natural and black. Other colors are available on a custom basis. Nylon type 6/6 natural is FDA, USDA, NSF, and 3A-Dairy compliant.

Common Trade Names:

- Nylatron® (MCG)
- Nylon® 101 (MCG)
- Sustamid® 66 (Rochling Sustaplast)
- Tecamid® 6/6 (Ensinger)

Typical Features:

- Broadest size range availability
- Good mechanical and electrical properties
- Ideal balance of strength and toughness
- Many grade options: FDA compliant, internally lubricated, heat stabilized
- Natural is FDA, USDA, NSF and 3A-Dairy compliant

Product Applications:

- Bushings and bearings
- Gears and sprockets
- Wear rails, pads and strips
- Sheaves and pulleys
- Feed screws
- Conveyor wheels and rollers

Nylon - Extruded

Type 6/6 / PA 66 / Extruded Nylon

Extruded Nylon Sheet

Standard Thickness (inches) :	1/16" up to 4" thick
Standard Sheet Size (inches) :	24 x 48 24 x 144 (select sizes)
Standard Sheet Color :	Natural and Black

Extruded Nylon Rod

Standard Diameter (inches) :	1/16" up to 8" diameter
Standard Rod Length (feet) :	8 ft and 4 ft Varies by rod diameter
Standard Rod Color :	Natural and Black

Extruded Nylon Tube

Standard Outside Diameter :	1/2" up to 2" diameter
Standard Wall Thickness :	1/16" up to 1/4" thick
Standard Tube Length (feet) :	10 ft and 8 ft Varies by tube diameter
Standard Tube Color :	Natural and Black

Engineering Note:

Nylons can absorb up to 7% (by weight) water under high humidity or submerged in water. This can result in dimensional changes up to 2% and a corresponding reduction of physical properties. Proper design techniques can frequently compensate for this factor.

Nylon - Heat Stabilized

Type 6, Cast Nylon, Heat Stabilized Blue

A heat stabilized cast nylon offers long-term thermal stability up to 260°F. It is blue in color and used in a variety of bearing and structural applications such as wheels, gears and custom parts. The heat stabilizer retards the loss of physical properties as temperature increases. This allows the material to function at approximately 10% higher temperatures than standard grades; meaning that a heat stabilized nylon operating at 200°F (93°C) will have approximately the same physical properties as a standard material at 185°F (85°C). This material has delivered successful performance throughout the years.

Heat stabilized cast nylon exhibits all the properties which generally make nylon a superior engineering material: high strength, low friction and wear resistance. However, because of the casting process, part size and thickness are almost unlimited without degradation of the materials internal structure.

Common Trade Names:

- Nylatron® MC901 (MCG)
- Nycast® XHA Blue (Cast Nylons LTD)
- Sustamid® 6G HS (Rochling Sustaplast)

Typical Features:

- Can work at higher operation temperatures
- Retains physical properties under higher temps
- Excellent abrasion and wear resistance
- Good mechanical and electrical properties
- Ideal balance of strength and toughness
- Easy to machine
- Light weight

Product Applications:

- Bushings and bearings
- Gears and sprockets
- Wear rails, pads and strips
- Sheaves and pulleys
- Feed screws
- Conveyor wheels and rollers

Nylon - Heat Stabilized

Type 6, Cast Nylon, Heat Stabilized Blue

Heat Stabilized Nylon Sheet

Standard Thickness (inches) :	3/16" up to 4" thick
Standard Sheet Size (inches) :	24 x 48 (all thicknesses) 48 x 120 (select sizes)
Standard Sheet Color :	Blue (standard) Natural, Black & Forest Green (limited)

Heat Stabilized Nylon Rod

Standard Diameter (inches) :	2" up to 12" diameter
Standard Rod Length (feet) :	5 ft, 4 ft and 1 ft Varies by manufacturer
Standard Rod Color :	Blue

Heat Stabilized Nylon Tube

Standard Outside Diameter :	2" up to 18" diameter
Standard Wall Thickness :	Please inquire
Standard Tube Length (inches) :	78", 26" and 13" Varies by tube diameter
Standard Tube Color :	Blue

Nylon - Nycast® 6PA MoS2

Type 6, Cast Nylon, Molybdenum Disulfide

Nycast® 6PA MoS_2 is a nylon and molybdenum disulfide (MoS2) composition designed to improve the mechanical, thermal and bearing properties to type 6/6 Nylon while maintaining its basic electrical and chemical characteristics.

Through compounding, finely divided particles impart extra lubricity to this nylon, permitting Nylon MD parts to operate with little or no lubrication. This makes it especially suited to applications where external lubrication is impractical, contaminating or difficult to maintain. The added lubricity also contributes dramatically to component service life, making Nylon MD a very cost-efficient choice.

Nylon MD provides non-galling and non-scratching characteristics, sound dampening qualities, insulating properties, resistance to oils, greases, most alkalies, solvents, and organic acids.

Typical Features:

- Greater wear resistance
- Lower surface friction
- Higher strength and greater rigidity
- Improved dimensional stability

Product Applications:

- Bushings and bearings
- Gears and sprockets
- Wear surfaces
- Valve seats
- Thrust washers
- Wheels and rollers
- Forming dies
- Tooling fixtures
- Sleeves

Engineering Note:

Nylons can absorb up to 7% (by weight) water under high humidity or submerged in water. This can result in dimensional changes up to 2% and a corresponding reduction of physical properties. Proper design techniques can frequently compensate for this factor.

Nylon - Nycast® 6PA MoS2

Type 6, Cast Nylon, Molybdenum Disulfide

Nycast® 6PA MoS_2 Sheet

Standard Thickness (inches) :	1/16" up to 8" thick
Standard Sheet Size (inches) :	24" x 24" and 24" x 48"
Standard Sheet Color :	Dark Gray

Nycast® 6PA MoS_2 Rod

Standard Diameter (inches) :	3/16" up to 12" diameter
Standard Rod Length (feet) :	5 ft, 4 ft and 1 ft Varies by diameter
Standard Rod Color :	Dark Gray

Nycast® 6PA MoS_2 Tube

Standard Outside Diameter :	2" up to 40" diameter
Standard Wall Sections :	1/4" up to 4" thick
Standard Tube Length (inches) :	52", 26" and 13" Varies by tube diameter
Standard Tube Color :	Dark Gray

CAST NYLONS LIMITED

Nylon - Oil-Filled

Type 6, Cast Nylon, Green Oil-Filled - Nyloil®

A cast nylon with built-in oil lubrication, oil-filled cast nylon provides superior machinability, performance, and durability compared to other plastic and traditional bearing materials. Three grades of oil-filled nylon are available to fit the most demanding applications: original green oil-filled for most bearing applications; natural (white) food-grade, for direct contact with food; and MoS2 filled Gray oil-filled nylon with slightly higher compressive load capabilities than original oil-filled Nylon.

During the manufacturing process, an oil lubricant package is completely dispersed within the cast nylon matrix, making it an integral part of the casting structure. Although not evident by sight or touch, the oil lubricant in the nylon is always at the surface regardless of the amount of material removed during finish machining or normal wear.

Food Grade (FG/LFG) is a self lubricating nylon bearing material which meets the provisions of FDA Regulations 21 CFR, Section 177.15 (and others) and USDA 3A Sanitary Standards 20-17 for direct contact with food. This is a particularly useful material where additional lubrication is not desirable because of cleanability, contamination, or other considerations.

Common Trade Names:

- Nylatron® LIG (MCG)
- Nylatron® LFG (MCG)
- Nyloil® (Cast Nylons LTD)
- Nyloil® FG/MDX (Cast Nylons LTD)
- Sustamid® 6G OL (Rochling Sustaplast)
- ZL® 1100 Oil (ZL Engineering)

Typical Features:

- Lubrication results in 25% lower coefficient of friction than other grades of nylon
- Performs in harsh environments where lubrication is difficult, impossible, or un-desirable
- Operates efficiently in direct contact with abrasive slurries
- Works successfully in marine applications
- Reduced water absorption promotes higher dimensional stability
- Works and machines as easily as brass
- Oil will not spin out, dry out, or drain out, even under the harshest operating conditions
- Nylon weighs only 1/7 the weight of Bronze

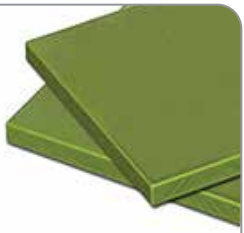
Product Applications:

- Gears and sprockets
- Bushings and bearings
- Wear rails, pads and strips
- Sheaves and pulleys
- Conveyor wheels and rollers
- Feed screws
- Star wheels

Nylon - Oil-Filled

Type 6, Cast Nylon, Green Oil-Filled - Nyloil®

Oil-Filled Nylon Sheet / Plate



Standard Thickness (inches) :	1/4" up to 4" thick
Standard Sheet Size (inches) :	24 x 48 and 48 x 120
Standard Sheet Color :	Green (standard grade) White (food grade) Gray (MoS2 filled)

Oil-Filled Nylon Rod

Standard Diameter (inches) :	1" up to 12" diameter
Standard Rod Length (feet) :	5 ft and 4 ft Varies by rod diameter
Standard Rod Color :	Green (standard grade) White (food grade) Gray (MoS2 filled)

Oil-Filled Nylon Tubular Bar

Standard Outside Diameter :	2" up to 40" diameter
Standard Wall Sections :	1/4" up to 4" thick
Standard Tube Length (inches) :	26" and 13" Varies by tube diameter
Standard Tube Color :	Green (standard grade) White (food grade) Gray (MoS2 filled)

Please inquire about large diameter discs (12-1/2" up to 60" dia), rings (up to 60" diameter) and rectangular square bar (over 4" thick). Custom castings are available upon request. Minimums may apply and lead times to be determined at time of quote and or order.

Nylon - Cast & Extruded

Typical Properties Comparison Chart

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Specific Gravity	D792	g/cc
Water Absorption, Immersion, 24 hours	D570(2)	%
Water Absorption, Immersion, at Saturation	D570(2)	%
MECHANICAL PROPERTIES		
Hardness Rockwell R (Shore D)	D785 (D2240)	---
Tensile Strength	D638	psi
Tensile Strength at 65°C (150°F)	D638	psi
Elongation at Break	D638	%
Tensile Modulus	D638	psi
Flexural Strength	D790	psi
Flexural Modulus	D790	psi
Compressive Strength, 10% Deformation	D695	psi
Compressive Modulus	D695	psi
Shear Strength	D732	psi
Izod Impact (Notched)	D256 Type A	ft.-lb./in.
Coefficient of Friction, Dynamic (Dry vs. Steel)	QTM 55007	---
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min./ft.-lb.-hr.
Limiting PV (with 4:1 safety factor applied)	QTM 55007	psi-ft./min.
ELECTRICAL PROPERTIES		
Surface Resistivity per Square	EOS/ESD S11.11	ohm
Dielectric Strength (Short Term)	ASTM D149	kV/in.
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831	µin./in.-°F
Thermal Conductivity	F433	BTU-in./hr.-ft^2-°F
Melting Point (Crystalline, Peak)	D3418	°F
Maximum Service Temp., Air (Long Term)	---	°F
Deflection Temp at 1.8 MPa (264 psi)	D648	°F
Flammability, UL94 (1/8", est. rating)	---	---
COMPLIANCE PROPERTIES		
3A-Dairy	---	---
Canada AG	---	---
FDA	---	---
NSF	---	---
USDA	---	---
USP Class VI	---	---

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

Nylon - Cast & Extruded

Typical Properties Comparison Chart (continued)

MC 907 PA6 (Cast Nylon)	NYLON 101 (Extruded)	NYCAST® MoS_2 (Molybdenum Disulfide)	NYLOIL® (Oil-Filled Nylon)	NYLATRON® LIG (Oil-Filled Nylon)
1.15	1.15	1.15 - 1.17	1.14 - 1.15	1.14
0.60	0.30	0.50 - 0.60	0.40 - 0.60	0.30
7.0	7.0	5.0 - 6.0	4.0 - 5.0	6.0
115 (85)	115 (80)	115-125 (78-83)	110-115 (74-80)	120 (---)
12,000	12,000	10,000-13,500	9,500-11,000	9,900
6,000	6,000	---	---	6,000
20%	50%	20 - 55%	35 - 55%	50%
400,000	425,000	---	375,000-475,000	465,000
16,000	15,000	15,500-17,500	14,000-16,000	15,000
500,000	450,000	420,000-500,000	375,000-475,000	525,000
15,000	12,500	13,500-16,000	13,500-15,000	13,500
400,000	420,000	325,000-400,000	325,000-375,000	330,000
11,000	10,000	10,000-11,000	8,000-9,000	9,300
0.400	0.600	0.70 - 0.90	1.40 - 1.80	1.00
0.20	0.25	0.22	0.12	0.14
100.0×10^{-10}	80.0×10^{-10}	---	---	72.0×10^{-10}
3,000	2,700	---	---	6,000
>= 1.00e + 13	>= 1.00e + 13	---	---	>= 1.00e + 13
500	400	500 - 600	500 - 600	---
50.0	55.0	---	50.0	56.0
1.70	1.70	---	---	---
420°	500°	450°	430°	420°
200°	210°	230°	230°	220°
200°	200°	200° -400°	200° -300°	200°
HB	V-2	---	---	HB
Yes	**Yes**	No	No	No
No	No	No	No	No
Yes	**Yes**	No	No	No
No	**Yes**	No	No	No
Yes	**Yes**	No	No	No
No	No	No	No	No

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

Nylon - Nylatron® GSM /GS

Cast & Extruded Nylon, Molybdenum Sulfide

Nylatron® is a registered trade name of the Mitsubishi Chemical Group. The Nylatron® product line features a variety of materials designed to excel in specific applications. Please read below on each specific Nylatron® product for more information.

Nylatron® GS Nylon (Extruded)

Molybdenum disulphide (MoS^2) filled extruded nylon offering improved strength and rigidity. With a lower coefficient of linear thermal expansion than Nylon 101, Nylatron® GS parts maintain better fit and clearances, and have less tendency to seize as bearings.

Nylatron® GSM Nylon (Cast)

Nylatron® GSM cast nylon contains finely divided particles of molybdenum disulphide (MoS^2) to enhance its load bearing capabilities while maintaining the impact resistance inherent to nylon. It is the most commonly used grade for gears, sheaves, sprockets and custom parts. It is grey-black in color.

Nylatron® GSM Blue Nylon

The first cast nylon to combine both molybdenum disulphid (MoS^2) and oil for the load capacity of Nylatron® GSM nylon, plus improved frictional characteristics. It excels in higher pressures, and at low speeds-up to 40 fpm. It offers 20% lower coefficient of friction, 50% greater limiting PV, and a lower “k” factor than Nylatron® GSM, and the lowest “slip-stick” of any nylon product making it ideal for slide pads, thrust washers and trunion bearings.

Typical Features:

- Broadest size range availability
- Good mechanical and electrical properties
- Ideal balance of strength and toughness
- Improved load bearing properties
- Cast as finished parts or near net shapes (GSM)

Product Applications:

- Gears, sprockets and starwheels
- Bushings and bearings
- Wear pads, rails and strips
- Pulleys, sheaves and guides
- Conveyor wheels
- Rollers and sleeves
- Supports and rubbing blocks
- Valve seats and seals

Nylon - Nylatron® GSM /GS

Cast & Extruded Nylon, Molybdenum Sulfide

Nylatron® GS Sheet

Standard Thickness (inches) :	1/16" up to 2" thick
Standard Sheet Size (inches) :	24" x 48" 24" x 144" (1/4" & 3/8" only)
Standard Color :	Dark Gray (Marbled)

Nylatron® GSM Sheet

Standard Thickness (inches) :	3/16" up to 4" thick
Standard Sheet Size (inches) :	24" x 48" 48" x 120" (limited)
Standard Color :	Dark Gray

Nylatron® GS Rod

Standard Diameter (inches) :	3/16" up to 2" dia.
Standard Rod Length (feet) :	8 feet (96") long
Standard Color :	Dark Gray (Marbled)

Nylatron® GSM Rod

Standard Diameter (inches) :	2" up to 12" dia.
Standard Rod Length (feet) :	5 feet (2" to 4" dia) 4 feet (4.25" to 6" dia) 1 foot (6.25" dia and up)
Standard Color :	Dark Gray

Nylon - Nylatron® NSM

Premium Bearing & Wear Grade, Cast Nylon

Nylatron® NSM is the premium bearing and wear nylon product available today. Solid lubricant additives impart self-lubricating, high pressure/velocity and superior wear resistance characteristics. This wear resistance is delivered without either start-up or running lubrication making it ideal for bearings, gears and wear pads. It is a proprietary type 6 nylon formulation produced using MCG's Monocast process. Nylatron® NSM was developed specifically for demanding applications where larger size parts are required. In wear applications, Nylatron® NSM lasts up to 10 times longer than standard Type 6 nylon.

Developed specifically for demanding applications, Nylatron® NSM outperforms all other "premium" wear grade materials by far. Ideal for bearings and wear pads, Nylatron® NSM offers advantages beyond superior wear resistance at an affordable price. It provides weight and noise reduction, corrosion resistance, and easy machining. With less downtime and reduced maintenance, save time and money by realizing the increased performance and productivity of this self-lubricating nylon.

Typical Features:

- High mechanical strength, stiffness, hardness and toughness
- High mechanical dampening ability
- Excellent wear resistance
- Good sliding properties
- Good electrical insulating properties
- Good resistance to high energy radiation (gamma/x-rays)
- Good fatigue resistance
- Good machinability

Product Applications:

- Bushings and bearings
- Rollers and sleeves
- Conveyor and star wheels
- Wear components
- Gears

Nylatron® NSM

Standard Thickness (inches) :	**3/16" up to 4" thick**
Standard Sheet Size (inches) :	**24" x 48"** **48" x 120" (1/2" only)**
Standard Diameter (inches) :	**2" up to 12" diameter**
Standard Rod Length (inches) :	**2" up to 6" dia ..... 48" long** **7" dia and above ..... 12" long**
Standard Color :	**Dark Gray**

Nylon - Nylatron® Grades

Specialty Grades of Nylatron®

Nylatron® is a registered trade name of Mitsubishi Chemical Group (MCG). The Nylatron® product line features a variety of materials designed to excel in specific applications. Please read below on each specific Nylatron® product for more information.

Nylatron® GF30 PA66 (Glass Reinforced)

For applications requiring higher compressive strength and rigidity, 30% glass reinforced Nylon 6/6 is also available. It is stocked in diameters ranging from 10mm to 150mm (or .394" to 5.910" in meter lengths). Only available in black color.

Nylatron® LFG PA6 (FDA Compliant)

Nylatron® LFG takes the performance of Nylatron® LIG and adds FDA compliance for applications where food contact is possible. Food packaging and processing equipment users can now benefit from the benefits of this material.

Nylatron® LIG PA6 (Oil-Filled)

Nylatron® LIG combines the toughness of cast PA6 with an oil-based lubricant that is encapsulated within the nylon matrix. It increases the load bearing performance of the material when compared to unfilled nylons and reduces the coefficient of friction. It is an ideal material for industrial applications.

Nylatron® MC901 PA6 (Heat Stabilized)

Heat stabilized nylon offering long-term thermal stability to 260°F. It is blue in color and used in a variety of bearing and structural applications such as wheels, gears, and custom parts.

Nylatron® MD (Metal Detectable)

Nylatron® MD is a metal detectable grade of nylon offering improved strength and rigidity. With a lower coefficient of linear thermal expansion than Nylon 101, Nylatron® MD parts maintain better fit and clearances, and have less tendency to seize as bearings.

Nylatron® WP PA6 (Wear Pad)

Developed specifically for wear pads, Nylatron® WP outperforms its competition across a wide range of applications and in multiple industries. Nylatron® WP offers an economical solution to provide superior performance, weight and noise reduction, corrosion resistance, and easy machining.

Nylatron® 4.6 PA46

Offers superior heat aging and creep resistance and retention of stiffness up to 300°F. It is reddish brown in color and used where PA 6, PA 66, POM and PET fall short.

Nylatron® 703XL PA6 (Ultra-High Performance)

This ultra-high performance bearing grade of PA6 provides wear resistance near the levels of Nylatron NSM PA6 with superior load bearing capability and an industry first - a near zero level of "stick-slip."

MITSUBISHI CHEMICAL GROUP

Nylatron® Grades

Typical Properties Comparison Nylatron® Grades

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Specific Gravity	D792	g/cc
Water Absorption, Immersion, 24 hours	D570(2)	%
Water Absorption, Immersion, at Saturation	D570(2)	%
MECHANICAL PROPERTIES		
Hardness Rockwell R (Shore D)	D785 (D2240)	---
Tensile Strength	D638	psi
Tensile Strength at 65°C (150°F)	D638	psi
Elongation at Break	D638	%
Tensile Modulus	D638	psi
Flexural Strength	D790	psi
Flexural Modulus	D790	psi
Compressive Strength, 10% Deformation	D695	psi
Compressive Modulus	D695	psi
Shear Strength	D732	psi
Izod Impact (Notched)	D256 Type A	ft.-lb./in.
Coefficient of Friction, Dynamic (Dry vs. Steel)	QTM 55007	---
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min./ft.-lb.-hr.
Limiting PV (with 4:1 safety factor applied)	QTM 55007	psi-ft./min.
ELECTRICAL PROPERTIES		
Surface Resistivity per Square	EOS/ESD S11.11	ohm
Dielectric Strength (Short Term)	ASTM D149	kV/in.
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831	µin./in.-°F
Thermal Conductivity	F433	BTU-in./hr.-ft^2-°F
Melting Point (Crystalline, Peak)	D3418	°F
Maximum Service Temp., Air (Long Term)	---	°F
Deflection Temp at 1.8 MPa (264 psi)	D648	°F
Flammability, UL94 (1/8", est. rating)	---	---
COMPLIANCE PROPERTIES		
3A-Dairy	---	---
Canada AG	---	---
FDA	---	---
NSF	---	---
USDA	---	---
USP Class VI	---	---

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

Nylatron® Grades

Typical Properties Comparison Nylatron® Grades

NYLATRON® GS (Extruded)	NYLATRON® GSM (Cast)	NYLATRON® LFG (FDA Compliant)	NYLATRON® LIG (Oil-Filled)	NYLATRON® NSM (Premium Grade)
1.16	1.16	1.14	1.14	1.15
0.30	0.60	0.30	0.30	0.30
7.0	7.0	6.0	6.0	7.0
115 (85)	110 (80)	120 (---)	120 (---)	110 (85)
12,500	11,000	9,900	9,900	11,000
6,000	6,000	6,000	6,000	6,000
25%	30%	50%	50%	20%
480,000	400,000	465,000	465,000	410,000
17,000	16,000	15,000	15,000	16,000
460,000	500,000	525,000	525,000	475,000
16,000	14,000	13,500	13,500	14,000
420,000	400,000	330,000	330,000	400,000
10,500	10,500	9,300	9,300	10,000
0.500	0.500	1.00	1.00	0.500
0.20	0.20	0.14	0.14	0.18
90.0×10^{-10}	90.0×10^{-10}	72.0×10^{-10}	72.0×10^{-10}	12.0×10^{-10}
3,000	3,000	6,000	6,000	**15,000**
>= 1.00e + 13	>= 1.00e + 13	>= 1.00e + 13	>= 1.00e + 13	>= 1.00e + 13
350	400	---	---	400
40.0	50.0	56.0	56.0	55.0
1.70	---	---	---	---
500°	420°	420°	420°	420°
220°	200°	220°	220°	200°
200°	200°	200°	200°	200°
V-2	HB	HB	HB	HB
No	No	**Yes**	No	No
No	No	No	No	No
No	No	**Yes**	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No

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

Hydlar® Z

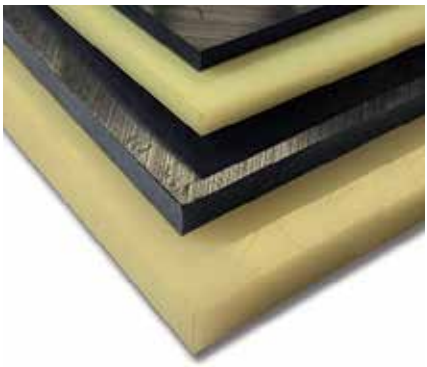
Kevlar® reinforced Nylon 6/6

Hydlar® Z is a Kevlar® fiber reinforced Nylon 6/6. With the addition of Kevlar®, Hydlar® Z's properties improve, better dimensional stability is achieved and wear resistance is increased ten times that of unfilled nylon. Hydlar® possesses a combination of physical properties that cannot be found in any other commercially available engineered plastic.

Hydlar® is applicable to a wide variety of industrial applications where high strength, extreme wear resistance and low abrasiveness are required. Typical applications would be wear strips, bearings, bushings, rollers, gears and wherever wear and abrasion resistant materials are required.

Typical Features:

- Extremely wear resistant
- Superior abrasion resistance
- Outstanding machinability
- Good dimensional stability
- No galling or mating wear surfaces



Product Applications:

- Bushings
- Bearings
- Gears
- Rollers
- Wear strips

Hydlar® Z	
Standard Thickness (inches) :	**1/4" to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**12" x 12", 12" x 24", 12" x 48" and 24" x 48"**
Standard Diameter (inches) :	**1/4" to 6" dia. (standard increments)**
Standard Rod Length (inches) :	**60" or 120" (may vary by diameter)**
Hydlar Z Color :	**Yellow-Brown**

Polyolefin

Polyethylene, Polypropylene & more

Polyethylenes 4-2

Low Density Polyethylene 4-3

Compare: Polyethylenes ..... 4-4 to 4-5

High Density Polyethylene ..... 4-6 to 4-7

King ColorBoard® ..... 4-8 to 4-9

King ColorCore® ..... 4-10 to 4-11

Densetec® Grades ..... 4-12 to 4-13

Cutting Board ..... 4-14 to 4-21

King StarBoard® ..... 4-22 to 4-31

King Hy-Pact® ..... 4-32 to 4-33

UHMW Polyethylene ..... 4-34 to 4-37

TIVAR® UHMW ..... 4-38 to 4-47

Polystone® UHMW ..... 4-48 to 4-49

Polyslick Rocket Plate ..... 4-50 to 4-51

Polypropylene ..... 4-52 to 4-53

Polystone® P CubX® ..... 4-54 to 4-55

Foamlite® P ..... 4-56 to 4-57

LubX® C & CV ..... 4-58 to 4-59

EZ-Pro Durawood ..... 4-60 to 4-61

Densetec® HMW 4-62

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

Polyethylene

Common Grades of Polyethyelene

Polyethylene is a thermoplastic polymer with variable crystalline structure and an extremely large range of applications depending on the particular type. It is one of the most widely produced plastics in the world (tens of millions of tons are produced worldwide each year). Thermoplastic materials become liquid at their melting point (110°-130° degrees Celsius in the case of LDPE and HDPE respectively). A major useful attribute about thermoplastics is that they can be heated to their melting point, cooled, and reheated again without significant degradation. Instead of burning, thermoplastics like Polyethylene liquefy, which allows them to be easily injection molded and then subsequently recycled.

There are a vast array of applications for polyethylene in which certain types are more or less well suited. Generally speaking, High Density Polyethylene (HDPE) is much more crystalline, has a much higher density, and is often used in completely different circumstances than Low Density Polyethylene (LDPE). For example, LDPE is widely used in plastic packaging such as for grocery bags or plastic wrap. HDPE by contrast has common applications in construction (for example in its use as a drain pipe). Ultra High Molecular Weight Polyethylene (UHMW) has high performance applications in things such as chain guides, sprockets and tensioners.

Polyethylene Grades:

- **LDPE** - Low Density Polyethylene
- **HDPE** - High Density Polyethylene
- **VHMW-PE** - Very High Molecular Weight Polyethylene
- **UHMW-PE** - Ultra High Molecular Weight Polyethylene

LDPE

Low Density Polyethylene

LDPE is a corrosion resistant, extruded material that sustains low moisture permeability. It also has a relatively low working temperature, soft surface and low tensile strength. LDPE is more flexible than HDPE, which makes it a good choice for prosthetic devices, most of which are either drape formed or vacuum formed.

Its impact resistance makes it a natural choice for impact pads, while its easy machinability makes it a good choice for fabricated parts where chemical and corrosion resistance is demanded.

Typical Features:

- Meets food handling guidelines
- Good impact resistance
- Chemical and corrosion resistant
- Thermoforming performance
- No moisture absorption
- Extremely flexible
- Lightweight

Product Applications:

- Orthotic & prosthetic devices
- Thermoformed pads
- Impact pads
- Die pads
- Hinges

LDPE - Low Density

Standard Thickness (inches) :	**1/16" up to 1" thick**
Standard Sheet Size (inches) :	**48" x 96"**
Standard LDPE Color(s):	**Natural (White)**

Polyethylene

Typical Properties Comparison Chart

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Specific Gravity	D792	g/cc
Water Absorption, immersion, 24 hrs	D570(2)	%
Water Absorption, immersion	D570(2)	%
MECHANICAL PROPERTIES		
Hardness, Durometer, Shore D	D2240	---
Tensile Strength	D638	psi
Tensile Strength @ 65°C (150°F)	D638	psi
Elongation at Break	D638	%
Tensile Modulus	D638	psi
Flexural Strength	D790	psi
Flexural Modulus	D790	psi
Compressive Strength	D695	psi
Compressive Modulus	D695	psi
Shear Strength	D732	psi
Izod Impact, Notched .125"	D256, "A"	ft.•lb./in.
Coefficient of Friction, Dynamic	QTM55007	Dry vs Steel
Sand Slurry (1018 Steel = 100)	---	---
Limiting Pressure Velocity	QTM55007	psi-ft/min
ELECTRICAL PROPERTIES		
Surface Resistivity per Square	D257	ohm
Dielectric Constant	D150	@Freq 1e+6 Hz
Dielectric Strength (short term)	D149	kV/in.
Dissipation Factor	D150	@Freq 1e+6 Hz
THERMAL PROPERTIES		
CTE, Linear	E831	µ in/in-°F
Thermal Conductivity	---	BTU-in./hr.•ft²-°F
Melting Point, crystalline, peak	D3418	°F
Maximum Service Temp., Air	---	°F
Deflection Temp at 1.8 MPa (264 psi)	D648	°F
Flammability	UL 94	---
COMPLIANCE PROPERTIES		
3A-Dairy	---	---
Canada AG	---	---
FDA	---	---
NSF	---	---
USDA	---	---
USP Class VI	---	---

Polyethylene

Typical Properties Comparison Chart

LDPE (Natural)	HDPE (Natural)	VHMW-PE (White)	UHMW-PE (Natural)
0.920	0.960	0.950	0.930
<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%
<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%
45	70	65	66
1,400	4,600	> 4,100	5,800
400	400	---	400
100%	400%	260%	300%
57,000	200,000	---	80,000
1,500	4,500	---	3,500
29,000	174,000	186,000	87,000
1,400	4,600	3,000	3,000
54,000	100,000	80,000	80,000
---	4,800	4,800	4,800
No Break	1.30	4.07	No Break
---	0.20	0.12	0.12
---	110	40	10
---	---	---	3,000
>=1.00e +15	>=1.00e +15	>=1.00e +15	>=1.00e +15
---	---	2.30	2.30
---	---	2,300	2,300
---	---	0.00050	0.00050
---	61.0	---	110
---	---	---	2.84
244°	260°	---	275°
160°	180°	---	180°
116°	176°	---	116°
HB	HB	HB	HB
No	No	No	**Yes**
No	No	No	**Yes**
Yes	**Yes**	**Yes**	**Yes**
No	No	No	No
Yes	**Yes**	**Yes**	**Yes**
No	No	No	No

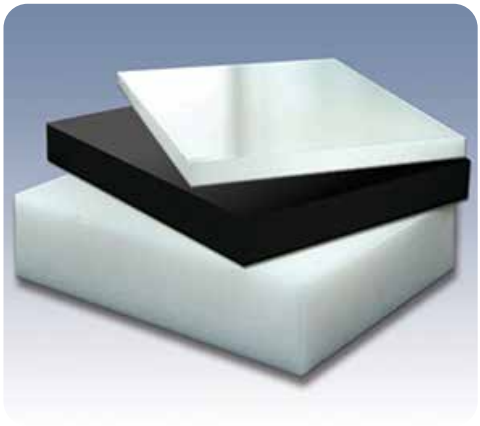
HDPE

High Density Polyethylene

High Density Polyethylene (HDPE) has excellent tensile strength, energy absorption, abrasion resistance and resistance to stress cracks. HDPE has little branching, giving it stronger intermolecular forces and tensile strength than lower-density polyethylene. The difference in strength exceeds the difference in density, giving HDPE a higher specific strength. It is also harder and more opaque and can withstand somewhat higher temperatures (120 °C/ 248 °F for short periods, 110 °C /230 °F continuously). High-density polyethylene, unlike polypropylene, cannot withstand normally-required autoclaving conditions.

Typical Features:

- Meets FDA/USDA food handling guidelines (Natural)
- Chemical- and corrosion-resistant
- No moisture absorption
- Excellent tensile strength
- Lightweight and non-toxic
- Thermoforming performance
- Excellent machinability



Product Applications:

- Light duty chain guides
- Orthotic and prosthetic devices
- Secondary containment
- Tanks
- Thermoformed material handling devices
- Water storage

HDPE - High Density

Standard Thickness (inches) :	**1/16" up to 5" thick**
Standard Sheet Size (inches) :	**48 x 96 48 x 120 48 x 144 60 x 120 (Natural)** **48 x 96 48 x 120 (Black)**
Standard Diameter (inches) :	**1/4" up to 14" diameter**
Standard Rod Length (inches) :	**120" (10 foot) long**
Standard Colors :	**Natural (White) and Black** **Custom colors available by request**

HDPE

High Density Polyethylene Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	NATURAL	BLACK
PHYSICAL PROPERTIES				
Specific Gravity	D792	g/cc	0.960	0.960
Water Absorption, 24 hrs	D570(2)	%	<= 0.010%	<= 0.010%
Water Absorption, Saturation	D570(2)	%	<= 0.010%	<= 0.010%
MECHANICAL PROPERTIES				
Hardness, Shore D	D2240	---	70	70
Tensile Strength	D638	psi	4,600	4,600
Tensile Strength at 150°F	D638	psi	400	400
Elongation at Break	D638	%	400%	300%
Tensile Modulus	D638	psi	200,000	210,000
Flexural Strength	D790	psi	4,600	4,600
Flexural Modulus	D790	psi	174,000	202,000
Compressive Strength, 10% Def.	D695	psi	4,600	4,600
Compressive Modulus	D695	psi	100,000	100,000
Izod Impact Strength (Notched)	D256 "A"	ft-lb/in	1.30	1.30
Coefficient of Friction, Dynamic	QTM55007	---	0.20	0.20
ELECTRICAL PROPERTIES				
Surface Resistivity per Square	D257	ohm	>= 1.00e +15	>= 1.00e +15
THERMAL PROPERTIES				
CTE, Linear	E831	µin/in-°F	61.0	61.0
Melting Point, Crystalline, peak	D3418	°F	260°	260°
Maximum Service Temp, Air	Long Term	°F	180°	180°
Deflection Temp at 1.8 MPa (264 psi)	D648	°F	176°	176°
Flammability, 1/8" (est. rating)	UL 94	---	HB	HB
COMPLIANCE PROPERTIES				
3-A Dairy	---	---	No	No
Canada AG	---	---	No	No
FDA	---	---	**Yes**	No
NSF	---	---	No	No
USDA	---	---	**Yes**	No
USP Class VI	---	---	No	No

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

HDPE

King ColorBoard®

King ColorBoard® is a high density polyethylene sheet that is environmentally stabilized for outdoor use. It's bright, primary colors make it ideal for sign, industrial, marine, playground and recreational applications. For maximum versatility, standard colors are made to coordinate with King ColorCore®. King ColorBoard® features an attractive matte finish and is manufactured to the highest standards in the industry. Base material is FDA approved as are most pigments.

It is made with impact resistant high density polyethylene to handle more abuse than conventional sign and playground materials. ColorBoard® is environmentally stablized and will never fade or discolor in direct sunlight. And you never have to worry about delamination, rotting or warping with King ColorBoard®.

King ColorBoard® is now available with our exclusive antimicrobial additive King MicroShield®. The latest technology for protecting the product surface against a broad spectrum of damaging bacteria, algae, and fungi by reducing the amount of microbes by 99.99%.

Typical Features:

- Environmentally stabilized for harsh sun & outdoor applications
- Will not rot, swell, splinter or delaminate when exposed to water
- Durable matte-textured surface on both sides
- Extremely flat and consistent sheets
- Easy to fabricate with standard woodworking tools

Product Applications:

- Children's furniture
- Hospitals
- Museums
- Parks and recreation
- School equipment
- Theme parks

King ColorBoard®

Standard Thickness (inches) :	**1/4" 1/2" 3/4"**
Standard Sheet Size (inches) :	**48 x 96**
Standard Colors :	**Tan, Blue, Green, Red, Orange and Yellow**

HDPE

King ColorBoard® - Typical Properties

PROPERTY TESTED	ASTM	UNITS	COLORBOARD
PHYSICAL PROPERTIES			
Density	D1505	g/cc	0.955
Tensile Strength at Yield	D638	psi	> 4,100
Tensile Modulus	D638	psi	255,000
Elongation at Yield	D638	%	9.80
Elongation at Break	D638	%	> 600
Flexural Modulus	D790	psi	185,000
Flexural Stress at 5% Strain	D790	psi	3,810
Compressive Properties 10% Strain	D695	psi	4,950
Hardness, Durometer	D2240	Shore D	68
Tensile Impact	D1822	ft-lbs/in^2	115
Izod Impact Resistance	D256	ft-lbs/in^2	1.10
Brittleness Temperature	D746	°C (°F)	<-76°C (<-105°F)
Vicat Softening Temperature	D1525	°C (°F)	123°C (253°F)
Heat Deflection Temperature	D648	°C (°F)	75°C (167°F)
Screw and Nail Withdrawal	D1761	lbs	657 & 63
Flammability	UL 94	Rating	HB

All values are determined on specimens prepared according to ASTM Standards.
Nominal values should not be interpreted as specifications.
King ColorBoard® is made entirely from FDA and USDA approved material.
King ColorBoard® meets ASTM D4976.
The raw material used to make King ColorBoard® does not contain BPA's or Phthalates.

HDPE

King ColorCore®

King ColorCore® is a versatile, environmentally stabilized sheet with multiple layers of contrasting color. Its thin cap layers and bright primary colors make it ideal for signage, marine, playground and recreational applications. For maximum versatility, standard colors are made to coordinate with King ColorBoard®.

The sheets are easy to engrave and machine, as the cap is approximately ten percent of nominal thickness for high production speeds. Base materials are FDA approved as are most pigments. King ColorCore® is made with high-impact-resistant polymer to handle more abuse than conventional sign materials. King ColorCore® is a superior homogeneous sheet, made with a unique state-of-the-art continuous process called PolyFusion®, manufactured to the highest standards in the industry.

Typical Features:

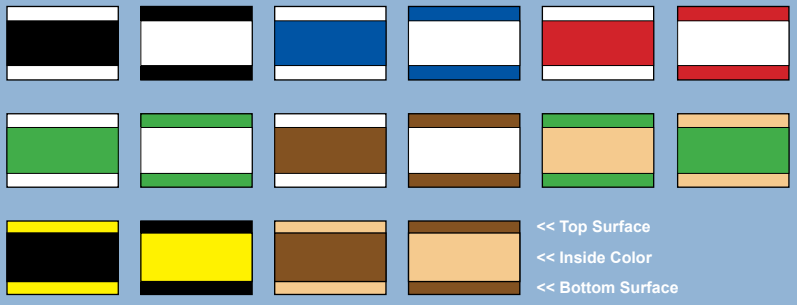
- Environmentally stabilized for harsh sun & outdoor applications
- Will not rot, swell, splinter or delaminate when exposed to water
- Durable matte-textured surface on both sides
- Extremely flat and consistent sheets
- Easy to fabricate with standard woodworking tools

Product Applications:

- Carnival games
- Children's furniture
- Marine applications
- Point-of-Purchase displays
- Signage and Wayfinding

King ColorCore®

Standard Thickness (inches) :	**1/4" 1/2" 3/4"**
Standard Sheet Size (inches) :	**48 x 96**
Standard Colors :	**See Below**



HDPE

King ColorCore® - Typical Properties

PROPERTY TESTED	ASTM	UNITS	COLORCORE
PHYSICAL PROPERTIES			
Density	D1505	g/cc	0.955
Tensile Strength at Yield	D638	psi	> 4,100
Tensile Modulus	D638	psi	255,000
Elongation at Yield	D638	%	9.80
Elongation at Break	D638	%	> 600
Flexural Modulus	D790	psi	185,000
Flexural Stress at 5% Strain	D790	psi	3,810
Compressive Properties 10% Strain	D695	psi	4,950
Hardness, Durometer	D2240	Shore D	68
Tensile Impact	D1822	ft-lbs/in^2	115
Izod Impact Resistance	D256	ft-lbs/in^2	1.10
Brittleness Temperature	D746	°C (°F)	<-76°C (<-105°F)
Vicat Softening Temperature	D1525	°C (°F)	123°C (253°F)
Heat Deflection Temperature	D648	°C (°F)	75°C (167°F)
Screw and Nail Withdrawal	D1761	lbs	657 & 63
Flammability	UL 94	Rating	HB

All values are determined on specimens prepared according to ASTM Standards.
Nominal values should not be interpreted as specifications.
King ColorBoard® is made entirely from FDA and USDA approved material.
King ColorBoard® meets ASTM D4976.
The raw material used to make King ColorBoard® does not contain BPA's or Phthalates.

HDPE

Densetec® HDPE Product Offerings

Polymer Industries' Densetec® High Density Polyethelyne sheet exhibits the properties of high impact strength, abrasion resistance, and low coefficient of friction. The material is also moisture, stain and odor resistant, and is FDA approved to be used in the food processing industry. The material's durability makes it ideally suited for a variety of applications such as water tanks, chute linings and numerous industrial uses.

POLYMER INDUSTRIES
GEARED TOWARDS EXCELLENCE

Densetec® ANTIMICROBIAL

Polymer Industries integrates the antimicrobial protection into the product during the manufacturing process. Our antimicrobial material kills or inhibits the growth of microorganisms caused by bacteria, algae and fungi. Our products are also non-porous and kill the spread of bacteria resistant to moisture and mildew. Antibacterial products are created by incorporating an antibacterial agent (biocide) to suppress the growth of bacteria on the surfaces of products through a process called zone inhibition to control growth of bacteria, fungus and algae.

Antimicrobial products are treated with an antimicrobial agent to inhibit bacterial or fungal growth and are resistant to deterioration by mold, fungus or mildew. Studies have shown that surfaces with antimicrobial technology can inhibit the the amount of certain product-damaging bacteria by 99%.

Densetec® ANTI SKID

Densetec® Anti Skid is specifically designed for the playground and marine industries incorporating the latest available technologies to produce a non-skid surface ideal for all type of flooring applications. Firstly, Anti Skid incorporates an embossed surface with your choice of either round or square protrusions on one side of the sheet. These protrusions actually grip the tread of the shoe of the person walking on the surface. Also, water drains on the surface of the sheet beneath the protrusions making Anti Skid especially effective in wet conditions.

Secondly, Anti Skid is manufactured by using a high grip compound on the surface of the sheet presenting a tacky, high coefficient of friction material on the walking surface. This material is a more skid resistant material than HDPE and enhances Anti Skid's anti-skid properties.

Densetec® MARINE

Densetec® Marine Board is specially formulated to withstand the rigors of harsh outdoor marine environments. It is UV-stabilized to resist damage and retain its beauty, even after years of direct sunlight. Increasingly, Densetec® Marine Board is replacing wood and laminates in boating applications. It does not splinter, crack, delaminate, rot, swell, or absorb water like traditional materials. Even under heavy foot traffic on yacht decks, it remains virtually maintenance-free. In addition, there is no need to stain or paint Densetec® Marine Board every few years. The color is integrated with the polymer and retains its vibrant appearance better than painted wood.

Densetec® Marine Board forms easily for smooth curves and bends. Since there is no grain pattern, parts can be cut from any part of the sheet virtually eliminating waste for greater economy than wood.

HDPE

Densetec® HDPE Product Offerings

Densetec® PARTITION

Densetec® Partition Board is the ideal partition material for a wide variety of commercial applications such as schools, parks, stadiums, office buildings and airports. The durability of our material makes it immune to such problems as vandalism and constant traffic. In addition, the material is totally unaffected by water and humidity preventing it from shrinking, expanding, bowing, warping or delaminating in any way whatsoever. It is resistant to markings by pens, pencils, most markers and paints and cleans with ordinary household detergent or solvents for more stubborn stains. Minor surface damage can easily be repaired. Finally, the material does not have to be painted and is virtually maintenance free.

Densetec® PLAY

Densetec® Playground Board is making a big splash in the playground industry. The variety of bright contrasting colors make it perfectly suited to this environment where high impact colors are required. Because the color is embedded in the sheet, it never needs painting. Especially with the rigors and abuse that children inflict upon playground equipment, this material lasts much longer than wood.

The versatile properties of Densetec® Playground Board make it virtually vandal resistant. The UV stabilizers added to the material make the colors fade-resistant and the standard properties of the HDPE used in the production of Densetec® Playground Board make it weather-resistant and the perfect choice for outdoor environments.

Densetec® SHIELD

Densetec® Shield is a product specially designed for nuclear shielding applications. The material employs 5% Boron by weight to shield neutrons in a variety of applications including high intensity X-rays, cancer treatment facilities, nuclear submarines, and nuclear power plants.

Densetec® SIGN

The material is manufactured by extruding one color on the inside and a contrasting color on the outside. The layers are combined while the material is still molten. The result is a homogenous sheet that is guaranteed not to delaminate, crack or chip. It is superior to other sign materials, which are separate layers of material laminated together.

Densetec® Sign Board is easily routed or engraved using current CNC router technology. As the skin of the material is removed by the router, the inside color shows through and, voila, a sign is easily fabricated with minimum finishing requirements. The material does not have to be painted because the color is embedded into the sheet. The durable textured finish resists scratches and marring. The product is UV stabilized to resist deterioration in harsh outdoor environments, making it the perfect signage material.

POLYMER INDUSTRIES
GEARED TOWARDS EXCELLENCE

HDPE Cutting Board

Sanalite® HDPE

Sanalite® is a premium cutting board material with a surface that is easy on cutting blades. Sanalite is used in a wide array of applications — from home use to commercial food preparation and some of the largest packing plants in the United States.

Sanalite® HDPE can be ordered in three different sheet sizes: 48" x 96" and 48" x 120" sheets with gauge sizes ranging from 1/4" to 1"; 60" x 120" sheets with four gauge sizes ranging from 1/2" to 1".

Typical Features:

- NSF certified under Standard 02 and Standard 51
- Meets FDA Regulation 21CFR 177.1520 Item 2.1
- USDA compliant & Ag Canada approved
- Chemical & Corrosion resistant
- No moisture absorption
- Pebble surface resists acids
- Easily cleaned
- Lightweight

Product Applications:

- Deli counter tops
- Dough boards
- Drip trays
- Proof boards
- Splash shields

Sanalite® Cutting Board

HDPE Thickness (inches) :	**1/4 through 1" thick**
HDPE Sheet Size (inches) :	**48 x 96 and 48 x 120. 60 x 120 (1/2" and up)**
HDPE Sheet Color :	**Natural**

HDPE Cutting Board

Sanalite® HDPE Typical Properties

PROPERTY TESTED	ASTM	UNITS	HDPE
PHYSICAL PROPERTIES			
Specific Gravity	D792	g/cc	0.960
Water Absorption (24 hrs)	D570(2)	%	<= 0.010
Water Absorption at Saturation	D570(2)	%	<= 0.010
MECHANICAL PROPERTIES			
Hardness, Shore D	D2240	---	70
Tensile Strength	D638	psi	4,600
Tensile Strength at 65°C (150°F)	D638	psi	400
Elongation at Break	D638	%	400%
Tensile Modulus	D638	psi	200,000
Flexural Strength	D790	psi	4,600
Flexural Modulus	D790	psi	174,000
Compressive Strength (10% Def)	D695	psi	4,600
Compressive Modulus	D695	psi	100,000
Izod Impact, Notched	D256 Type A	ft.-lb./in.	1.30
Coefficient of Friction, Dynamic	QTM55007	---	0.20
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	D257	ohm	>= 1.00e + 15 ohm
THERMAL PROPERTIES			
CTE, Linear	E831	µin/in-°F	61.0
Melting Point (Crystalline, Peak)	D3418	°F	260°
Maximum Service Temp., Air	Long Term	°F	180°
Deflection Temp. at 1.8 MPa (264 psi)	D648	°F	176°
Flammability, UL94 (1/8")	Est Rating	---	HB
COMPLIANCE PROPERTIES			
3A-Dairy	---	---	No
Canada AG	---	---	Yes
FDA	---	---	Yes
NSF	STD 2 & 51	---	Yes
USDA	---	---	Yes
USP Class VI	---	---	No

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

HDPE Cutting Board

Densetec® HDPE Cutting Board

Traditional wooden cutting boards are no match for boards fabricated with Densetec® Cutting Board from Polymer Industries. Wood and other materials absorb bacteria, splinter, chip, swell, peel, rot, warp, bend and crack. Densetec® Cutting Board eliminates those problems, substantially outlasting cutting boards made from other materials.

Densetec® Cutting Board is engineered for durability, low maintenance and safety. Its textured, matte surface safely holds food in place without slipping. The "natural" bright white color is favored for its sanitary look.

Knives stay sharp when cutting on Densetec® Cutting Board. Instead of striking a rigid surface that dulls the blade, Densetec® Cutting Board gives on contact. Because of its unique molecular structure, cuts seal and become indiscernible. Over time, using Densetec® Cutting Board can lead to significant savings when compared with other materials.

Densetec® colored cutting board is the perfect choice to help prevent cross contamination of food borne pathogens such as salmonella and E-coli. By color coding the food to the color of the cutting board such as blue for fish, red for red meat, yellow for poultry, etc., the risk of spreading these dangerous microorganisms is greatly diminished.

Typical Features:

- USDA and FDA approved for food applications
- NSF Standard 51 certified
- Easy to clean and fabricate, RoHS and REACH compliant
- Will not rot, swell, splinter, crack, chip or delaminate
- Durable matte-textured surface on both sides
- Will not dull knife blades
- Will not absorb bacteria
- Mildew and moisture resistant
- Chemical and acid resistant
- Stain and odor resistant

Product Applications:

- Buffets
- Salad bars
- Industrial cutting surfaces
- Residential cutting boards
- Commercial cutting boards
- Shelving
- Food stations
- Butcher blocks
- Food preperation area
- Food processing equipment

HDPE Cutting Board

Densetec® HDPE Cutting Board

Densetec® Cutting Board

Standard Thickness (inches) :	1/4" up to 1-1/4" thick
Standard Sheet Size (inches) :	48 x 96 48 x 120 60 x 120
Standard Sheet Color :	Natural, Red, Yellow, Blue, Green, Beige & Black

Densetec HDPE Cutting Board - Available Surface Finishes

Orange Peel

NSF Logo

Smooth

HDPE Cutting Board

King CuttingBoard® HDPE

King CuttingBoard® is an exceptionally white natural polyethylene color, creating the bright, clean sanitarty look that commercial food processing operations require. Bacteria, odors and cleaning fluids wash completely off. King CuttingBoard® won't dull knives like wood. It is made to last in the most demanding commercial environments. It is easy to clean, easy to maintain and will not rot or splinter and complies with FDA and NSF guidelines for sanitary work surfaces.

King CuttingBoard® XL is an exceptionally white natural polyethylene color, creating the bright, clean, sanitary look that commercial food processing operations require. The sheets are approximately one-third lighter in weight than standard King CuttingBoard®, allowing for easy handling and cleanup. Bacteria, odors and cleaning fluids wash completely off. King CuttingBoard® XL won't dull knives like wood. King CuttingBoard XL is tested and certified by the NSF and the material is FDA approved. It is made to last in the most demanding commercial environments. It is easy to clean, easy to maintain, and will not rot or splinter.

Typical Features:

- FDA and NSF certified for food contact
- Will not rot, swell, splinter or delaminate when exposed to water
- Durable matte-textured surface on both sides
- Extremely flat and consistent sheets
- Easy to fabricate with standard woodworking tools

Product Applications:

- Cutting boards
- Restaurants
- Kitchens

CuttingBoard® and XL

Standard Thickness (inches) :	**1/4" 1/2" 3/4" 1"**
Standard Sheet Size (inches) :	**48 x 96 and 60 x 120**
Standard Sheet Color :	**White (Polyethylene)**

How to clean: Scrub the material with a strong bristle brush and professional-strength detergent to remove any detritus or stains. Rinse with hot water. Sanitize with a ten percent bleach solution. Rinse thoroughly with cold water. King CuttingBoard® materials are dishwasher safe. Remove from the dishwasher before the drying cycle for the best result. Allow to air dry.

HDPE Cutting Board

King CuttingBoard® HDPE

PROPERTY TESTED	ASTM	UNITS	CUTTINGBOARD®	CUTTINGBOARD® XL
PHYSICAL PROPERTIES				
Density	D1505	g/cc	0.955	0.77 & 0.7187
Tensile Strength at Yield	D638	psi	>4,100	>3,300
Tensile Modulus	D638	psi	255,000	165,000
Elongation at Yield	D638	%	9.8	9.6
Elongation at Break	D638	%	>600	---
Flexural Modulus	D790	psi	185,000	130,000
Flexural Modulus at 5% Strain	D790	psi	3,810	2,990
Compressive Properties 10% Strain	D695	psi	4,950	2,910
Hardness, Durometer	D2240	Shore D	68	64.9
Tensile Impact	D1822	ft. lbs./in.^{2}	115	---
Izod Impact	D256	ft. lbs./in.^{2}	1.1	1.4
Brittleness Temperature	D746	°C (°F)	< -76° (< -105°)	---
Vicat Softening	D1525	°C (°F)	123° (253°)	---
Heat Deflection Temp., at 66 psi	D648	°C (°F)	75° (167°)	87° (188°)
Screw and Nail Withdrawl	D1761	lbs	657 & 63	325 & ---
Flammability	UL94	Rating	HB	---

**All values are determined on specimens prepared according to ASTM standards. Nominal values should not be interpreted as specifications.*
King CuttingBoard® is made entirely from FDA and USDA approved materials
King CuttingBoard® meets ASTM D4976 PE235
King CuttingBoard® is NFS approved for Standards 2 & 51

King CuttingBoard and King CuttingBoard XL have both been tested and certified by the NSF and the materials are both FDA approved for food contact.

HDPE Cutting Board

King CuttingColors® HDPE

King CuttingColors® is a NSF-certified family of color-coded cutting board sheets in five different industry-standard colors to help combat cross contamination. A textured matte finish and solid surface provide a stable and sanitary work area. It is available in large sheets that can be cut to fit most counter tops. Bacteria, odors and cleaning fluids wash completely off. King CuttingColors® won't dull knives like wood. It is produced with the same FDA and NSF certification as King CuttingBoard®.

How to clean: Scrub the material with a strong bristle brush and professional strength detergent to remove any detritus or stains. Rinse with hot water. Sanitize with a ten percent bleach solution. Rinse thoroughly with cold water. King CuttingColors® materials are dishwasher safe. Remove from the dishwasher before the drying cycle for the best result. Allow to air dry.

Typical Features:

- Five different colors to help combat cross-contamination
- FDA and NSF certified for food contact
- Will not rot, swell, splinter or delaminate when exposed to water
- Durable matte-textured surface on both sides
- Extremely flat and consistent sheets
- Easy to fabricate with standard wood working tools

King CuttingColors®

Standard Thickness (inches) :	**1/2" and 3/4" thick**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Sheet Color :	**Red (meat), Green (vegetables), Blue (seafood), Yellow (poultry) and Tan (cooked meats)**

HDPE Cutting Board

King CuttingColors® HDPE

PROPERTY TESTED	ASTM	UNITS	CUTTINGCOLORS®
PHYSICAL PROPERTIES			
Density	D1505	g/cc	0.955
Tensile Strength at Yield	D638	psi	>4,100
Tensile Modulus	D638	psi	255,000
Elongation at Yield	D638	%	9.8
Flexural Modulus	D790	psi	185,000
Flexural Modulus at 5% Strain	D790	psi	3,810
Compressive Properties, 10% Strain	D695	psi	4,950
Hardness, Durometer	D2240	Shore D	68
Izod Impact Resistance	D256	ft. lbs./in.^{2}	1.1
Vicat Softening	D1525	°C (°F)	123° (253°)
Heat Deflection Temperature, at 66 psi	D648	°C (°F)	75° (167°)
Screw and Nail Withdrawl	D1761	lbs	657 & 63
Flammability	UL94	Rating	HB

**All values are determined on specimens prepared according to ASTM standards. Nominal values should not be interpreted as specifications.*
This product meets all requirements for the FDA for olefin polymers to be used as articles or components of articles for contact with food as set forth in 21 CFR 177.1520.
King CuttingColors® also meets NSF guidelines.

King CuttingColors comes in five standard colors to help combat cross-contamination. Green (vegetables), Red (meat), Tan (cooked meats), Yellow (poultry) and Blue (seafood).

King Plastic Corporation
Our Innovation. Your Imagination.®

King StarBoard®

The Original Marine-Grade Polymer Sheet

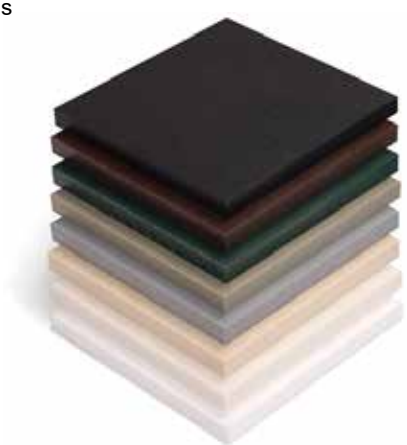
The King StarBoard® family of products has been used by nearly every boat manufacturer and by thousands of boat owners because of its durability and nearly endless applications. Now that the products have been proven in harsh marine environments, creative individuals and fabrication companies are finding dozens of new uses for the products, from outdoor kitchens and furniture, to theme park wet areas, to industrial rigging.

King StarBoard® is the original marine-grade polymer and the industry standard. It is the product of a proprietary process called K-Stran®, the most advanced manufacturing process available for producing consistently flat continuous sheets. King StarBoard® is environmentally stabilized to withstand the harshest marine conditions. It will not rot or discolor like teak and other solid woods, and it will not delaminate like wood laminates.

King StarBoard® is easy to work with using standard woodworking tools, and design changes are a snap. In addition, the installed cost of King StarBoard® is less than teak, other common marine woods, and fiberglass. Boat buyers appreciate King StarBoard's® low-maintenance finish. Repair and refinishing due to weathering and decay are eliminated, and cleaning is easy. King StarBoard® has a handsome matte finish on both sides to hide scuffs and scratches that would show on glossy textured sheets or acrylics.

Typical Features:

- Extremely flat and consistent sheets
- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Easy to fabricate with standard woodworking tools
- Durable matte-textured surface on both sides
- Easy to clean and never needs refinishing



Product Applications:

- Hatches and doors
- Grab rails and handles
- Step and dock boxes
- Rod and cup holders
- Countertops and tray tables
- Chairs and benches

King Plastic Corporation
Our Innovation. Your Imagination.®

King StarBoard®

The Original Marine-Grade Polymer Sheet

PROPERTY TESTED	ASTM	UNITS	STARBOARD®
PHYSICAL PROPERTIES			
Density	D1505	g/cc	0.955
Tensile Strength at Yield	D638	psi	>4,100
Tensile Modulus	D638	psi	255,000
Elongation at Break	D638	%	>600
Elongation at Yield	D638	%	9.8
Flexural Modulus	D790	psi	185,000
Flexural Stress at 5% strain	D790	psi	3,810
Compressive Prop at 10% strain	D695	psi	4,950
Durometer	D2240	Shore D	68
Tensile Impact	D1822	ft•lbs/in^2	115
Izod Impact Resistance	D256	ft•lbs/in^2	1.1
Brittleness Temperature	D746	°C (°F)	<-76° (<-105°F)
Vicat Softening Temperature	D1525	°C (°F)	123° (253°F)
Heat Deflection Temp at 66 psi	D648	°C (°F)	75° (167°F)
Screw and Nail Withdrawal	D1761	lbs	657 & 63
Flammability	UL 94	rating	HB

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

King StarBoard®

Sheet Thickness (inches) : 1/4" 3/8" 1/2" 3/4" 1" 1-1/2"

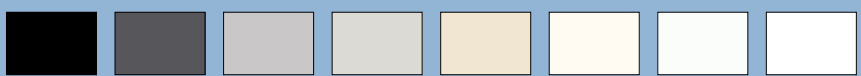
Standard Sheet Size (inches) : 54" x 96"

Standard Color : All standard colors available

Sheet Thickness (inches) : 1-1/2" (only)

Standard Sheet Size (inches) : 48" x 96"

Standard Color : All standard colors available



Black | Charcoal Gray | Dolphin Gray | Light Gray | Sanshade | Seafoam | Arctic White | White/ White

King StarBoard® AS

Anti-Slip Grade of King StarBoard®

King StarBoard® AS is a sure-grip marine-grade decking material designed specifically for high-traffic areas. This unique product features a special high-friction surface polymer in a Diamond or Dot pattern to prevent slipping and promote drainage. King StarBoard® AS needs no maintenance other than normal cleaning, is excellent for gangways, steps, and virtually any walk-on surface, and is available in the same colors as King StarBoard® for a perfect match.

Typical Features:

- Durable, sure-grip material for virtually every walk-on marine application
- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Precise tolerances ensure consistent color, thickness and density
- Diamond or dot pattern on walking surface
- Easy to clean and never needs refinishing

Product Applications:

- Swim platforms
- Engine room grates
- Ladder Treads
- Stairways
- Decking & hatches
- Shower floors

"Diamond" Pattern

"Dot" Pattern

King StarBoard® AS

Sheet Thickness (inches) :	**1/2" 3/4" and 1" thick**
Standard Sheet Size (inches) :	**54" x 96"**
Standard Color :	**Seven standard colors available, see below**
Standard Surface Finish :	**Diamond or Dot pattern**

Black | Charcoal Gray | Dolphin Gray | Light Gray | Sanshade | Seafoam | White/ White

King StarBoard® ST

The Polymer Buiding sheet that lasts a lifetime

This unique and advanced polymer makes the material 25% stiffer than the original King StarBoard®. King StarBoard® ST is our most scratch-resistant polymer making it an excellent construction material for cabinetry, case goods and architectural partitions. King StarBoard® ST is environmentally stabilized and has been developed to withstand the harshest outdoor conditions. It will not warp, rot, or delaminate when exposed to humidity or water. It can be fabricated using common woodworking tools and techniques.

King StarBoard® ST XL is available in a lighter version as a custom product. King StarBoard® ST XL sheets are up to 30% lighter in weight than King StarBoard® ST and are made with the same textured surface and colors for a perfect match.

King StarBoard® ST is upgradable to King MicroShield® with an exclusive antimicrobial additive from Biosafe®, the latest technology for protecting the product surface against stain and odor causing bacteria, algae and fungi. King StarBoard® ST is upgradable with King FlameShield, for ASTM E-84 Class A or B Flame/Smoke Compliance and CAN/ULC-S102 for Canadian Compliance.

Typical Features:

- Extremely flat and consistent sheets
- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Easy to fabricate with standard woodworking tools
- Easy to clean and never needs refinishing

Product Applications:

- Indoor & Outdoor cabinets
- Counter & Tabletops
- Playground equipment
- Lockers, dugouts & benches
- Medical casegoods
- Furniture & kick plates

King StarBoard® ST

Sheet Thickness (inches) :	**1/4" 3/8" 1/2" 3/4" 1" 1-1/2"**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Color :	**Nine standard colors available, see below**

Black | Mocha Brown | Evergreen | Everglade | Charcoal Gray | Dolphin Gray | Sanshade | Seafoam | White/ White

King StarBoard® WG

The All-Weather Wood Grain Polymer Sheet

King StarBoard® WG is a high-density polyethylene sheet with a wood grain finish. It is the product of a proprietary process called K-Stran™, the most advanced manufacturing process for superior flatness and consistency. King StarBoard® WG has a wood grain finish on both sides of the sheet. It is environmentally stabilized to withstand the harshest outdoor conditions. King StarBoard® WG will not rust, delaminate or rot when exposed to UV, humidity or water. It is ideal for a variety of applications from replacing wood, to building furniture. The wood grain polymer sheet never needs painting or refinishing, works like wood, and is easy to fabricate with common woodworking tools and techniques.

King Plastic pioneered King StarBoard®, the original marine-grade polymer sheet. Now, we deliver the highest performance and durability in our new wood grain plastic sheet King StarBoard® WG with elegance and casual sophistication for outdoor living. King StarBoard® WG, the all-weather wood grain polymer sheet inspiring everyone to live outdoors.

Typical Features:

- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Durable, wood grain finish on two sides suitable for outdoor living applications.
- Easy to clean with little to no maintenance
- Easy to fabricate
- Qualifies for LEED points

Product Applications:

- Fire pits
- Indoor & Outdoor Cabinets
- Outdoor Cabinetry & Storage
- Outdoor furniture
- Planters
- Tabletops
- Boat Components

Upgrades Available:

King StarBoard® WG is upgradable to King MicroShield® with an advanced antimicrobial technology for protecting the product surface against stain and odor causing bacteria, algae and fungi.*

King StarBoard® WG is upgradable with King FlameShield, for ASTM E-84 Class A Flame Compliance and CAN/ULC-S102 for Canadian Compliance.

King StarBoard® WG

The All-Weather Wood Grain Polymer Sheet

King StarBoard® WG

Sheet Thickness (inches) :	**1/2" and 3/4"**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Color :	**Five standard colors available, see below**

Mocha Brown | Nutmeg | Indigo | Charcoal Gray | Slate Gray

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King StarBoard® XL

The Lightweight Marine-Grade cellular sheet

King StarBoard® XL is a lighter, more economical version of the popular King StarBoard®. This 100% virgin marine-grade polymer has a high density polyethylene cap and a closed cellular inner core which has an excellent surface finish that looks good enough to use in high-visibility applications where structural strength and a finished edge are not important.

King StarBoard® XL sheets are up to 30% lighter in weight than King StarBoard®, and are made with the same textured surface and colors for a perfect match. As with King StarBoard®, King StarBoard® XL is made with the exclusive K-Stran® process for superior consistency and flatness, and has a thickness tolerance of plus or minus 5% (unlike ordinary polymer sheets that use 10% as an acceptable tolerance).

Typical Features:

- Weighs up to 30% less with the same surface finish as King StarBoard®
- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Easy to fabricate with standard woodworking tools
- Durable matte-textured finish on both sides
- Resists odor, even in wet conditions
- Holds staples and screws securely
- Easy to clean and never needs refinishing

Product Applications:

- Deck components & equipment mounts
- Recess hatches & bait well covers
- Doorstops and thresholds
- Electronic mountings
- Cockpit covers & tackle centers
- Ladder steps

King StarBoard® XL

Sheet Thickness (inches) :	**1/4" 3/8" 1/2" 3/4"**
Standard Sheet Size (inches) :	**60" x 96"**
Standard Color :	**Seven standard colors available, see below**

Black | Charcoal Gray | Dolphin Gray | Light Gray | Sanshade | Seafoam | White/ White

King StarLite® XL

The Lightweight Marine-Grade cellular sheet

King StarLite® XL is an economical cellular (closed cell) utility sheet made from select high-grade King StarBoard® recycled polymer material. It is ideal for boat parts, as an upholstery substrate and in other behind-the-scenes applications where edges aren't visible.

King StarLite® XL is up to 35% lighter in weight than King StarBoard® and it offers the same quality textured surface on both sides.

Typical Features:

- Weighs up to 35% less with the same surface finish as King StarBoard®
- Environmentally stabilized for harsh sun & tough marine environments
- Will not rot, swell, splinter or delaminate when exposed to water
- Perfect lightweight replacement for plywoods or MDF
- Flexes without breaking, unlike plywood or PVC foam products
- Perfect for upholstered parts, bends without breaking
- An excellent substrate for mounting instruments
- Easy to fabricate with standard woodworking tools
- Durable matte-textured finish on both sides
- Resists odor, even in wet conditions
- Easy to clean and never needs refinishing

Product Applications:

- Deck components & equipment mounts
- Recess hatches & bait well covers
- Doorstops and thresholds
- Upholstery substrate
- Tackle centers

King StarLite® XL

Sheet Thickness (inches) :	**1/4" 3/8" 1/2" 3/4"**
Standard Sheet Size (inches) :	**60" x 96"**
Standard Color :	**Three standard colors available, see below**

Utility Black | Utility Gray | Utility White

King StarBoard® Grades

Typical Properties Comparison Chart

PROPERTY TESTED	ASTM	UNITS	STARBOARD®
PHYSICAL PROPERTIES			
Density	D1505	g/cc	0.955
Tensile Strength at Yield	D638	psi	>4,100
Tensile Modulus	D638	psi	255,000
Elongation at Break	D638	%	>600
Elongation at Yield	D638	%	9.8
Flexural Modulus	D790	psi	185,000
Flexural Stress at 5% strain	D790	psi	3,810
Compressive Prop at 10% strain	D695	psi	4,950
Durometer	D2240	Shore D	68
Tensile Impact	D1822	ft•lbs/in^2	115
Izod Impact Resistance	D256	ft•lbs/in^2	1.1
Brittleness Temperature	D746	°C (°F)	<-76° (<-105°F)
Vicat Softening Temperature	D1525	°C (°F)	123° (253°F)
Heat Deflection Temp at 66 psi	D648	°C (°F)	75° (167°F)
Screw and Nail Withdrawal	D1761	lbs	657 & 63
Flammability	UL 94	rating	HB
WEIGHT BY THICKNESS			
1/4" thick (6.4 mm)	---	lbs./sqft	1.25 lbs
3/8" thick (9.53 mm)	---	lbs./sqft	1.875 lbs
1/2" thick (12.7 mm)	---	lbs./sqft	2.50 lbs
3/4" thick (19 mm)	---	lbs./sqft	3.75 lbs
1" thick (25.4 mm)	---	lbs./sqft	5.00 lbs
1-1/2" thick (38 mm)	---	lbs./sqft	7.50 lbs

King StarBoard® Grades

Typical Properties Comparison Chart

STARBOARD® AS	STARBOARD® ST	STARBOARD® WG	STARBOARD® XL	STARLITE® XL
0.960	0.963	0.955	0.77 & 0.7187	0.77 & 0.7187
>4,100	>4,500	>4,100	>3,300	>3,300
225,000	318,000	255,000	165,000	165,000
>600	>600	>600	---	---
9.8	8.8	9.8	9.6	9.6
185,000	225,000	185,000	130,000	130,000
3,810	4,480	3,810	2,990	2,990
4,000	4,790	4,950	2,910	2,910
66	69	68	65	65
115	99	115	---	---
1.1	1.4	1.4	1.4	1.4
<-76° (<-105°F)	<-75° (<-103°F)	<-76° (<-105°F)	---	---
123° (253°F)	132° (270°F)	123° (253°F)	---	---
75° (167°F)	84° (183°F)	75° (167°F)	87° (188°F)	87° (188°F)
657 & 63	755 & 55	657 & 63	325 & n/a	325 & n/a
HB	HB	HB	---	---
---	1.25 lbs	---	1.00 lbs	0.90 lbs
---	1.875 lbs	---	1.538 lbs	1.40 lbs
2.50 lbs	2.50 lbs	2.50 lbs	2.00 lbs	1.80 lbs
3.75 lbs	3.75 lbs	3.75 lbs	3.00 lbs	2.70 lbs
5.00 lbs	5.00 lbs	---	---	---
---	7.50 lbs	---	---	---

King Plastic Corporation
Our Innovation. Your Imagination.®

King Hy-Pact®

Very High Molecular Weight Polyethylene

There are many cases in which UHMW is specified for installations where its ultimate abrasion and impact resistance are not necessary. In many cases, the customer's only alternative was to use standard HDPE, which lacks the durability of UHMW in most applications.

King Hy-Pact® is the super tough industrial polymer sheet that is environmentally stabilized with excellent physical properties. Tests have shown after 2,000 hours of UV exposure, King Hy-Pact® outperforms both UV stabilized HDPE and UHMW with superior toughness in wear resistance, flexibility and high-impact strength.

King Hy-Pact® has a clean white color with a smooth, non-skived finish for better material flow. King Hy-Pact® is produced in K-Stran™, our advanced proprietary manufacturing process of quality sheets with tight tolerances and custom widths up to 60". Applications include, but are not limited to, food processing chutes, star wheels, fabricated parts, snowplow blades and dock fenders. King Hy-Pact® is the smart choice for many high abuse applications requiring superior properties, outstanding flatness and a smooth surface while providing significant cost savings compared to UHMW.

Typical Features:

- Environmentally stabilized, indoor or outdoor use
- FDA and USDA approved, white opaque color
- Smooth, non-skived finish has low coefficient of friction
- Extremely flat, low-strain sheet
- Resistant to caking and bridging (build-up)
- Made from recycled plastics and 100% recyclable
- Not affected by most aqueous acids, alkalis or salt solutions

Product Applications:

- Abrasion and wear
- Bin and mixing linings
- Chain and belt guides
- Conveyor wear & guide rails
- Dock fenders
- Food processing
- Gears and pulleys
- Machine parts
- Snow plows
- Sprockets
- Star wheels
- Truck bed liners

King Hy-Pact®

Standard Thickness (inches) :	**1/8 1/4 3/8 1/2 3/4 1**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**White**
Sheet Tolerances :	**Thickness +/-5%** **Length & Width plus only at room temp**

King Hy-Pact®

Very High Molecular Weight Polyethylene

PROPERTY TESTED	ASTM	UNIT	King Hy-Pact®
Density	D1505	g/cc	0.95
Tensile Strength at Yield	D638	psi	> 4,100
Elongation at Yield	D638	%	9.60
Flexural Modulus	D790	psi	186,000
Durometer	D2240	Shore D	65
Izod Impact	D256	ft.lbs./in.^{2}	16.60
Brittleness Temperature	D746	°C (°F)	<-90°C (<-130°F)
Vicat Softening Temperature	D1525	°C (°F)	130°C (266°F)
Heat Deflection Temp at 66 psi	D648	°C (°F)	75°C (167°F)
Coefficient of Linear Expansion	D696	in./in./°F	6.0 x 10^{-5}

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

QUV Accelerated Weathering Tester	ASTM	UNIT	King Hy-Pact® Unexposed	King Hy-Pact® 2,000 Hrs Exposure
Tensile at Yield, 70°F	D638	psi	4,100	4,100
Elongation at Yield, 70°F	D638	%	9.60%	9.60%
Tensile at Break, 70°F	D638	psi	1,930	1,440
Elongation at Break, 70°F	D638	%	260%	210%
Taber Index	D4060	---	5	12
Izod Notched, 70°F	D256	ft.lbs./in.^{2}	16.60	15.70
Coefficient of Friction - Kinetic	D1894	---	0.107	0.107
Coefficient of Friction - Static	D1894	---	0.102	0.102

UHMW-PE

Ultra High Molecular Weight Polyethylene

Ultra-high-molecular-weight polyethylene (UHMW-PE or sometimes shortened to UHMW) is a subset of the thermoplastic polyethylene. It has extremely long molecular chains, with molecular weight numbering in the millions, usually between 2 and 6 million. The longer chain serves to transfer load more effectively to the polymer backbone by strengthening intermolecular interactions. This results in a very tough material, with the highest impact strength of any thermoplastic presently made. It is highly resistant to corrosive chemicals, with exception of oxidizing acids. It has extremely low moisture absorption, has a very low coefficient of friction, is self-lubricating, and is highly resistant to abrasion (15 times more resistant to abrasion than carbon steel). Its coefficient of friction is significantly lower than that of acetal. It is odorless, tasteless, and nontoxic.

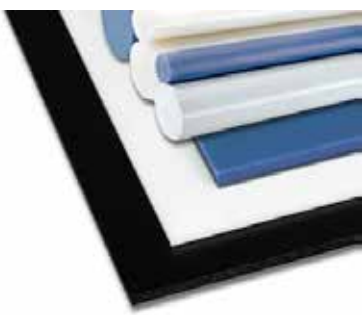
UHMW-PE (Ultra High Molecular Weight Polyethylene) is 1/8th the weight of mild steel, but is high in tensile strength and as simple to machine as wood. UHMW-PE is well-suited for applications where durability and low friction are of paramount importance. Moving parts operate quietly when made from UHMW-PE and also have good thermal and insulator properties. UHMW-PE is an inexpensive alternative to metals, ceramics and wood because it is self-lubricating, long-wearing and shatter, abrasion and corrosion resistant.

Common Trade Names:

- Gar-Dur® (Garland Manufacturing)
- Lennite® (Westlake Plastics)
- Polyslick® (Polymer Industries)
- Polystone® M (Rochling Sustaplast)
- Ramex® (Rochling Sustaplast)
- TIVAR® (Mitsubishi Chemical Group)

Typical Features:

- Excellent abrasion resistance
- Low coefficient of friction
- No moisture absorption
- Corrosion and wear resistant
- Excellent noise abatement
- Excellent impact strength
- Maintains key physical properties to -30°C



Product Applications:

- Augers
- Bearings and bushings
- Chain guides and sprockets
- Chute and hopper liners
- Flights and gears
- Guide rails and rollers
- Mixer bushings and paddles
- Scraper and plow blades

UHMW-PE

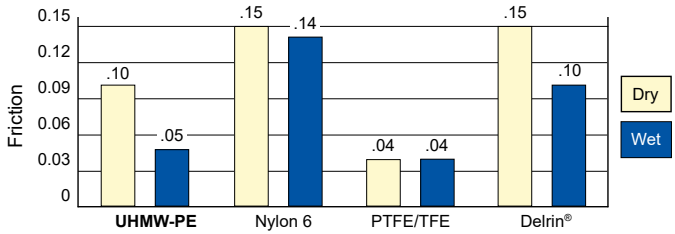
Ultra High Molecular Weight Polyethylene

PROPERTY TESTED	ASTM	UNITS	UHMW-PE
PHYSICAL PROPERTIES			
Specific Gravity	D792	g/cc	0.930
Water Absorption, immersion, 24 hrs	D570(2)	%	<= 0.010%
Water Absorption, immersion	D570(2)	%	<= 0.010%
MECHANICAL PROPERTIES			
Hardness, Durometer, Shore D	D2240	---	66
Tensile Strength	D638	psi	5,800
Tensile Strength @ 65°C (150°F)	D638	psi	400
Elongation at Break	D638	%	300%
Tensile Modulus	D638	psi	80,000
Flexural Strength	D790	psi	3,500
Flexural Modulus	D790	psi	87,000
Compressive Strength	D695	psi	3,000
Compressive Modulus	D695	psi	80,000
Shear Strength	D732	psi	4,800
Izod Impact, Notched .125"	D256, "A"	ft.•lb./in.	No Break
Coefficient of Friction, Dynamic	QTM55007	Dry vs Steel	0.12
Sand Slurry (1018 Steel = 100)	---	---	10
Limiting Pressure Velocity	QTM55007	psi-ft/min	3,000
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	D257	ohm	>=1.00e +15
Dielectric Constant	D150	@Freq 1e+6 Hz	2.30
Dielectric Strength (short term)	D149	kV/in.	2,300
Dissipation Factor	D150	@Freq 1e+6 Hz	0.00050
THERMAL PROPERTIES			
CTE, Linear	E831	µ in/in-°F	110
Thermal Conductivity	---	BTU-in./hr.•ft²-°F	2.84
Melting Point, crystalline, peak	D3418	°F	275°
Maximum Service Temp., Air	---	°F	180°
Deflection Temp at 1.8 MPa (264 psi)	D648	°F	116°
Flammability	UL 94	---	HB
COMPLIANCE PROPERTIES			
3A-Dairy	---	---	Yes (Natural)
Canada AG	---	---	Yes (Natural)
FDA	---	---	Yes (Natural)
NSF	---	---	No
USDA	---	---	Yes (Natural)
USP Class VI	---	---	No

UHMW-PE

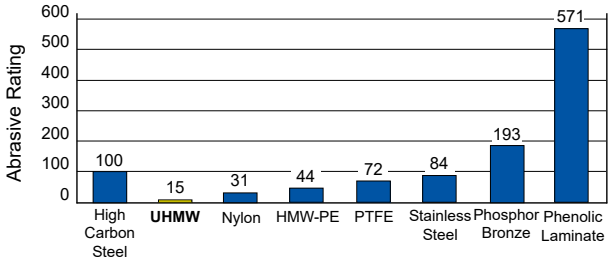
Ultra High Molecular Weight Polyethylene

Comparison of Dynamic Coefficient of Friction on Polished Steel



Abrasion Wear Resistance

(Sand Slurry Test: Each material was rotated 24 hours @ 1750 r.p.m. with 50/50 sand/water slurry. Carbon steel = abrasive rating of 100. Weight loss for each material is relative to 100. The lower the figure, the better the abrasion resistance.



UHMW - Expansion & Contraction Simplified

UHMW is cut to size at the factory in a temperature of about 75° Farenheit. UHMW will expand when subjected to higher temperatures and contract at lower temperatures. The same effect occurs after UHMW is installed. A change in temperature from time of installation will cause the material to expand or contract.

Always work from the installation temperature.

Multiply the number of degrees of change between the install temperature and maximum operating temperature.

x **the length of the piece** of UHMW in inches
x **.0001** (if the temperature is going warmer like 75°F to 85°F) OR
x **.000078** (if the temperature is going colder, like 75°F to 65°F)

Expansion Example:

Installing at 78°F, the maximum operating temperature can reach up to 150°F, and the UHMW piece is 120" long.

150°F - 78°F = 72°F of temperature change
72 (deg F) x 120(") x .0001 = .864" of expansion

Contraction Example:

Installing at 78°F, the lowest operating temp. could reach -20°F, and the UHMW piece is 120" long.

78°F + 20°F = 98°F of temperature change

98 (deg F) x 120(") x .000078 = .917" of contraction

UHMW-PE

Ultra High Molecular Weight Polyethylene

UHMW Sheet & Rod

Standard Thickness (inches) :	1/16" up to 8" thick
Standard Sheet Size (inches) :	48" x 96"..... 1/16" to 8" 48" x 120" ..... 1/16" to 6" 48" x 144" ..... 1/4" to 1" 60" x 120" ..... 3/8" to 1"
Standard Diameter (inches) :	1/4" up to 12" diameter
Standard Rod Length :	120" (10 ft) long
Standard Color :	Natural (white) and Black

UHMW-PE is also available in tubing, angle, profiles and compression molded parts. Please inquire with your Alro representative for more information on any of these shapes.

UHMW Wear Strip

Standard Thickness (inches) :	.030 .040 .050 .060 .070 .080 .090 .100 .125
Standard Widths (inches) :	1" up to 24" wide
Standard Tolerance :	Thick: +/-10%, Width +/- 1/32"
Standard Roll Length (feet) :	50 ft & 100 ft
Standard Color :	Natural (white) and Black

Pressure sensitive adhesive available by request at an additional cost

Pressure Sensitive Tape

Standard Thickness (inches) :	.003 .005 .010 .015 .020 .030 .125
Standard Widths (inches) :	1/4" 1/2" 3/4" 1" 1-1/2" 2" 3" 4" 5" 6" 7" 8" 10" 12" 18"
Standard Tolerance :	Thick: +/-10%, Width +/- 1/32"
Standard Roll Length (feet) :	50 foot and 100 foot
Standard Color :	Natural (white) and Black

TIVAR® UHMW-PE

Ultra High Molecular Weight Polyethylene

UHMW-PE (Ultra High Molecular Weight Polyethylene) is 1/8th the weight of mild steel, but is high in tensile strength and as simple to machine as wood. UHMW-PE is well-suited for applications where durability and low friction are of paramount importance. Moving parts operate quietly when made from UHMW-PE and also have good thermal and insulator properties. UHMW-PE is an inexpensive alternative to metals, ceramics and wood because it is self-lubricating, long-wearing and shatter, abrasion and corrosion resistant.

Food processing, packaging, bulk material handling or pharmaceutical processing...TIVAR® can improve your business performance. If your process machinery has problems with noise, premature wear, stretched chains, unscheduled downtime or expensive replacements, TIVAR® solves those problems, and your machinery runs longer and smoother.

TIVAR® formulations are recognized worldwide for their wear and corrosion resistance, low friction surface and impact strength. TIVAR® can outperform stainless steel; yet it weights only 1/8 as much. It can handle wide temperature ranges making it ideal for use on freezing lines or on lines with intermittent temperatures up to 212°F (100°C). From intricate wear components to large-scale installations, a TIVAR® product can fit the application.

TIVAR UHMW-PE Grades:

- **TIVAR® 1000** - General Purpose grade
- **TIVAR® 88** - Premium Lining Material
- **TIVAR® 88-2** - Premium Weldable Lining Material
- **TIVAR® Ceram P®** - Alternative to sintered ceramics
- **TIVAR® CleanStat™** - Electro Static Dissipative, FDA compliant
- **TIVAR® DrySlide** - Electro Static Dissipative
- **TIVAR® ECO** - Reprocessed/Recycled grade
- **TIVAR® ESD/EC** - Electro Static Discharges
- **TIVAR® H.O.T.** - Higher Operating Temperature
- **TIVAR® HPV** - Bearing grade for conveyor systems
- **TIVAR® Oil Filled** - Oil filled polymers
- **TIVAR® UV Resistant** - UV resistant grade
- **TIVAR® VMX FG** - Visual, Metal, X-ray detectable Food Grade

TIVAR® UHMW-PE

Ultra High Molecular Weight Polyethylene

TIVAR® 1000 sets the standard for engineered polymers with a unique combination of wear and corrosion resistance, low friction surface and impact strength. An excellent general-purpose material, TIVAR® 1000 (natural) is a cost-effective solution for food handling problems, and meets FDA, USDA and 3-A Dairy guidelines for food processing and handling. Quadrant also offers custom colors compounded with FDA/USDA approved pigments, which meet FDA and USDA guidelines for food processing and handling. Whether your business is grain, pharmaceuticals, pizza dough or frozen poultry, TIVAR® material will reliably move your materials and products.

Typical Features:

- Meets FDA and USDA guidelines; 3-A Dairy approved (Natural)
- Meets ASTM-D-4020-05 of 3.1 to 6.2-million molecular weight
- Chemical, corrosion and wear resistant
- Non-toxic, low friction surface
- Self lubricating
- Reduces noise
- No moisture absorption

Product Applications:

- Augers
- Bearings and bushings
- Chain guides and sprockets
- Chute and hopper liners
- Deboning tables
- Flights and gears
- Guide rails and rollers
- Mixer bushings and paddles
- Scraper and plow blades

TIVAR® 1000

Standard Thickness (inches) :	**1/16" up to 8" thick**
Standard Sheet Size (inches) :	**48" x 96"..... 1/16" to 8"** **48" x 120" ..... 1/16" to 6"** **60" x 120" ..... 3/8" to 1"**
Standard Diameter (inches) :	**1/4" up to 12" diameter**
Standard Rod Length :	**120" (10 ft) long**
Standard Color :	**Natural (white) and Black**

TIVAR 1000 is also available in tubing, angle, profiles and compression molded parts. Please inquire with your Alro representative for more information on any of these shapes.

TIVAR® DrySlide

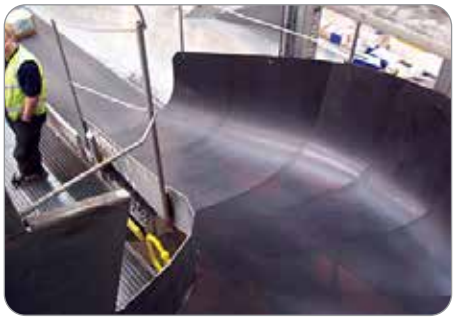
Electro Static Dissipative Grade

TIVAR® DrySlide is a self-lubricating grade of UHMW designed for the packaging industry. Modified with special lubricants, TIVAR® DrySlide has the lowest coefficient of friction of any of the TIVAR® products.

The enhanced coefficient of friction and anti-static properties make TIVAR® DrySlide an excellent performer in dusty environments. Even damp boxes or parcels covered in shrink-wrap won't stick to TIVAR® DrySlide. In addition, the enhanced surface lubricity won't mar packaging or products, but allow them to move freely without jamming from dirt, grit or static build-up.

Typical Features:

- Electro static dissipative
- Ideal for dusty environments
- Helps reduce surging
- Won't mar packaging or products
- Corrosion-resistant
- Self-lubricating
- Reduces noise
- No moisture absorption



Product Applications:

- Belt scrapers
- Bunker liners
- Chain conveyor flights
- Chute liners
- Conveyor skirting
- Cyclones
- Drag chain conveyor liners
- Dragline buckets
- Dust collection hopper liners
- Front end loader bucket liners
- Hopper liners
- Offroad truck beds
- Railcar liners
- Screw conveyor liners
- Silo liners
- Slider beds
- Storage & surge bin liners
- Transfer chute liners
- Under chain guides
- Vibratory bin dischargers

TIVAR® DrySlide

Standard Thickness (inches) :	**1/16" up to 2" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**Black / Dark Gray**

TIVAR® ECO

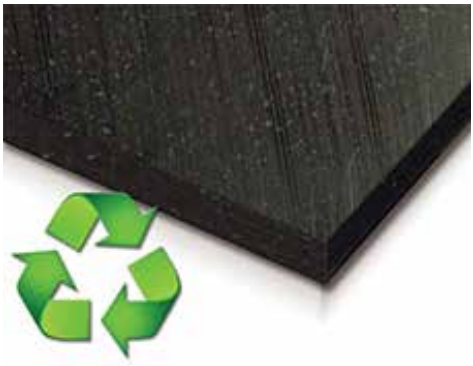
Reprocessed UHMW-PE Grade

Looking to save a little money or for a more environmentally friendly grade of UHMW? Take a look at TIVAR® ECO, the reprocessed grade of UHMW polyethylene. This grade, partially composed of reprocessed PE-UHMW material, has an overall lower property level than the virgin TIVAR® 1000.

Our TIVAR® ECO grade shows a favorable price-performance ratio for applications in many kinds of industries with less demanding requirements. TIVAR® ECO is available in sheet/slab form and comes in standard black color. There will be very tiny, colored specs of reprocessed materials throughout this material. Unfortunately reprocessed UHMW is not FDA or USDA compliant, so it is not suitable for those types of applications. It is however less expensive than virgin UHMW and an ideal material for rack jobs, guide rails, chain guides and many other industrial applications.

Typical Features:

- Chemical, corrosion and wear resistant
- Cost effective alternative to virgin UHMW
- Environmentally friendly "**Green**" material
- Helps to reduce noise
- No moisture absorption



Product Applications:

- Chain guides
- Guide rails
- Rack material
- Chute and hopper liners

TIVAR® ECO

Standard Thickness (inches) :	**1/16" up to 6" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**Black (speckled)**

TIVAR® H.O.T.

Higher Operating Temperatures UHMW-PE

Formulated to maintain key performance properties in an extended temperature range, TIVAR® H.O.T. will excel in a variety of industrial manufacturing environments where temperatures range up to 275° F, nearly 100 higher than competing UHMW-PE formulations. TIVAR® H.O.T. reduces the oxidization rate of the material at higher temperatures thereby slowing material degradation and extending wear-life in chemical, elevated temperature and thermo-cycling environments. In many applications, TIVAR® H.O.T. will last up to 10 times longer in higher temperature environments and has excellent wear and release characteristics.

TIVAR® H.O.T. is also a great material for use in conveyor systems or other equipment that is frequently exposed to chemical washdowns in such industries as poultry/meat processing and packaging. It can also be used in applications ranging from wearstrips for spiral conveyors in the baking industry to drag conveyor flights for moving bulk materials in grain elevators, or wearstrips for conveyor dryers in drying and dehydrating systems.

Typical Features:

- Meets FDA and USDA guidelines; 3-A Dairy approved (Natural)
- Inhibits oxidation, extends material wear-life
- Abrasion, chemical, corrosion and moisture resistant
- Extended operating temperature range
- Excellent release characteristics

Product Applications:

- Chain guides
- Conveyor components
- Drying equipment
- Machined parts
- Wear strips, pads & plates

TIVAR® H.O.T.

Standard Thickness (inches) :	**1/16" up to 6" thick**
Standard Sheet Size (inches) :	**48" x 120"..... 1/16" up to 6"** **48" x 240"..... 3/4" up to 3"**
Standard Color :	**White**

TIVAR® VMX FG

Visual, Metal, X-Ray Detectable Food Grade PE

TIVAR® VMX Food Grade UHMW-PE is an EU 10/2011 and FDA 21 CFR § 177.1520 compliant material containing a metal detectable additive. The material has been specifically tailored for use in the food processing and packaging industries where it can easily be traced by different detection systems installed to detect contamination of the foodstuffs. TIVAR VMX Food Grade presents excellent toughness and impact strength and even improved wear and abrasion resistance compared with TIVAR 1000 and therefore make this grade especially suited for wear and friction applications.

Typical Features:

- Best in class impact resistance and low Coefficient of Friction
- Medium dimensional stability due to extreme low water absorption, but high Coefficient of Linear Thermal Expansion (CLTE)
- Good performance in a cryogenic environment
- Excellent release properties
- Continuous use temperature up to 80°C (176°F)
- Highly visible blue color

Product Applications:

- Chain guider elements
- Funnels
- Rollers
- Bushings
- Sprockets
- Mixing paddles

TIVAR® VMX FG

Standard Thickness (inches) :	**1/2" up to 2" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**Highly Visible Blue**

MITSUBISHI CHEMICAL GROUP

TIVAR® 88

Premium Lining Material UHMW-PE

Recognized worldwide as the premium lining material for bulk material handling, TIVAR® 88 is noted for its performance in promoting bulk solids flow of cohesive or non-free flowing materials due to its low surface friction. TIVAR® 88 liners are the perfect solution when you need to reduce or eliminate arching, ratholing and erratic material flow challenges in bins, bunkers, hoppers and chutes, railcars, etc. Although every application is unique, some have specific environmental challenges. Quadrant has developed several proprietary formulation packages for TIVAR® 88 that enhance certain properties without negatively impacting TIVAR® 88's key properties.

UV Resistant
For applications in outdoor environments that receive high exposure to ultra violet rays, TIVAR® 88 UV Resistant prevents premature degradation of material.

Electro Static Dissipative
In dusty or volatile environments, TIVAR® 88 ESD protects against the build-up of electrical charges.

Typical Features:

- Promotes reliable, steady bulk material flow
- Reduces or eliminates arching, ratholing & erratic flow
- Abrasion, chemical and corrosion resistant
- Low coefficient of friction
- No moisture absorption

Product Applications:

- Belt scrapers
- Bunker and chute liners
- Conveyor chain flights
- Conveyor skirting
- Drag chain conveyor liners
- Dragline buckets
- Dust collection hopper liners
- Front end loader bucket liners
- Hopper liners
- Offroad truck beds
- Pugmill paddles
- Railcar liners
- Reclaimer buckets
- Self-unloading ships
- Silo and storage bin liners
- Slider beds
- Transfer chute liners

TIVAR® 88

Standard Thickness (inches) :	**1/4" up to 2" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**Dark Blue**

TIVAR® UHMW

Additional TIVAR Product Offerings

TIVAR® Ceram P®

For high load, high speed and severe sliding abrasion applications, TIVAR® Ceram P® should be THE material of choice. Its high tensile strength and wear resistance have been successful in the lumber, paper, steel and agricultural industries. Composed of virgin polymer and premium additives, TIVAR® Ceram P® is a shatter-resistant alternative to sintered ceramics, reducing parts wear and machine maintenance downtime. TIVAR® Ceram P® is easily recognizable by its lime-green color.

TIVAR® CleanStat™

TIVAR® CleanStat™ can cut downtime and fines build-up in a variety of applications. It eliminates static build-up problems, meets FDA, USDA and 3A-Dairy guidelines for food contact and exhibits a longer wearing, lower coefficient of friction sliding surface than stainless steel. TIVAR® CleanStat™ can be easily fabricated into components and replacement parts that reduce noise levels in plants and require less frequent cleaning. Its welded design capabilities result in seamless welded components.

TIVAR® UV Resistant

Outdoor applications for TIVAR® UV Resistant are endless. The modified formula retains all the key properties of TIVAR® - low friction surface, wear and corrosion resistance, impact strength - and, exhibits enhanced stability for outdoor, UV-exposed applications. In agricultural applications, TIVAR® UV Resistant extends the life and performance of field equipment. Parts made from TIVAR® UV Resistant are self-lubricating and won't corrode or freeze, offering extended life and improved performance whether used on new machinery or as retrofits on weathered equipment.

TIVAR® ESD/EC

If static electricity poses a significant problem in your manufacturing environment, take action by choosing TIVAR® ESD or TIVAR® EC. With a surface resistivity range of 10^5 to 10^9 (ohms/sq) TIVAR® ESD handles tough conditions where dust and static electricity can cause problems. TIVAR® ESD is an ideal material to use when potentially volatile conditions exist, such as those in grain elevators and munitions plants, effectively safeguarding against static discharges. In addition, it resists heat and protects robotics and other products that are sensitive to dust accumulation and electrical charge buildup. Where you need the material to be conductive, TIVAR® EC provides a surface resistivity of $<10^5$.

TIVAR® HPV

With its built in dry lubricant and 80% COF reduction, TIVAR® HPV was developed specifically for use in today's most demanding production environments experiencing; high speeds, high temperatures, high friction,high loads and aggressive cleaning agents. TIVAR® HPV materials and finished parts offer reduced friction, near zero level "slip stick," and a LPV value 18-35% higher (more slick) than competitive materials.

TIVAR® Oil Filled

TIVAR® Oil Filled is the material of choice for packaging, bottling, and food processing and handling applications requiring FDA and USDA compliance. This advanced product uses oil filled polymers to lubricate mating surfaces with a dynamic coefficient of friction formula of less than 0.14. With TIVAR® Oil Filled, conveyors operate more effectively, without the effort and added expense of unnecessary lubrication. On TIVAR® Oil Filled guides, sprockets and conveyor components, chains move easily with less tension, stretching or binding.

TIVAR® UHMW-PE

Typical Properties Comparison TIVAR products

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Specific Gravity	D792	g/cc
Water Absorption, Immersion, 24 hours	D570(2)	%
Water Absorption, Immersion, at Saturation	D570(2)	%
MECHANICAL PROPERTIES		
Hardness, Durometer, Shore D	D2240	---
Tensile Strength	D638	psi
Tensile Strength at 65°C (150°F)	D638	psi
Elongation at Break	D638	%
Tensile Modulus	D638	psi
Flexural Strength	D790	psi
Flexural Modulus	D790	psi
Compressive Strength, 10% Deformation	D695	psi
Compressive Modulus	D695	psi
Shear Strength	D732	psi
Izod Impact (Notched)	D256 Type A	ft.-lb./in.
Coefficient of Friction, Dynamic (Dry vs. Steel)	QTM 55007	---
Sand Slurry (1018 Steel = 100)	QTM 55010	in^3-min./ft.-lb.-hr.
Limiting PV (with 4:1 safety factor applied)	QTM 55007	psi-ft./min.
ELECTRICAL PROPERTIES		
Surface Resistivity per Square	EOS/ESD S11.11	ohm
Dielectric Constant	ASTM D150	@Frequency 1e+6Hz
Dielectric Strength (short term)	ASTM D149	kV/in.
Dissipation Factor	ASTM D150	@Frequency 1e+6Hz
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831	µin./in.-°F
Thermal Conductivity	F433	BTU-in./hr.-ft^2-°F
Melting Point (Crystalline, Peak)	D3418	°F
Maximum Service Temp., Air (Long Term)	---	°F
Deflection Temp at 1.8 MPa (264 psi)	D648	°F
Flammability, UL94 (1/8", est. rating)	---	---
COMPLIANCE PROPERTIES		
3A-Dairy	---	---
Canada AG	---	---
FDA	---	---
NSF	---	---
USDA	---	---
USP Class VI	---	---

TIVAR® UHMW-PE

Typical Properties Comparison TIVAR products

TIVAR® 1000 (Gen Purpose)	TIVAR® ECO (Reprocessed)	TIVAR® DrySlide (Electro Static Dissipat.)	TIVAR® H.O.T. (Higher Oper. Temp.)	TIVAR® 88 (Liner Grade)
0.930	0.930	0.940	0.940	0.930
<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%
<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%	<= 0.010%
66	67	64	68	69
5,800	4,000	5,100	6,800	5,800
400	400	400	400	400
300%	200%	200%	300%	300%
80,000	98,000	87,000	72,500	61,000
3,500	2,000	2,600	3,800	3,200
87,000	81,000	72,000	80,000	72,500
3,000	2,800	2,900	3,000	3,000
80,000	60,000	80,000	80,000	70,000
4,800	---	---	4,800	---
No Break	No Break	No Break	No Break	No Break
0.12	0.14	0.08	0.12	0.12
10	18	10	10	8
3,000	3,000	4,000	3,000	4,000
>= 1.00e + 15	>= 1.00e + 13	1e+05 - 1e+09	>= 1.00e + 13	>= 1.00e + 15
2.30	---	---	2.30	2.30
2,300	---	---	2,300	2,300
0.00050	---	---	0.00050	0.00050
110.0	110.0	110.0	110.0	110.0
2.84	---	---	2.84	2.84
275°	275°	275°	275°	275°
180°	180°	180°	**275°**	180°
116°	116°	116°	116°	116°
HB	HB	HB	HB	HB
Yes	No	No	**Yes**	No
Yes	No	No	No	No
Yes	No	No	**Yes**	No
No	No	No	No	No
Yes	No	No	**Yes**	No
No	No	No	No	No

Polystone® M MDT

Metal Detectable UHMW-PE

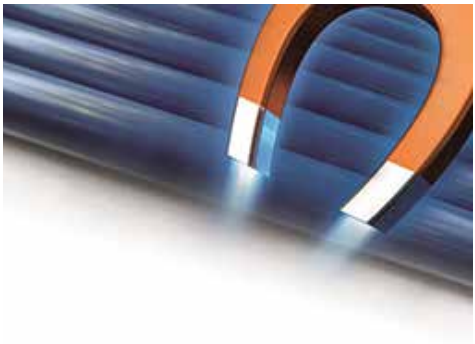
Food processors face the ever present risk of contamination finding its way into their product. The risks and potential financial losses can be significant if not detected early. Rochling Engineering Plastics now offers a ground breaking solution to this problem with the introduction of Polystone® M MDT.

The unique additives in this product allow it to be easily traced by standard metal detectors while continuing to provide the outstanding wear-resistance and sliding properties you would expect from Polystone® M. Designed to replace machined parts made from steel and lower performing plastics, this engineering polymer has high-impact strength, is easily machined and has no moisture absorption.

Polystone® M MDT complies with FDA regulations concerning direct contact with food. Every food processor that utilizes metal detectors in their processing or packaging operations can easily realize the advantages of Polystone® M MDT.

Typical Features:

- Metal detectable and FDA compliant
- Outstanding wear resistance
- High impact strength
- No moisture absorption
- Easily machined



Product Applications:

- Bearings and bushings
- Gears and guides
- Wear strips and sprockets
- Scraper blades
- Pillow blocks

Polystone® M MDT

Standard Thickness (inches) :	**3/8" up to 4" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Diameter (inches) :	**1/2" up to 8" diameter**
Standard Rod Length (inches) :	**120" (10 ft) long**
Standard Color :	**FDA Compliant Blue**

Polystone® M XDT

X-Ray Detectable UHMW-PE

The need for traceable plastics, especially machined parts for filling, sorting and packaging machinery is critical due to strict FDA regulations regarding foreign materials and contaminants. Since Rochling introduced their line of Metal Detectable engineering plastics more than two years ago, these unique products continue to be an effective solution for plastics parts used in open product zone applications.

However, moving forward, Rochling quickly realized a demand for X-ray detectable plastic parts for today's high speed machinery as processors turn to X-ray inspection equipment especially for post-package inspection.

Working together with one of the world's largest food processors and a leading manufacturer of X-ray inspection systems, Polystone® M XDT has proven to be detected with a particle size as small as 3mm cube. Running speeds as fast as 250 feet-per-minute, this product can be detected and automatically sorted to a product hold area for further inspection. It works effectively with various types of packaging including metal cans, plastic and composite containers and glass jars.

Typical Features:

- X-Ray detectable and FDA compliant
- Outstanding wear resistance
- High impact strength
- No moisture absorption
- Easily machined

Product Applications:

- Wear & Filler plates
- Piston & Pocket fillers
- Scraper blades
- Mixer components
- Hopper guides
- Dividers

Polystone® M XDT

Standard Thickness (inches) :	**3/8" up to 4" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Diameter (inches) :	**1/2" up to 6" diameter**
Standard Rod Length (inches) :	**120" (10 ft) long**
Standard Color :	**FDA Compliant Blue**

Rocket Plate

Polyslick® Rocket Plate UHMW-PE

Polyslick® Rocket plate is a UHMW sheet with hemispherical nodules on one side to reduce surface contact facilitation easier movement and rotation of heavy material in any direction. These sheets are easy to install and require almost no maintenance making them ideal for workstation or belt conveyor applications where heavy equipment needs to be moved.

Typical Features:

- Low friction
- Wear resistant
- Impact resistant
- Lightweight
- Chemical and corrosion resistant
- Maintenance free

Product Applications:

- Package handling
- Work stations
- Air cargo support
- Saw infeed/outfeed- belt conveyors
- Scale decks
- Assembly line surfaces

Polyslick® Rocket Plate

Standard Thickness (inches) :	**1/2" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Color :	**Black, Yellow & FDA Natural**

POLYMER INDUSTRIES
GEARED TOWARDS EXCELLENCE

Rocket Plate

Polyslick® Rocket Plate Typical Properties

PROPERTY TESTED	ASTM	UNITS	ROCKET PLATE
PHYSICAL PROPERTIES			
Density	D792	g/cc	0.932
Water Absorption, immersion, 24 hrs	D570(2)	%	<= 0.010%
Water Absorption, immersion	D570(2)	%	<= 0.010%
MECHANICAL PROPERTIES			
Hardness, Durometer, Shore D	D2240	---	64
Tensile Strength	D638	psi	3,500
Tensile Strength @ 65°C (150°F)	D638	psi	---
Elongation at Break	D638	%	300%
Tensile Modulus	D638	psi	---
Abrasion Resistance*	---	---	10
Izod Impact Strength	D4020	KJ/m^2	> 100
Coefficient of Friction, Static	D1894	---	0.20
Coefficient of Friction, Kinetic	D1894	---	0.15
Limiting Pressure Velocity	QTM55007	psi-ft/min	---
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	D257	ohm	1×10^{12}
Volume Resistivity	D257	ohm-cm	1×10^{14}
Dielectric Constant	D150	@Freq 1e+6 Hz	2.30
Dielectric Strength (short term)	D149	kV/m	90.3
THERMAL PROPERTIES			
CTE, Linear	E831	µ in/in-°F	8.3×10^{-5}
Thermal Conductivity	---	BTU-in./hr.•ft^2-°F	---
Melting Point, crystalline, peak	D3418	°F	271°
Maximum Service Temp., Air	---	°F	---
Deflection Temp at 1.8 MPa (264 psi)	D648	°F	---
Flammability	UL 94	---	HB
COMPLIANCE PROPERTIES			
FDA	---	---	Yes (Natural)

The nominal properties listed above are typical of the product but do not reflect normal testing variance and therefore should not be used for specification purposes.

* Refers to relative volumetric abrasion in a sand slurry test with Polystick Natural = 10. The lower the number the better the abrasion resistanc.

Polypropylene

Polypropylene, also known as polypropene, is a thermoplastic polymer available as a Homopolymer (PP-H) or Copolymer (PP-C) Polypropylene is used in a wide variety of applications including packing and labeling, textiles, stationery, automotive components, laboratory equipment, plastic parts and reusable containers of various types.

Polypropylene is an economical material that offers a combination of outstanding physical, chemical, mechanical, thermal and electrical properties not found in any other thermoplastic. Polypropylene is a high corrosion resistant material that has high temperature and tensile strength. Polypropylene possesses excellent resistance to organic solvents and degreasing agents as well as electrolytic attack. Polypropylene has a relatively slippery "low energy surface" that means that many common glues will not form adequate joints. Joining of polypropylene is often done using welding processes.

Compared to low or high density polyethylene, polypropylene has a lower impact strength but superior working temperatures and tensile strength. In addition, polypropylene is lightweight, stain resistant and has a low moisture absorption rate.

Copolymer (PP-C) vs Homopolymer (PP-H)

The homopolymer grade of Polypropylene is the most widely used grade. PP-H offers a high strength to weight ratio, excellent chemical resistance; resisting most acids, alkalis and solvents and has high performance in corrosion environments. Homopolymer is often favored in orthotic and prosthetic devices, pump components, storage tanks, and valve bodies.

- Zero moisture absorption
- Thermoformable
- FDA, NSF, and SSI Standard compliant

Copolymer Polypropylene(PP-C) although softer has better impact strength making it more durable then PP-H. Copolymer is more pliable, has improved resistance to cracking and low temperature toughness making it ideal for components in die cutting pads, fire truck water and foam tanks and plating and anodizing process equipment.

- Easy to fabricate and weld
- Minimal centerline porosity
- FDA and NSF compliant

Polypropylene	
Standard Thickness (inches) :	**1/16" up to 4" thick**
Standard Sheet Size (inches) :	**48" x 96" 48" x 120"**
Standard Diameter (inches) :	**1/4" up to 10" diameter**
Standard Rod Length (inches) :	**48" and 96", varies by diameter**
Standard Color :	**Natural (opaque-white) and Black**

Polypropylene

Typical Properties Comparison

PROPERTY TESTED	ASTM	UNITS	PROTEUS®	PROPYLUX® M
PHYSICAL PROPERTIES				
Specific Gravity	D792	g/cc	0.90	0.92
Water Absorption (24 hrs)	D570(2)	%	max 0.01%	0.01%
Water Absorption at Saturation	D570(2)	%	max 0.01%	0.01%
MECHANICAL PROPERTIES				
Hardness, Shore D	D2240	---	72	R100 (Rockwell)
Tensile Strength, Ultimate	D638	psi	3,400	4,230
Elongation at Break	D638	%	11%	70%
Tensile Modulus	D638	psi	152,000	319,000
Flexural Modulus	D790	psi	180,000	329,000
Flexural Yield Strength	D790	psi	4,800	9,370
Compressive Strength (10% Def)	D695	psi	4,800	6,880
Compressive Modulus	D695	psi	175,000	---
Izod Impact, Notched	D256 Type A	ft.-lb./in.	8.0	3.0
Coefficient of Friction, Dry vs Steel	QTM55007	---	0.24	---
ELECTRICAL PROPERTIES				
Surface Resistivity per Square	D257	ohm	>= 1.00e + 15 ohm	---
THERMAL PROPERTIES				
Melting Point (Crystalline, Peak)	D3418	°F	305°	---
Maximum Service Temp., Air	Long Term	°F	180°	---
Deflection Temp. at 1.8 MPa (264 psi)	D648	°F	212°	201°
Flammability, UL94 (1/8")	Est Rating	---	HB	HB
MISCELLANEOUS PROPERTIES				
FDA Compliance	1 - 10	---	Yes	Yes
Machinability	---	---	3 (1=easiest)	3

Common Trade Names:

- Fortilene® (Solvay Polymers)
- Proteus® (Mitsubishi Chemical Group)
- Polystone® P (Rochling Sustaplast)
- Propylux® (Westlake Plastics)
- Tecafine® PP (Ensinger)
- Versadur® Polypro H & C (Simona)

Product Applications:

- Acid tank / lineup
- Battery cases
- Cutting boards
- Fume hoods
- Machined parts
- Metal plating barrels
- Orthopedic appliances
- Plating modules

Polypropylene

Polystone® P CubX®

The tank construction sheet Polystone® CubX® features a unique inner cube structure for outstanding stiffness properties. Polystone® P CubX® has a high isotropic stiffness with very low weight. Potential steel reinforcement reductions of up to 100%, the time savings in tank construction are enormous.

Typical Features:

- Easy to weld by means of heating element butt welding, hot gas welding and extrusion welding
- High longitudinal and transversal stiffness
- High Chemical resistance
- Light weight, easy handling
- Good thermal insulation

Product Applications:

- Rectangular tanks
- Lids and partitions for round tanks
- Enclosures for ventilation systems
- Retrofitting and repair of rectangular tanks

Polystone P CubX®

Standard Thickness (mm) :	**57 mm thick**
Standard Sheet Size (mm) :	**1500 mm x 2000 mm**
Standard Color :	**Gray RAL 7032 (standard)** **Other colors available by request**

Polypropylene

Polystone® P CubX® Typical Properties

Properties for the full cross-ribbed twin-wall sheet

PROPERTY TESTED	TEST METHOD	UNITS	VALUES
Density	DIN EN ISO 1183	g/cm^3	0.3
Area Weight	---	kg/m^2	17.1
Weld strength lattice/covering sheets	---	MPa	≥ 20
Flatness	DIN EN ISO 15860	mm/m	≤ 3
Water Absorption	DIN EN ISO 62	%	< 0.1
Dielectric Strength	REP internal Tests	kV	> 130
Thermal Conductivity	ISO 8302*	W/(m*K)	Lambda 0.18

** Tested with GHP 500-1, single-sheet process*

Properties for the covering sheets

PROPERTY TESTED	TEST METHOD	UNITS	VALUES
Density, RT	DIN EN ISO 1183	g/cm^3	0.92
Yield Stress	DIN EN ISO 527	MPa	32
Elongation at Break	DIN EN ISO 527	%	> 50
Tensile Modulus of Elasticity	DIN EN ISO 527	MPa	1,500
Notched Impact Strength	DIN EN ISO 179	kJ/m^2	8
Dielectric Constant	IEC 60250	---	2.4
Surface Resistivity	DIN EN 62631-3-2	Ω	$> 10^{14}$

The data stated above are average values ascertained by statistical tests on a regular basis. They are in accordance with DIN EN 15860. The data above are provided purely for information and shall not be regarded as binding unless expressly agreed in a contract of sale.

RÖCHLING Engineered Plastics

Foamlite® P

Lightweight Material for Greater Benefits

Rochling has developed the closed-pore foamed material Foamlite® P especially for applications in which construction materials need to have a very low weight and have a high level of mechanical stability. This opens up a wide range of possibilities in lightweight design. Foamlite® P sheets are nearly 30 per cent lighter than comparable compact sheets. Depending on application, the lightweight sheet saves on materials, conserves resources and is easy to handle.

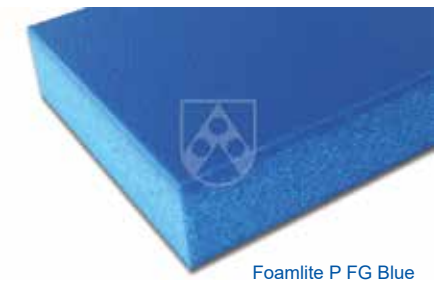
Foamlite® P is a PP-C-based lightweight construction material. With a density of 0.65 g/cm³, Foamlite® P offers clear weight advantages over a sheet made of compact polypropylene at 0.915 g/cm³. The material also has an excellent combination of toughness, high rigidity, strength and chemical resistance. The surface is optionally available with a smooth finish or with a fine grain.

Sealable cutting edges: The open-pored cutting edges of Foamlite® P can be sealed on request in order to cater for specific requirements in terms of appearance and hygiene.

Integrated hinge: Foamlite® P has an "integrated" hinge. It is sufficient to mill a simple 90-degree V-notch into it. The high bending fatigue strength of the material means that the hinge can be folded more than 40,000 times without breaking.

Typical Features:

- Lightweight / low weight
- Long service life
- Superior surface quality
- High mechanical strength
- Good insualtion properties
- Easy processing



Foamlite P FG Blue

Foamlite® P

Standard Thickness (mm) :	**6 8 10 12 14 15 18 mm thick**
Standard Sheet Size (mm) :	**1500 x 3050** **Custom widths up to 1500 mm** **Custom lengths theoretically umlimited**
Standard Colors :	**Black, White, Gray & Rochling Gray** **Fine embossing & cubic grain on one side**

Foamlite® P

Product Offerings and Descriptions

Foamlite® P - Cubic Grain (Step Safety)

Foamlite® P is available in a slip-resistant design with the special "cubic grain" surface structure. The three-dimensional, cube-shaped grain ensures a mechanical frictional connection between floor and shoe. The slip-resistant property of Foamlite® "cubic grain" is tested according to the following guidelines:

- **DIN 51097:** Testing of floor coverings; determination of the anti-slip properties; wet loaded barefoot areas
- **DIN 51130:** Testing of floor coverings; determination of the anti-slip properties; work rooms and work areas with slip risk

Foamlite® P FG Blue (Food Grade)

Foamlite® P FG blue is a special material for the food industry. It meets the requirements of EU Regulation 10/2011 – Plastic materials and articles intended to come into contact with food as well as the requirements of the US Food and Drug Administration (FDA). Its UV resistance makes Foamlite® P FG blue suitable for use in industrial food areas with UV-based hygiene systems. The material is available in blue (RAL 5010). Further colours on request.

Foamlite® P AST

Rochling has developed Foamlite® P AST especially for areas where there is a need for controlled conductance of electrostatic charge and low weight at the same time. High voltage pulses can arise with uncontrolled electrostatic discharge and destroy sensitive equipment, components and workpieces. With Foamlite® P AST, these components are protected by controlled conductance of the electrostatic charge.

Foamlite® G

Foamlite® G is a PE-HD-based lightweight sheet. With a density of 0.65 g/cm³, Foamlite® G has a weight advantage of more than 30 per cent compared with compact polyethylene at 0.95 g/cm³. The material boasts a superior surface quality, is optionally available with a smooth or grained finish and is very easy to process. At the same time, Foamlite® G can be welded with polyethylene (PE) very easily.

LubX® C

High Performance Sliding Materials

With LubX® C and LubX® CV, Röchling Engineering Plastics offers two new high-performance materials, which have outstanding dry-running properties at their disposal. They have been especially developed for applications in materials-handling and automation technologies.

LubX® C. Compared with conventional sliding materials, conveying systems equipped with LubX® C need considerably less energy. The considerably lower coefficient of friction of LubX® C eliminates the possibility of the slip-stick effect (backsliding) almost completely and thus increases process stability.

In the development of LubX® C, great care has not only been taken to minimize the coefficient of friction of the sliding materials, but also to consider the tribological system of the sliding partners in an integrated manner and especially aligned to the particular specific requirements concerned. The individual motion and transport segments of different conveying systems were analyzed, and the relative movements of the elements and the frictional forces arising at the points of contact examined. These frictional forces have a decisive impact on the performance of the conveying system.

Typical Features:

- Especially aligned to polyoxymethylene (POM) and Steel (e.g. chain conveyors)
- Coefficient of friction with POM as sliding partner up to 75% less than UHMW-PE
- Coefficient of friction with Steel as sliding partner up to 60% less than UHMW-PE
- Suitable for contact with food stuffs (FDA/21, CFR 177.1520)
- Noise reducing
- Energy savings

LubX® C Availability

Standard Thickness (inches) :	**1/2" up to 4" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Rod Diameter (inches) :	**1/4" up to 10" diameter**
Standard Rod Length (inches) :	**120" long (10 foot)**
Standard LubX® C Color:	**Light Blue**

LubX® CV

High Performance Sliding Materials

With energy prices rising in the long term, lowering energy costs plays an increasingly more important role in the project planning of production, storage and logistic processes. When utilising components with optimized sliding properties in conveying processes, the conveying power required – and thus the energy applied – may be reduced to a minimum. The performance and efficiency of the plant can thus be considerably enhanced.

LubX® CV was developed especially for systems operated at higher speeds and therefore higher productivity. LubX® CV has exceptionally good sliding properties and at the same time exhibits a very low temperature development. Both results in lower wear and a longer lifespan of the entire system. LubX® CV is an ideal material for sliding and conveyor parts for conveyor technology, automation and the food industry. LubX® CV is available in molded & skived sheets, extruded profiles, rods and custom finished parts per print.

Typical Features:

- Excellent sliding properties even at high velocities and pressue loads
- Excellent dry running properties
- High wear resistance
- Food compliance according to 10/2011/EU, 1935/2004/EC, FDA
- GMP-compliant according to 2023/2006 EC
- Long life, longer maintenance intervals
- Good machinability

LubX® CV Availability

Standard Thickness (inches) :	**1/2" up to 4" thick**
Standard Sheet Size (inches) :	**48" x 120"**
Standard Rod Diameter (inches) :	**1/4" up to 6" diameter**
Standard Rod Length (inches) :	**120" long (10 foot)**
Standard LubX® CV Color:	**Royal Blue**

RÖCHLING Engineered Plastics

EZ-PRO Durawood

EZ-Pro Durawood is a lightweight, protective material that is extremely durable, scratch free, and withstands strong impacts. This material has been used in the automotive, aerospace, and trucking industry for over 30 years.

Typical Features:

- Protects Class A surfaces
- Flexible and unbreakable
- Excellent workability
- Heavy load resistant
- Non-toxic and 100% recyclable
- Lightweight

Compared to traditional materials used to make part protection, transport and storage items for industrial applications, EZ-Pro Durawood is ideal in many respects. It is noted for being flexible, unbreakable and scratch-free. It is easy to machine and can be pieced together using standard screws. It is an excellent choice for anything requiring sawing or cutting, pressing, punching, drilling and milling with standard tools. EZ-Pro Durawood has no sharp edges and it will not splinter. When needed, an ESD (electrostatic discharge) option is available.

Over time customers switching to EZ-Pro Durawood note reduction in part damage, maintenance, and replacement costs. It is also non-toxic and 100% recyclable.

Product Applications:

- Part protection
- Transport containers
- Pallets
- Storage drawers
- Shelf dividers

EZ-PRO/Durawood

Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	VALUES
Density	ISO 845	g/cm^3	0.52
Water Absorption	ISO 62	%	0.22
Bending Strength	ISO 1209-2	MPa	10.8
Bending Young	ISO 1209-2	MPa	644
Compressive Strength (10%)	ISO 844	MPa	32.9
Charpy No Notch	ISO 179-1	kJ/m2	11.841
Charpy with Notch	ISO 179-1	kJ/m2	4.684
Abrasion Index	ISO 9352	g	0.009
Thermal Expansion (23°C - 60°C)	ISO 11359-2	/°C	12.6×10^{-5}

Protection

Holds parts secure and protects Class A Surfaces. Helps prevent scratches or damages.

Flexibility

Flexible enough not to break even if you bend it or hit it.

Lightweight

Half the weight of other materials

EZ-Pro Durawood

Standard Thickness (mm) : 3 mm up to 40 mm thick

Standard Sheet Size (mm) : Width: 60 mm up to 640 mm
Length: 2000 mm

Standard EZ-Pro Color: Yellow

Densetec HMW

High Molecular Weight Polyethylene

Polymer Industries' Densetec HMW is the extruded material needed when Densetec HDPE is not enough and UHMW is not necessary. Densetec HMW has higher impact strength than HDPE and is more abrasion resistant. The fact that Densetec HMW is more wear resistant than standard HDPE, and is more economical than standard UHMW makes it the ideal material for wear applications and machined parts. It may also be used in applications such as snowplow linings and fertilizer spreaders.

Typical Features:

- High impact strength
- Abrasion resistant
- Moisture resistant
- Stain resistant
- Low coefficient of friction
- UV stabilized for outdoor use

Product Applications:

- Snow plow lining
- Fertilizer spreaders
- Ice rink floors
- Dasher boards for hockey rinks
- Various machined parts
- Wear applications

Natural | Black | Red

Densetec HMW

Standard Thickness (inches) :	**1/32" up to 1" thick**
Standard Size (inches) :	**48" x 96"**
Standard Colors :	**Natural (white), Black and Red**

Thermoset Composites

Phenolics, Glass Epoxy and Laminates

Phenolic C & CE 5-2

Phenolic LE 5-3

Molded Rod vs Sheet Rod 5-4

Phenolic XX 5-5

Properties Comparison, Phenolic .....5-6 to 5-7

Phenolic G10/FR4 .....5-8 to 5-9

Phenolic G7, G9, G11 5-10

Phenolic G14 5-11

Properties Comparison, Glass .....5-12 to 5-13

Glastherm HT .....5-14 to 5-15

GPO-3 .....5-16 to 5-17

Alro Online Store 5-18

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

Phenolic C & CE

Canvas Based Industrial Laminate Grade

Phenolic C (NEMA C) consists of a cotton canvas fabric and general-purpose phenolic resin. The product is easy to machine and operates with less noise than metal. In addition, this material is not as abrasive as fiberglass alternatives when used in wear applications. Since it does not spark when struck, Phenolic C can be used in explosion-proof environments.

Phenolic C material is commonly used to make gears, pulleys, rollers, and guides. Phenolic C is a mechanical grade and does not have electrical properties comparable to Phenolic CE.

Phenolic C complies with the requirements of MIL-I-24768/16, Type FBM.

Phenolic CE (NEMA CE) consists of a cotton canvas type fabric and electrically insulating phenolic resin system. NP310E is easy to machine and operates with less noise than metal. In addition, this material is not as abrasive as fiberglass alternatives when used in wear applications.

Phenolic CE can be used in explosion-proof environments. This material is commonly used to make gears, pulleys, rollers, and guides, as well as electrically insulated parts such as control boards.

Phenolic CE complies with the requirements of MIL-I-24768/14, Type FBG

Typical Features:

- Good mechanical properties & toughness
- High impact strength
- Good wear resistance qualities
- Withstand up to 275°F
- Good machinability

Phenolic C/CE

Standard Thickness (inches) :	**1/32" up to 4" thick**
Standard Sheet Size (inches) :	**36" x 48" 48" x 48" 48" x 72" 48" x 96" 48" x 120"**
Rod/Round Diameter (inches) :	**3/16" up to 6" diameter**
Standard Rod Lengths :	**24" and 48" long, varies by diameter**
Tube/Hollow Bar Dia (inches) :	**3/16"OD x 1/8"ID up to 2.50"OD x 1.50"ID**
Standard Tube Lengths :	**24" and 48" long, varies by diameter**
Standard Color :	**Brown (reddish-brown)**

Phenolic LE

Linen Based Industrial Laminate Grade

Phenolic LE (NEMA LE) is used where better machining is needed compared to that offered by other canvas grades. This product consists of a fine-weave linen fabric and electrical grade of phenolic resin. Besides easy machining, Phenolic LE operates with less noise than metal. In addition, this physical material is not as abrasive as fiberglass alternatives when used in wear applications.

Since it does not spark when struck, Phenolic LE can be used in explosion-proof environments. Suitable for smaller and more intricate shapes than those made with Phenolic C, this product is commonly used to make gears, pulleys, rollers, and guides, as well as electrical insulating parts.

Phenolic LE complies with the requirements of MIL-I-24768/13, Type FBE.

Typical Features:

- Outstanding electrical properties
- Easily machined and fabricated
- Dimensionally stable
- Good wear characteristics

Product Applications:

- Gears
- Pulleys
- Rollers
- Guides
- Electrical insulating parts

Phenolic LE	
Standard Thickness (inches) :	**1/16" up to 4" thick**
Standard Sheet Size (inches) :	**36" x 48" 48" x 48" 48" x 96" 48" x 120"**
Rod/Round Diameter (inches) :	**1/16" up to 6" diameter**
Standard Rod Lengths :	**24" and 48" long, varies by diameter**
Tube/Hollow Bar Dia (inches) :	**3/16"OD x 1/8"ID up to 2.50"OD x 1.50"ID**
Standard Tube Lengths :	**24" and 48" long, varies by diameter**
Standard Color :	**Light Brown**

Phenolic Rod

Molded vs Sheet Differences

Phenolic rod can be made in different ways, rod made from sheet and molded rod. The type of rod affects tolerances, standards length, cost, and performance in certain applications. The following explains the differences between the two methods.

Molded Rod features:

- Typically available in random 46" lengths
- Linen and FR4 natural are the only grades available
- From 1/4" diameter up to 5" diameter
- Tolerances consistent from most mills, tighter tolerances on molded
- Approximately 30% more expensive than sheet rod
- Molded and laminated, rolled, make for better compressive strength
- Preferred if machining a tube from rod, molded works better due to the circular lamination pattern from how it is made.

Sheet Rod features:

- Typically available in random 48" lengths
- Available in many grades
- From 1/16" diameter up to 6" diameter
- Tolerances consistent from most mills
- Approximately 30% less expensive than molded rod
- Made by cutting strips out of sheet material
- Majority of Alro in stock material is sheet rod

Molded Rod Sample

Sheet Rod Sample

Phenolic XX

Paper Based Industrial Laminate Grade

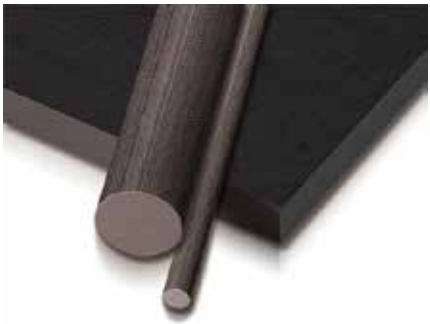
Phenolic XX (NEMA XX) is a paper based phenolic that is a machining grade with less robust electrical properties than those of Phenolic XXX (Phenolic XXX - not stocked, but can be special ordered). Designed for electrical insulation, the product can be used in dry or high humidity conditions.

Applications include barriers, breaker arms, switch panel boards, and relay and switch bases.

This product meets the requirements of MIL-I-24768/11, Type PBG.

Typical Features:

- Extremely high mechanical strength
- Low water absorption
- Superior electrical characteristics
- Good machinability



Product Applications:

- Terminal boards
- Washers
- Sleeves
- Structural components

Phenolic XX	
Standard Thickness (inches) :	**1/16" up to 4" thick**
Standard Sheet Size (inches) :	**36" x 48" 48" x 48" 48" x 96" 48" x 120"**
Rod/Round Diameter (inches) :	**1/16" up to 2-1/4" diameter**
Standard Rod Lengths :	**24" and 48" long, varies by diameter**
Tube/Hollow Bar Dia (inches) :	**3/16"OD x 1/8"ID up to 2.50"OD x 1.50"ID**
Standard Tube Lengths :	**24" and 48" long, varies by diameter**
Standard Color :	**Dark Gray**

Phenolic Grades

	PAPER Phenolic XX	PAPER Phenolic XXX
Military / Fed Spec	**MIL-I-24768/11 Type PBG**	**MIL-I-24768/10 Type PBE**
Specific Gravity	1.35	1.38
Tensile Strength (psi)	17,000	13,000
Compressive Strength (psi)	35,000	35,000
Flexural Strength (psi)	34,000	22,000
Hardness, M Scale	120	101
Bond Strength (psi)	1,500	1,200
Shear Strength (psi)	11,500	12,800
Dissipation Factor 10^6 Cycles, Cond. A	0.040	0.035
Dielectric Constant 10^6 Cycles, Cond. A	5.30	5.10
Electric Strength V/Mil, Cond. A	750	700
Flammability Rating	94HB	94HB
Max Operating Temp. (°F)	284°	284°
Coefficient of Thermal Exp. in/in/°C x 10^{-5}	1.20	1.50
Water Absorption, % 24 hrs	2.00	0.57
Izod Impact Strength (ft/lb/in) @49°C	0.80	0.55

All values given are average based on test samples. The performance characteristics attributed to the products described herein are based on assumptions of general and reasonable use. As results cannot be predicted or guaranteed for any specific set of conditions, each user should make their own determination of these products' suitability for their particular application. 08/2021

Phenolic Grades

CANVAS Phenolic C	CANVAS Phenolic CE	LINEN Phenolic L	LINEN Phenolic LE
MIL-I-24768/16 Type FBM	MIL-I-24768/14 Type FBG	MIL-I-24768/15 Type FBI	MIL-I-24768/13 Type FBE
1.35	1.37	1.34	1.34
11,200	10,000	14,000	13,000
37,000	36,000	35,000	36,000
22,000	17,000	23,000	18,000
103	100	105	100
2,000	1,900	1,700	1,900
14,000	14,000	13,500	13,500
---	0.048	---	0.065
---	5.50	---	5.70
---	550	---	625
94HB	94HB	94HB	94HB
257°	257°	257°	257°
1.10	2.00	1.04	1.80
1.60	2.00	1.04	1.90
1.95	1.70	1.70	1.35

All values given are average based on test samples. The performance characteristics attributed to the products described herein are based on assumptions of general and reasonable use. As results cannot be predicted or guaranteed for any specific set of conditions, each user should make their own determination of these products' suitability for their particular application. 08/2021

Phenolic G-10/FR4

Glass Cloth Epoxy Industrial Laminate Grade

Phenolic G-10/FR4 is a continuous woven glass fabric laminated with an epoxy resin. This grade is extremely high in mechanical strength, has low water absorption and dissipation factors and has superior electrical characteristics, which are exhibited over a wide range of temperatures and humidities.

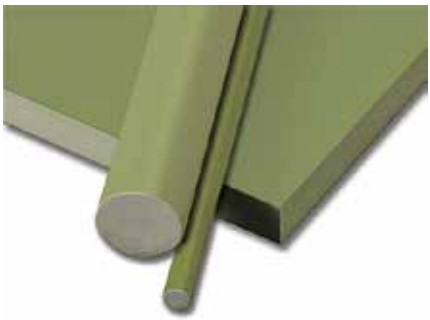
Grade G-10 is used for terminal boards, washers, sleeves, structural components, and parts where the strength to size ratio is critical.

Grade G-10 complies with the requirements of MIL-1-24768/2, Type GEE

Grade FR4 complies with the requirements of MIL-24768/27 Type GGE-F

Typical Features:

- Extremely high mechanical strength
- Superior electrical characteristics
- Low water absorption
- Dimensionally stable



Product Applications:

- Terminal boards
- Washers
- Sleeves
- Structural components
- Electrical insulating parts

Phenolic G-10/FR4

Standard Thickness (inches) :	**1/16" up to 4" thick**
Standard Sheet Size (inches) :	**36" x 48" 48" x 48" 48" x 96" 48" x 120"**
Rod/Round Diameter (inches) :	**1/16" up to 2-1/4" diameter**
Standard Rod Lengths :	**24" and 48" long, varies by diameter**
Tube/Hollow Bar Dia (inches) :	**3/16"OD x 1/8"ID up to 2.50"OD x 1.50"ID**
Standard Tube Lengths :	**24" and 48" long, varies by diameter**
Standard Color :	**Green**

Phenolic G-10/FR4

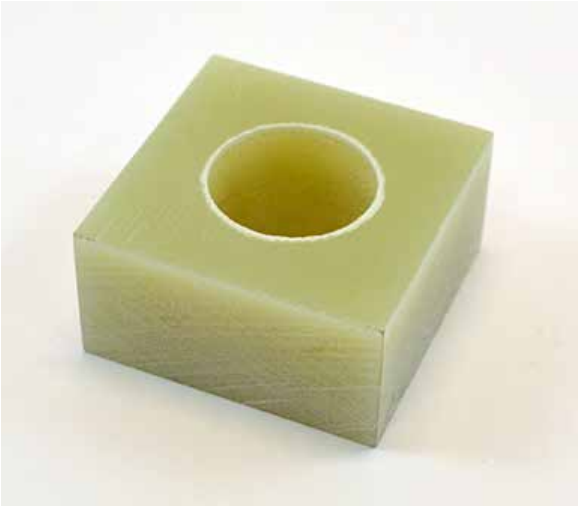
NEMA Grade G-10 vs NEMA Grade FR4

Although they are typically made from the same base material (E-Glass), the epoxy resin used for binding each material is different. This is due to the addition of bromine into the resin for FR-4. “FR’ stands for flame retardant and indicates that the flammability of **FR-4 is in compliance with the UL standard 94V-0.**

The Mil-I-24768 & NEMA specs require similar mechanical and electrical properties for both material grades. However, modern FR-4 resins and manufacturing processes produce superior mechanical and electrical properties compared to G-10. One area where G-10 will actually outperform the FR-4 is when the material application is immersed in salt water.

G-10: Mil-I-24768/2 Type GEE
FR4: Mil-I-24768/27 Type GEE-F

NEMA = National Electrical Manufacturers Association



Phenolic G7, G9, G11

Glass Based Industrial Laminate Grades

Phenolic G-7 (Glass cloth / Silicone)

Phenolic G-7 is a continuous glass fabric laminated with a silicone resin. Grade G-7 is unequalled for high heat and arc resistance applications, and where good mechanical and electrical properties must be exhibited in humid conditions in excess of 500°F.

Phenolic G-7 complies with the requirements of MIL-1-24768/17, Type GSG

G-7 applications include terminal boards, washers, sleeves and structural components. Please inquire for available shapes and sizes.

Phenolic G-9 (Glass cloth / Melamine)

Phenolic G-9 (NEMA G-9) glass melamine laminate is a very hard, flame resistant grade that has excellent arc resistance and electric strength properties even under humid or wet conditions. Phenolic G-5 and G-9 laminate sheet has high mechanical strength and machines well. This product also has good dimensional stability.

Phenolic G-9 complies with the requirements of MIL-I-24768/1, Type GME

G-9 material is especially suited for applications requiring arc and flame resistance as well as stiffness and high mechanical strength. Please contact your Alro sales representative for shapes and sizes.

Phenolic G-11 (Glass cloth / Epoxy)

Phenolic G-11 (NEMA G-11) is a high performance thermoset epoxy fiberglass composite that provides higher strength than similar products. Phenolic G-11 is chosen over high-temperature mat glass thermoset composites and high performance glass-filled thermoplastics because of its excellent machining characteristics, outstanding dimensional stability, superior creep resistance, and excellent high-temperature and performance characteristics.

Phenolic G-11 complies with the requirements of MIL-1-24768/3, Type GEB.

G-11 is considered the premier material for use as Class F insulation in electrical power generation and transmission equipment. Please refer to page #202 for more information on G-11. Please contact your Alro sales rep for shapes and sizes.

Phenolic G14

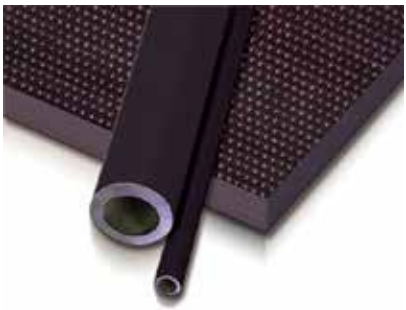
Acculam® Matrix HT™ Industrial Laminate Grade

Acculam® Matrix HT™ is a new thermoset composite comprised of woven fiberglass and a unique blend of high temperature resin binders developed for applications that demand superior performance over wide temperatures. It maintains a high percentage of mechanical and insulating properties up to 500°F.

Acculam Matrix HT has outstanding flexural and impact strength. It maintains rigidity with excellent dimensional stability and creep resistance over wide temperature ranges, as well as good resistance to moisture, chemicals, alkali and acids. It does not melt or soften at high temperatures, and offers users extended application capability beyond typical NEMA grades. Unlike thermoplastics, Matrix HT does not lose strength.

Typical Features:

- Maintains excellent physical properties up to 500°F
- Outstanding flexural and impact strength
- Creep resistance over a wide temperature range
- Good chemical resistance to alkali and acids
- Excellent dimensional stability
- Good moisture resistance



Product Applications:

- Spacers
- Arc chutes
- Stand-offs
- Control panels & fuses
- Structural supports
- Motor wedges
- Test boards
- Switch gears
- Motor mounts
- Flanges
- Shims
- Shields, Heat shields
- Framework
- Braking systems
- Thermal insulators

Acculam® Matrix HT™

Standard Thickness (inches) :	**.016" up to 2" thick**
Standard Sheet Size (inches) :	**48" x 48" 48" x 96"**
Tube/Hollow Bar Dia. (inches) :	**.500"ID (minimum)** **.062" wall (minimum)** **Up to 10" Diameter (maximum)**
Standard Tube Lengths :	**48" (4 ft) randoms**
Standard Color :	**Eggplant (Purple) and Black**

Phenolic Glass Grades

	GLASS Phenolic G-3	GLASS Melamine G-9
Military / Fed Spec	**MIL-I-24768/18 Type GBG**	**MIL-I-24768/1 Type GME**
Specific Gravity	1.85	1.85
Tensile Strength (psi)	42,000	39,000
Compressive Strength (psi)	76,000	70,000
Flexural Strength (psi)	55,000	55,000
Hardness, M Scale	110	115
Bond Strength (psi)	1,500	1,900
Shear Strength (psi)	18,000	18,000
Dissipation Factor 10^6 Cycles, Cond. A	0.023	0.015
Dielectric Constant 10^6 Cycles, Cond. A	7.30	7.00
Electric Strength V/Mil, Cond. A	600	450
Flammability Rating	94HB	94V-O
Max Operating Temp. (°F)	284°	284°
Coefficient of Thermal Exp. in/in/°C x 10^{-5}	1.00	1.50
Water Absorption, % 24 hrs	2.00	0.60
Izod Impact Strength (ft/lb/in) @49°C	12.00	12.50

All values given are average based on test samples. The performance characteristics attributed to the products described herein are based on assumptions of general and reasonable use. As results cannot be predicted or guaranteed for any specific set of conditions, each user should make their own determination of these products' suitability for their particular application. 08/2021

Phenolic Glass Grades

GLASS Epoxy G-10	GLASS Epoxy FR4	GLASS Epoxy G-11	GLASS Silicone G-7
MIL-I-24768/2 Type GEE	MIL-I-24768/27 Type GEE-F	MIL-I-24768/3 Type GEB	MIL-I-24768/17 Type GSG
1.80	1.85	1.82	1.78
40,000	38,000	37,000	18,000
65,000	66,000	63,000	45,000
75,000	60,000	75,000	25,000
110	115	112	105
2,200	2,300	2,200	900
19,000	21,500	22,000	17,000
0.020	0.022	0.020	0.003
5.00	4.80	5.00	4.20
800	800	900	400
94HB	94V-O	94HB	94V-O
284°	284°	356°	428°
1.00	1.00	1.10	1.00
0.11	0.10	0.20	0.20
14.00	14.00	12.00	6.50

All values given are average based on test samples. The performance characteristics attributed to the products described herein are based on assumptions of general and reasonable use. As results cannot be predicted or guaranteed for any specific set of conditions, each user should make their own determination of these products' suitability for their particular application. 08/2021

Glastherm HT

A fiberglass reinforced, mineral filled sheet, with heat resistant polyester thermo-setting resin. This material offers a high compressive strength and heat resistance with a service temperature of 550° F while also reducing heat loss. It is finished to a close thickness tolerance making it great for insulation between the fold and the press or within a mold.

It is completely Asbestos free and durable enough to withstand rough handling during the installation process. It can be cut, die-cut, machined and stamped with standard metal working equipment. Diamond cutting tools are recommended for longer life.

Typical Features:

- High Hot compressive strength
- Low thermal conductivity
- Oil and moisture resistant
- Helps control temperature
- Faster mold setup

Product Applications:

- Thermal barrier
- Thermal install
- Pipelines
- Chemical processing industry
- Oil and gas industry

Glasstherm HT

Standard Thickness (inches) :	**1/8" up to 2" thick**
Standard Sheet Size (inches) :	**36 x 72 and 48 x 96**
Standard Color :	**Natural/White**

Glastherm HT

Typical Properties

PROPERTY TESTED	ASTM	UNITS	GLASTHERM HT
PHYSICAL PROPERTIES			
Density	D792	lbs/ft^3	123
Water Absorption	D570	% by wt.	0.20
Coefficient of Therm Expansion	D696	$in./in./^oC \times 10^{-5}$	11.62.21
Thermal Conductivity	C177	$BTU \cdot in./hr. \cdot Ft^2 \cdot ^oF$	1.90
Maximum Service Temperature	---	^oF	550^oF
MECHANICAL PROPERTIES			
Flexural Strength	D790	psi	31,000
Compressive Strength			
@75°F / 24°C	D695	psi	49,000
@302°F / 150°C	D695	psi	27,000
@392°F / 200°C	D695	psi	18,000
@550°F / 288°C	D695	psi	17,000
Compressive Modulus	D695	psi	1,800,000
IZOD Impact Strength (notched)	D256	Ft.lb./in.	8
ELECTRICAL PROPERTIES			
Electrical Strength-Perpendicular S/T in Air	D149	Vpm	50
FLAME and SMOKE			
UL Subject 94	UL 94	0.94 in	HB

GPO-3

Electrical Grade Sheet Laminate

GPO-3 is an electrical grade sheet laminate. All grades of our electrical grade sheet laminates are produced using polyester resin and fiberglass reinforcement. They are U.L. recognized and are available in 36" x 72" and 48" x 96" sheet sizes. The sheets are manufactured in thickness ranging from 1/32" to 1" thick, with most sizes in stock for immediate shipment.

Polyply L-50: Track resistant, flame retardant laminate which meets or exceeds NEMA GPO-3 requirements.

U.L. Recognition File Number: Polyply #L50, NEMA Grade GPO-3, Red (color), #E82624.

Typical Features:

- Electrical insulation
- Track resistance
- Self extinguishing UL94 (V-0)
- Chemical resistance
- Impact & Abrasion resistant
- Good mechanical strength
- Low conductivity
- Low smoke

Product Applications:

- Mounting panels in switch bars
- Phase & End barriers
- Insulating supports
- Bus bar supports
- Transformers
- Antenna bases
- Spacers

GPO-3

Standard Thickness (inches) :	**1/32 1/16 3/32 1/8 3/16 1/4 3/8 1/2 5/8 1**
Standard Sheet Size (inches) :	**36 x 72 and 48 x 96**
Standard Color :	**Red**

GPO-3

Electrical Grade Sheet Laminate

PROPERTY TESTED	ASTM UL TEST#	UNITS	POLYPLY L50 GPO-3
GENERAL INFORMATION			
Polyply Grade	---	---	L50
NEMA Grade	---	---	GPO-3
Color	---	---	RED
U.L. Recognition File #	---	---	E82624
MECHANICAL PROPERTIES			
Tensile Strength	D638	psi	10,000
Flexural Strength	D790	psi	23,200
Compressive Strength	D695	psi	32,800
Flexural Modulus	D790	psi x 10^6	1.23
Shear Strength	D732	psi	14,000
Izod Impact Strength (Notched)	D256	ft-lb/in	8.2
Water Absorption	D570	% by weight	0.21
Hardness, Barcol	D2583	---	50
Specific Gravity	D792	---	1.8
ELECTRICAL PROPERTIES			
Dielectric Strength	D149	volts/mil	400
Dielectric Strength (parallel in oil)	D149	kV	57
High Voltage Arc Resistance	D495	sec	200+
Dielectric Constant at 60 Hz	D150	---	4.8
Dielectric Constant at M Hz	D150	---	4.7
Dissipation Factor at 60 Hz	D150	---	0.013
Dissipation Factor at M Hz	D150	---	0.011
Comparative Tracking Index	D3638	volts	500+
THERMAL PROPERTIES			
Coefficient of Thermal Expansion	D696	in/in/°C x 10^{-5}	2.0
Thermal Conductivity	C177	btu/hr/ft^2/in/°F	1.9
UL Temp Index - Electrical	UL746B	°C	120
UL Temp Index - Mechanical	UL746B	°C	140
FLAME RESISTANCE PROPERTIES			
U.L. Subject 94	UL 94	---	94V0

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

Alro Online Store

MyAlro.com

Aluminum • Alloys • Carbon Steel • Stainless Steel • Red Metals • Plastics

Did you know Alro also offers online shopping and e-business solutions for all of our customers? Visit the Alro Online Store from your computer or mobile device 24 hours a day. Set up your company account and purchase metals and plastics from our vast inventory.

Alro utilizes systems technology to achieve the benefits of e-Business in raw material procurement processes.

- **Business to Business (B2B) – Helps reduce purchasing transaction costs.**
- **Web Ordering (MyAlro.com) – Helps with material selection, quoting and estimating.**
- **Automated Inventory Replenishment (APOS) – helps reduce Kan Ban replenishment costs**
- **Summary Billing – helps reduce admin costs of processing raw material payables**
- **Advance Shipping Notices – helps reduce receiving time**

Alro computers retrieve business information from customers/vendors computers via the internet. During the process we pickup and deliver electronic business documents. This process typically does not require any programming on the part of our customers, as Alro systems are designed to accept virtually any customer document format. Some examples of these documents are as follows:

- **Purchase orders**
- **Invoices**
- **Quotes**
- **POD - Electronic Proof of Delivery**
- **ACH Payment notifications**
- **Mill Certifications**
- **CAD drawings**
- **Burn prints**
- **Material releases**

Polycarbonate

Grades, Descriptions and Sizes

Polycarbonate, General 6-2

TUFFAK® GP ..... 6-2 to 6-3

TUFFAK® AR ..... 6-4 to 6-5

TUFFAK® FD 6-6

TUFFAK® SL 6-7

TUFFAK® LD 6-8

TUFFAK® Other Grades ..... 6-9 to 6-11

Recycled Polycarbonate ..... 6-12 to 6-13

TUFFAK® MG & WG Thick Gauge ..... 6-14 to 6-15

Zelux® Machine & Window Grade ..... 6-16 to 6-17

Hygard® Bullet & Blast Resistant ..... 6-18 to 6-19

Twinwall & Multiwall sheet 6-20

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

Polycarbonate

Polycarbonate Sheets

Polycarbonate is a unique engineering thermoplastic which has an excellent balance of clarity and toughness while displaying a wide range of high-heat deflection temperatures. Toughness is the most outstanding feature of polycarbonate; for applications such as safety shields and sports equipment this durable material is without equal. Other characteristics include excellent electrical properties, dimensional stability and inherent ignition resistant properties. The close tolerance machinability and transparency of this material make it appropriate for applications which require high performance characteristics.

Polycarbonate is available in both general purpose and FDA grades. General purpose polycarbonate is enhanced by the addition of thermal stabilizers, U.V. stabilizers, mold release agents, glass fibers and ignition resistant additives. Fabrication techniques such as milling, forming or cutting can be performed using standard equipment and tools.

Common Trade Names:

- AZCARB (AZ Polymers)
- TUFFAK® (Plaskolite)
- Lexan® (Sabic)
- Palsun® (Palram Industries Ltd)
- Altron™ PC (Mitsubishi Chemical)
- Sustanat® PC (Rochling Sustaplast)
- Tecanat® (Ensinger)
- Zelux® (Westlake Plastics)

TUFFAK® GP (General Purpose)

TUFFAK® GP general purpose polycarbonate sheet is a polished surface, UV stabilized polycarbonate product for use in glazing and industrial applications, and features outstanding impact strength and superior dimensional stability. TUFFAK® GP polycarbonate sheet's five year warranty against breakage, along with its UL 94 VO rating on gauges .220" and greater, make it cost effective in a wide range of industrial glazing, design, and structural applications, and thermoformed and fabricated components.

Typical Features:

- Outstanding impact strength
- Superior dimensional stability
- High temperature resistance
- High optical clarity
- Lightweight & thermoformable

Product Applications:

- Industrial glazing
- Machine guards
- Structural parts
- Thermoformed parts
- Fabricated parts

TUFFAK® GP

Standard Thickness (inches) :	**.030" up to .500" thick**
Standard Sheet Size (inches) :	**48 x 96, 48 x 120, 60 x 96, 60 x 120, 72 x 96 and 72 x 120**
Standard Colors :	**Clear A00, Bronze K09, Gray I30, Dark Gray I35 and Black L10**

Run to Size - Custom size sheet solutions are available to lower costs and reduce waste, please inquire.

Polycarbonate

TUFFAK® GP - Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	TUFFAK® GP
PHYSICAL PROPERTIES			
Specific Gravity	ASTM D792	---	1.20
Refractive Index	ASTM D542	---	1.586
Water Absorption, 24 hours	ASTM D570	%	0.15
Poisson's Ratio	ASTM E132	---	0.38
MECHANICAL PROPERTIES			
Tensile Strength, Ultimate	ASTM D638	psi	9,500
Tensile Strength, Yield	ASTM D638	psi	9,000
Tensile Modulus	ASTM D638	psi	340,000
Elongation	ASTM D638	%	110
Flexural Strength	ASTM D790	psi	13,500
Flexural Modulus	ASTM D790	psi	345,000
Compressive Strength	ASTM D695	psi	12,500
Compressive Modulus	ASTM D695	psi	345,000
Izod Impact, Notched, 1/8"	ASTM D256	ft•lbs/in	18
Izod Impact, Unnotched, 1/8"	ASTM D256	ft•lbs/in	60 (No Failure)
Shear Strength, Ultimate	ASTM D732	psi	10,000
Shear Strength, Yield	ASTM D732	psi	6,000
Shear Modulus	ASTM D732	psi	114,000
Rockwell Hardness	ASTM D785	---	M70 (R118)
THERMAL PROPERTIES			
Coefficient of Thermal Expansion	ASTM D696	in/in/°F	3.75×10^{-5}
Coefficient of Thermal Conductivity	ASTM C177	BTU•in/hr•ft²•°F	1.35
Heat Deflection Temp @ 264 psi	ASTM D648	°F	270°
Heat Deflection Temp @ 66 psi	ASTM D648	°F	280°
Brittleness Temperature	ASTM D746	°F	-200°
ELECTRICAL PROPERTIES			
Dielectric Constant @ 10 Hz	ASTM D150	---	2.96
Dielectric Constant @ 60 Hz	ASTM D150	---	3.17
Volume Resistivity	ASTM D257	ohm•cm	8.2×10^{16}
Dissipation Factor @ 60 Hz	ASTM D150	---	0.0009
Arc Resistance			
-Stainless Steel Strip electrode	ASTM D495	Seconds	10
-Tungsten Electrodes	ASTM D495	Seconds	120
Dielectric Strength, in air, 1/8"	ASTM D149	V/mil	380
FLAMMABILITY			
Horizontal Burn, AEB	ASTM D635	in	<1
Ignition Temperature, Self	ASTM D1929	°F	1,070
Ignition Temperature, Flash	ASTM D1929	°F	870
Flame Class @ 0.060"	UL 94	---	HB

Polycarbonate

TUFFAK® Abrasion Resistant Sheets

TUFFAK® AR polycarbonate sheet is a one or both sides hard-coated polycarbonate product, It has higher abrasion resistance and surface hardness. TUFFAK's inherent performance benefits remain of high impact strength and clarity. The proprietary hard-coat also provides chemical resistance and long lasting outdoor weathering performance.

This product is available in clear, a range of standard tints, or can be custom matched to any color. TUFFAK AR polycarbonate sheet has a seven (7) year Limited Product Warranty against breakage, yellowing, and hazing. TUFFAK 15 polycarbonate sheet has a fifteen (15) year Limited Product Warranty against breakage, yellowing, and hazing. The terms of the warranty are available on request.

Typical Features:

- High impact strength
- Superior abrasion resistance
- Superior long-term weatherability
- High optical clarity
- Limited product warranty

Product Applications:

- Bus and transportation shelters
- Glazing in schools
- Public buildings
- Medical and Correctional facilities

Security Ratings for AR 0.500":

- Forced Entry & Containment
- ASTM F 1233.08 Class 2.0 Body Passage
- ASTM F 1233.08 Class 1.4 Contraband Passage
- ASTM F 1915 Grade 3
- H.P. White TP 0500 Level 1 Sequence 8

TUFFAK® AR

Standard Thickness (inches) :	**TUFFAK AR - .118" up to .500" thick** **TUFFAK 15 - .236" up to .500" thick**
Standard Sheet Size (inches) :	**48 x 96, 60 x 96 and 72 x 96**
Standard Colors :	**Clear A00, Bronze K09, Gray I30, Dark Gray I35 and Green H35**

Polycarbonate

TUFFAK® AR - Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	TUFFAK® AR
PHYSICAL PROPERTIES			
Specific Gravity	ASTM D792	---	1.20
Refractive Index	ASTM D542	---	1.586
Water Absorption, 24 hours	ASTM D570	%	0.15
Poisson's Ratio	ASTM E132	---	0.38
MECHANICAL PROPERTIES			
Tensile Strength, Ultimate	ASTM D638	psi	9,500
Tensile Strength, Yield	ASTM D638	psi	9,000
Tensile Modulus	ASTM D638	psi	340,000
Elongation	ASTM D638	%	110
Flexural Strength	ASTM D790	psi	13,500
Flexural Modulus	ASTM D790	psi	345,000
Compressive Strength	ASTM D695	psi	12,500
Compressive Modulus	ASTM D695	psi	345,000
Izod Impact, Notched, 1/8"	ASTM D256	ft•lbs/in	18
Izod Impact, Unnotched, 1/8"	ASTM D256	ft•lbs/in	60 (No Failure)
Shear Strength, Ultimate	ASTM D732	psi	10,000
Shear Strength, Yield	ASTM D732	psi	6,000
Shear Modulus	ASTM D732	psi	114,000
Rockwell Hardness	ASTM D785	---	M70 (R118)
THERMAL PROPERTIES			
Coefficient of Thermal Expansion	ASTM D696	in/in/°F	3.75×10^{-5}
Coefficient of Thermal Conductivity	ASTM C177	BTU•in/hr•ft^2•°F	1.35
Heat Deflection Temp @ 264 psi	ASTM D648	°F	270°
Heat Deflection Temp @ 66 psi	ASTM D648	°F	280°
Brittleness Temperature	ASTM D746	°F	-200°
ELECTRICAL PROPERTIES			
Dielectric Constant @ 10 Hz	ASTM D150	---	2.96
Dielectric Constant @ 60 Hz	ASTM D150	---	3.17
Volume Resistivity	ASTM D257	ohm•cm	8.2×10^{16}
Dissipation Factor @ 60 Hz	ASTM D150	---	0.0009
Arc Resistance			
-Stainless Steel Strip electrode	ASTM D495	Seconds	10
-Tungsten Electrodes	ASTM D495	Seconds	120
Dielectric Strength, in air, 1/8"	ASTM D149	V/mil	380
FLAMMABILITY			
Horizontal Burn, AEB	ASTM D635	in	<1
Ignition Temperature, Self	ASTM D1929	°F	1,070°
Ignition Temperature, Flash	ASTM D1929	°F	870°
Flame Class @ 0.060"	UL 94	---	HB

Polycarbonate

TUFFAK® FD - FDA Compliant Sheet

TUFFAK® FD sheet is a non-UV stabilized transparent polycarbonate product which complies with FDA regulation 21 CFR § 177.1580 requirements for food contact. It features outstanding impact strength, superior dimensional stability, high temperature resistance, and high clarity. Ideally suited for demanding applications in food processing environments, as well as medical applications, this lightweight thermoformable sheet is also easy to fabricate and decorate. TUFFAK® FD sheet is offered with a five (5) year Limited Product Warranty against breakage. The terms of the warranty are available upon request.

Typical Features:

- FDA compliant
- Outstanding impact strength
- Chemical resistance
- Superior dimensional stability
- High temperature resistance
- High clarity

Product Applications:

- Food processing equipment & guards
- Bulk food bins
- Candy molds
- Sneeze guards
- Single use autoclave packaging
- Hospital trays & incubators
- Bassinets
- Medical device storage containers

TUFFAK® FD

Standard Thickness (inches) :	**.060" up to .500" thick**
Standard Sheet Size (inches) :	**48" x 96" and 60" x 96"**
Standard Colors :	**Clear (0A00)**

Polycarbonate

TUFFAK® SL - Sign Grade Sheet

TUFFAK SL Sign Grade sheet is a polycarbonate product with an advanced UV resistance technology that promotes long lasting outdoor weathering performance. It features outstanding impact strength, excellent dimensional stability, high temperature resistance, and high clarity. This lightweight thermoformable sheet is also easy to fabricate and decorate.

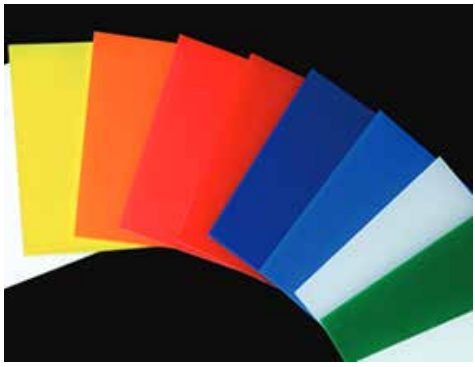
TUFFAK SL is offered in clear, a wide range of standard sign colors, or can be custom matched to any color. The product, available in either sheet or reels, has a proven track record of outstanding performance in extreme environments and meets the UL 879 standard for electric sign components. A ten (10) year limited product warranty is available for both clear and colors for breakage resistance. Clear sheet is also covered for weathering resistance. The terms of the warranty are available upon request.

Typical Features:

- Advanced UV resistance
- Excellent dimensional stability
- Outstanding impact strength
- High temperature resistance
- Lightweight and thermoformable

Product Applications:

- Flat and formed sign faces
- Channel letters



TUFFAK® SL

Standard Thickness (inches) :	**.118" up to .500"**
Standard Sheet Size (inches) :	**Width: 48", 60" and 72"** **Length: 96" and 120"**
Standard Colors :	**Variety of colors**
Reels & Coils Thickness (inches):	**.118", .150" and .177" thick**

Polycarbonate

TUFFAK® LD - Light Diffusing Sheet

TUFFAK® LD sheet is a highly UV stable polycarbonate product designed to provide superior light diffusion characteristics while maintaining high light transmission. The proprietary diffuser technology eliminates visible hot spots from pinpoint LED lights in typical flat and formed sign applications. The sheet is easy to form, fabricate and decorate and has excellent impact strength and dimensional stability.

Typical Features:

- Eliminates visible hot spots from LED lights
- Thinner deep draw areas retain strength
- Extensive inventory in sheet and reel stock
- Dimensional stability
- Clear & industry standard colors
- Custom colors and sheets

Certifications:

- UL 94 V-2, Flammability 0.118″– 0.177″
- UL 94 V-0, Flammability 0.236″– All colors
- UL 879 standard for use in electric signs
- Florida Building Code 2017, 6th Ed. High Velocity
- Hurricane Zone classified
- Miami Dade NOA
- UL 972: Burglary Resistant Glazing Materials: UL File #BP2126

TUFFAK® LD Standard Colors

Standard Plaskolite Color	Standard Industry Color	Standard Gauge
White / B48	2447	0.093" - 0.236"
White / B27	7328	0.093" - 0.236"
Red / D96	2283	0.118" - 0.177"
Red / D99	2793	0.118" - 0.177"
Blue / F84	2114	0.118" - 0.177"
Blue / F85	2051	0.118" - 0.177"
Green / H87	2108	0.118" - 0.177"
Yellow / M72	2037	0.118" - 0.177"
Orange / C59	2119	0.118" - 0.177"

Polycarbonate

TUFFAK® FI - High Flame Resistance sheet

TUFFAK® FI sheet is a flame retardant, non-UV stabilized, clear polycarbonate product with a UL 94 V-0 rating at 0.060″ and UL 94 5VA rating at 0.118″. It features high impact strength, superior dimensional stability, high temperature resistance, and high clarity. This lightweight thermoformable sheet is also easy to fabricate and decorate.

Typical Features:

- High impact strength
- Superior dimensional stability
- High optical clarity
- High temperature resistance

Product Applications:

- Electrical devices
- Equipment housings
- Switchgear covers
- Light fixtures

Availability:

- In Clear sheet, .060" and .125" thick and 48" x 96" sheet size.

TUFFAK® LF - Low Flammability sheet

TUFFAK® LF low flammability polycarbonate sheet is a flame inhibiting UV stable polycarbonate sheet. It meets the stringent UL 94 V-0 rating at 0.080" thickness, and conforms to FAR 25.853 (a), 1, (i) and (a), 1, (ii). Applications include interior aircraft components, switchgear covers, electrical devices, thermoformed equipment housings, and other current-carrying components.

Typical Features:

- High impact strength
- Superior dimensional stability
- High optical clarity
- High temperature resistance

Product Applications:

- Electrical devices
- Equipment housings
- Switchgear covers
- Light fixtures

Availability:

- In Clear sheet, .060" and .125" thick and 48" x 96" sheet size.

PLASKOLITE, INC.

Polycarbonate

TUFFAK® CA - Class A Fire Rating sheet

TUFFAK CA is an optical grade transparent polycarbonate sheet is designed to meet International Building Code (IBC) Class A flammability for interior wall and ceiling applications. This sheet product is virtually unbreakable, has high temperature resistance, high clarity and passes the National Fire Prevention Association (NFPA) 286 flammability requirement.

TUFFAK CA has been fire tested and certified in numerous installation configurations; both on and off wall and off ceiling. For maximum fire resistance, TUFFAK CA meets IBC code compliance for Class A performance when installed to specification.

Typical Features:

- Meets IBC flammability for Class A performance
- Passes NFPA 286
- UV stable
- Thermoformable
- Four approved attachment methods:
  - Direct to wall with four panel screws
  - Wall standoffs
  - Wall H-channels for seamless appearance
  - Ceiling standoff/hanger bars

Mounting Gauges:

- Walls: 0.118" - 0.236"
- Ceilings: 0.118" - 0.500"

TUFFAK® CA

Standard Thickness (inches) :	**.118", .236" and .500"**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Colors :	**Clear**

Please inquire for patterns, standard & diffusing colors and hard coated.

Polycarbonate

TUFFAK® WC - Weld Curtain sheet

TUFFAK WC sheet is a polished surface, transparent polycarbonate sheet product designed for welding curtain and screen applications. The sheet can also be used in applications requiring UV light blocking such as screens in tanning salons and intense sunlit areas. It features outstanding impact strength, superior dimensional stability, high temperature resistance, high clarity and it is light weight and easy to fabricate. The sheet protects individuals against intense and harmful light emitted during arc welding. TUFFAK WC polycarbonate sheet is offered with a five (5) year Limited Product Warranty against breakage. The terms of the warranty are available upon request.

TUFFAK® IR - Welding Face Shields

TUFFAK IR is a polycarbonate sheet product developed to meet ANSI Z87.1, EN 169, and CSA Z94.3 standards for face shield applications. Proprietary additive systems block UV and IR light providing protection during gas flame welding and cutting operations and meeting the requirements for welding shades 3 and 5. Polycarbonate's toughness provides outstanding impact performance and state-of-the-art extrusion manufacturing delivers high optical quality needed for face shield applications.

TUFFAK® LS - Laser Shielding sheet

Working with high intensity lasers doesn't need to lead to unsafe conditions. Using TUFFAK LS for laser shielding barriers protects eyes and skin from being harmed by accidental exposure to a laser beam. By installing specialty tinted safety screens, windows, enclosures and partitions of optically clear polycarbonate, high visibility is achievable while still maintaining the highest personal safety standards. TUFFAK LS is available in 0.118″, 2′x 4′, 4′x 8′ sheets and in three standard transparent colors; IR blocking light gray, visible light blocking bright amber and UV blocking yellow.

TUFFAK LS polycarbonate sheets are designed for a wide range of applications, including door and room windows, standing panels and screens, modular barriers, and enclosures.

PLASKOLITE, INC.

Polycarbonate

Recycled Polycarbonate sheet

Alro Plastics also offers recycled polycarbonate sheet as an eco-friendly alternative. We stock both post-industrial and post-consumer sheets. As more focus is placed on plastics and their role in society, we support our customers' environmental, social and governance (ESG) initiatives.

Recycled polycarbonate sheets are available in a wide range of thicknesses, colors and special effects. We can also supply recycled PC in run-to-size options.

Common Trade Names:

- TUFFAK® R (Plaskolite)
- AZCARB RENEW (AZ Plastics)

Typical Features:

- Optically clear extruded polycarbonate sheet with recycled polycarbonate content collected, separated and recovered back in the extrusion process.
- Maintains high quality and impact resistance.
- Eliminates waste and enables a circular thermoplastic ecosystem.
- Satisfies LEED Materials & Resources certified applications.
- Supports sustainability goals by meeting Environmental, Social, and Governance initiatives.

TUFFAK® R

TUFFAK® R is a recycled optically clear extruded polycarbonate sheet. TUFFAK® R's industry leading **up to 90% post-industrial recycled** content by collecting, separating and processing recovered polycarbonate sheet back into the extrusion process. Used by the worlds top brands for environmental responsibility through the use of sustainable products.

TUFFAK® R

Standard Thickness (inches) :	**.118", .177" and .236"**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Colors :	**Clear**

Polycarbonate

Recycled Polycarbonate sheet

AZCARB RENEW is the first truly closed loop sustainable Post Consumer extruded polycarbonate sheet. AZCARB RENEW is domestically manufactured in Gurnee, IL utilizing the newest state-of-the-art extrusion technology in an ISO 8 certified clean room environment. This **high-quality 75% post-consumer reprocessed** polycarbonate sheet is offered with warranty's against breakage and loss of Light Transmission in the UV2 format.

	TEST METHOD	UNITS	AZCARB RENEW
PHYSICAL PROPERTIES			
Specific Gravity	ASTM D792	---	1.20
Rockwell Hardness	ASTM D785	M scale	60
OPTICAL PROPERTIES			
Refractive Index @ 72°F	ASTM D542	---	1,588
Light Transmission, Clear @0.118"	ASTM D1003	%	84
Haze	ASTM D1003	%	1.10
MECHANICAL PROPERTIES			
Tensile Strength, Yield	ASTM D638	psi	8,800
Tensile Strength, Ultimate	ASTM D638	psi	9,150
Tensile Modulus	ASTM D638	psi	300,000
Tensile Elongation	ASTM D638	%	150
Flexural Strength, Yield	ASTM D790	psi	14,000
Flexural Modulus	ASTM D790	psi	348,000
Izod Impact Strength, Notched	ASTM D256	ft•lbs/in	2.10
Charpy Impact, Notched	ASTM D6110	ft•lbs/in	2.80
Instrumental Drop Dart	ASTM D3763	ft•lbs	96
THERMAL PROPERTIES		---	
Deflection Temperature Under Flexural Load @ 66psi	ASTM D648	°F	288°
Deflection Temperature Under Flexural Load @ 264psi	ASTM D648	°F	279°

Values reported are averages and should not be used for specification purposes.

- Data given are typical average values and should not be used for specific purposes
- There are no Quality Specifications associated with this products
- All testing preformed at 0.220' to 0.118" thickness unless otherwise specified
- All samples conditioned for at least 24 hours at 77oF –+ 2oF and 50% RH –+ 5%

AZCARB RENEW

Standard Thickness (inches) : .093" up to .375"

Standard Sheet Size (inches) : 48" x 96", 60" x 96" and 72" x 96"

Standard Colors : Clear and Black

Run to size & oversize sheet quoted upon request.
Gray and bronze available, minimuns may apply.

Polycarbonate

TUFFAK® Thick Gauge Sheet & Plate

TUFFAK® MG machine grade polycarbonate engineering plate is a low stress polycarbonate ideally suited for heavily fabricated, tight tolerance parts. It features extremely high impact strength, high modulus of elasticity, outstanding dimensional stability, and good electrical properties. TUFFAK® MG machine grade polycarbonate plate has a heat deflection temperature of 270°F (132°C) at 264 psi.

TUFFAK® WG window grade polycarbonate engineering plate is an optically clear, low stress polycarbonate plate ideally suited for heavily fabricated, tight tolerance parts. It features extremely high impact strength, high modulus of elasticity, outstanding dimensional stability, and good electrical properties. TUFFAK® WG window grade engineering plate has a heat deflection temperature 270°F (132°C) at 264 psi, and demonstrates low levels of black specks and other impurities.

Typical Features:

- Extremely high impact strength
- Outstanding dimensional stability
- High modulus of elasticity
- High optical clarity (Window Grade)
- Good mechanical and electrical properties

Product Applications:

- Manifolds
- Insulators
- Diaphragms
- Semiconductor
- Sight window for tanks/vessels
- Viewport windows
- Medical parts
- Military applications

TUFFAK® MG & WG

Standard Thickness (inches) :	**3/4 1 1-1/4 1-1/2 1-3/4 2**
Standard Sheet Size (inches) :	**48 x 96**
Machine Grade Colors :	**Clear A00 Matte and Black L10**
Window Grade Colors :	**Clear A00**

Polycarbonate

TUFFAK® MG & WG - Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	TUFFAK® MG	TUFFAK® WG
PHYSICAL PROPERTIES				
Specific Gravity	ASTM D792	---	1.20	1.20
Refractive Index	ASTM D542	---	---	---
Water Absorption, 24 hours	ASTM D570	%	0.15	0.15
Poisson's Ratio	ASTM E132	---	0.38	0.38
MECHANICAL PROPERTIES				
Tensile Strength, Ultimate	ASTM D638	psi	9,500	9,500
Tensile Strength, Yield	ASTM D638	psi	9,000	9,000
Tensile Modulus	ASTM D638	psi	340,000	340,000
Elongation	ASTM D638	%	110	110
Flexural Strength	ASTM D790	psi	13,500	13,500
Flexural Modulus	ASTM D790	psi	345,000	345,000
Compressive Strength	ASTM D695	psi	12,500	12,500
Compressive Modulus	ASTM D695	psi	345,000	345,000
Izod Impact, Notched, 1/8"	ASTM D256	ft•lbs/in	---	---
Izod Impact, Unnotched, 1/8"	ASTM D256	ft•lbs/in	---	---
Shear Strength, Ultimate	ASTM D732	psi	10,000	10,000
Shear Strength, Yield	ASTM D732	psi	6,000	6,000
Shear Modulus	ASTM D732	psi	114,000	114,000
Rockwell Hardness	ASTM D785	---	M70 (R118)	M70 (R118)
THERMAL PROPERTIES				
Coefficient of Thermal Expansion	ASTM D696	in/in/°F	3.75×10^{-5}	3.75×10^{-5}
Coefficient of Thermal Conductivity	ASTM C177	BTU•in/hr•ft²•°F	1.35	1.35
Heat Deflection Temp @ 264 psi	ASTM D648	°F	270°	270°
Heat Deflection Temp @ 66 psi	ASTM D648	°F	280°	280°
Brittleness Temperature	ASTM D746	°F	-200°	-200°
ELECTRICAL PROPERTIES				
Dielectric Constant @ 10 Hz	ASTM D150	---	2.96	2.96
Dielectric Constant @ 60 Hz	ASTM D150	---	3.17	3.17
Volume Resistivity	ASTM D257	ohm•cm	8.2×10^{16}	8.2×10^{16}
Dissipation Factor @ 60 Hz	ASTM D150	---	0.0009	0.0009
Arc Resistance				
-Stainless Steel Strip electrode	ASTM D495	Seconds	10	10
-Tungsten Electrodes	ASTM D495	Seconds	120	120
Dielectric Strength, in air, 1/8"	ASTM D149	V/mil	380	380
FLAMMABILITY				
Horizontal Burn, AEB	ASTM D635	in	---	---
Ignition Temperature, Self	ASTM D1929	°F	---	---
Ignition Temperature, Flash	ASTM D1929	°F	---	---
Flame Class @ 0.060"	UL 94	---	V-0	V-0

Polycarbonate

Zelux® Thick Gauge Sheet & Plate

Zelux® polycarbonate is an engineering plastic with excellent dimensional stability and good strength and stiffness over a wide range of service temperatures. Zelux® is often used for structural applications when clarity and impact strength are essential including lenses, manifolds, site glasses, and machine guards.

Zelux® is used for a wide variety of electrical applications since it has low moisture absorption, good insulating properties, and an excellent flammability rating. Zelux® polycarbonate is easy to fabricate, paint, and glue/bond. Zelux® is a registered trade name of Westlake Plastics.

Zelux® W is the Window grade (optically clear). **Zelux® M** is the machine grade, stress relieved (natural and black). Zelux® M-GF is glass-filled grades, 10%, 20%, 30% and 40%. FDA compliant grades and colors are available on a custom basis.

Typical Features:

- Optical clarity (window grade)
- Excellent impact resistance
- Excellent dimensional stability
- Low moisture absorption
- Easy to machine & fabricate
- Good strength & stiffness over a wide temperature range
- Good electrical insulating properties

Product Applications:

- Site glasses
- Viewing windows
- Impact shields
- Fluid handling components
- Manifolds
- Electrical components
- Housing and covers
- Scientific instrument components

Westlake plastics
LIFE IN POLYMERS

Zelux® M & W

Standard Thickness (inches) :	**3/8" up to 4" thick**
Standard Sheet Size (inches) :	**24 x 48**
Machine Grade Colors :	**Clear A00 Matte and Black L10**
Window Grade Colors :	**Clear A00**

Polycarbonate

Zelux® M & W - Typical Properties

PROPERTY TESTED	TEST METHOD	UNITS	ZELUX® M	ZELUX® W
PHYSICAL PROPERTIES				
Specific Gravity	ASTM D792	---	1.20	1.20
Refractive Index	ASTM D542	---	---	---
Water Absorption, 24 hours	ASTM D570	%	0.15	0.15
Poisson's Ratio	ASTM E132	---	0.35	0.35
MECHANICAL PROPERTIES				
Tensile Strength, Ultimate	ASTM D638	psi	9,500	9,500
Tensile Strength, Yield	ASTM D638	psi	8,400	8,400
Tensile Modulus	ASTM D638	psi	---	---
Elongation	ASTM D638	%	110	110
Flexural Strength	ASTM D790	psi	13,500	13,500
Flexural Modulus	ASTM D790	psi	340,000	340,000
Compressive Strength	ASTM D695	psi	12,500	12,500
Compressive Modulus	ASTM D695	psi	340,000	340,000
Izod Impact, Notched, 1/8"	ASTM D256	ft•lbs/in	16.0	16.0
Izod Impact, Unnotched, 1/8"	ASTM D256	ft•lbs/in	---	---
Shear Strength, Ultimate	ASTM D732	psi	10,000	10,000
Shear Strength, Yield	ASTM D732	psi	6,000	6,000
Shear Modulus	ASTM D732	psi	114,000	114,000
Rockwell Hardness	ASTM D785	---	M70-78 (R118)	M70-78 (R118)
THERMAL PROPERTIES				
Coefficient of Thermal Expansion	ASTM D696	in/in/°F	3.8×10^{-5}	3.8×10^{-5}
Coefficient of Thermal Conductivity	ASTM C177	BTU•in/hr•ft²•°F	1.35	1.35
Heat Deflection Temp @ 264 psi	ASTM D648	°F	275°	275°
Heat Deflection Temp @ 66 psi	ASTM D648	°F	280°	280°
Brittleness Temperature	ASTM D746	°F	---	---
ELECTRICAL PROPERTIES				
Dielectric Constant @ 10 Hz	ASTM D150	---	2.90	2.90
Dielectric Constant @ 60 Hz	ASTM D150	---	2.90	2.90
Volume Resistivity	ASTM D257	ohm•cm	1.0×10^{17}	1.0×10^{17}
Dissipation Factor @ 60 Hz	ASTM D150	---	---	---
Arc Resistance				
-Stainless Steel Strip electrode	ASTM D495	Seconds	---	---
-Tungsten Electrodes	ASTM D495	Seconds	---	---
Dielectric Strength, in air, 1/8"	ASTM D149	V/mil	380	380
FLAMMABILITY				
Horizontal Burn, AEB	ASTM D635	in	---	---
Ignition Temperature, Self	ASTM D1929	°F	---	---
Ignition Temperature, Flash	ASTM D1929	°F	---	---
Flame Class @ 0.060"	UL 94	---	V-0	V-0

Polycarbonate

TUFFAK® & HYGARD® Security Solutions

With a complete line of monolithic, containment, forced entry, and ballistic rated polycarbonate products, Plaskolite is committed to supplying high quality glazing materials for security glazing applications.

TUFFAK polycarbonate sheets maintain an aesthetically pleasing, glass-like appearance. These polycarbonate products offer a first line of defense against attack or unlawful entry and give time for law enforcement officials to gain control. Their performance has been tested by accredited, independent laboratories and the abrasion resistant hard coat provides excellent resistance against chemical attack.

Advantages vs Glass and Glass-Clad Products:

- Reduced Weight: Approximately 50% lighter than glass laminate of the same thickness
- Will not spall, spider web or white-out under attack, maintaining a clear line of site to provide an extra level of security
- TUFFAK 15, TUFFAK AR and HYGARD products feature a hard coat that resists abrasion, chemical, and graffiti attack
- TUFFAK AR offers a 7-year warranty against Yellowing, Loss of Light Transmission and Breakage
- TUFFAK 15 offers a 15-year warranty against Yellowing, Loss of Light Transmission and Breakage
- HYGARD products offer a 7-year limited warranty – See website for details

TUFFAK® & HYGARD®

THICKNESS	38 x 78	38 x 96	48 x 60	48 x 72	48 x 96	60 x 72	60 x 96
CG375	●			●	●		
CG500		●		●	●		●
CG750		●			●		
BR750	●	●	●	●	●	●	●
BR1000	●	●	●	●	●	●	●
BR1250	●	●	●	●	●	●	●

Colors: 0A00 Clear (standard). Gray, Bronze & Green by request, minimums will apply.

Polycarbonate

TUFFAK® & HYGARD® Security Solutions

Typical regulatory code compliance and certifications	Applicable Products
ANSI Z97.1 American National Standard for Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test, Class A, Unlimited	**AR / 15 / GP / OP / HYGARD**
CPSC 16 CFR 1201 Category I and Category II: Safety Standard for Architectural Glazing Materials	**AR / 15 / GP / OP / HYGARD**
Florida Building Code High Velocity Hurricane Zone Classified Miami-Dade	**AR / 15 / HYGARD**
ICC-ES Evaluation Report #ESR-2728	**AR / 15 / HYGARD**
Combustibility Class CC1	**AR / 15 / GP / OP / HYGARD**
UL 972 Burglary Resistant File #BP2126	**AR / 15 / GP**
UL 746C: Suitability for Outdoor Use, UL File #E87887	**AR / 15**
AAMA 501.8: Resistance to Human Impact of Windows Systems Intended for Use in Psychiatric Applications	**AR / 15**

PLASKOLITE, INC.

Polycarbonate

Twinwall & Multiwall sheet

Twinwall and MultiWall sheet and profile connectors are the innovative building material used in sports arenas, greenhouses, hurricane shutters, bus shelters, car ports, sunrooms, covered walkways, partition walls, facades, and roofing. Whether you want to keep the heat out in summer, or keep the heat in for winter.

Standard sheets are available in double and triple-layered styles. Sheets are manufactured in various colors and degrees of transparency. The sheets are designed for use in most conventional roofing and glazing applications.

Strength
Over 250 times more impact resistant than glass

Safety
Withstands hail damage, hurricane shutters

Superior Quality
10 year limited product warranty

Daylighting
Excellent thermal insulation

Common Trade Names:

- Polygal (Plaskolite)
- PoliCarb (Gallina)
- SUNLITE® (Palram)

Typical Features:

- Excellent insulation
- Controlled daylight transmission
- Virtually unbreakable
- Flexible and easy to install
- Flame retardant
- Lightweight
- UV-blocking
- Environmentally friendly

Twinwall & Multiwall

Double Layer Thickness (mm) :	**4mm, 6mm, 8mm, 10mm**
Double Layer Widths (mm) :	**980mm, 1050mm, 1200mm, 1250mm, 2100mm**
Double Layer Lengths (mm) :	**6000mm and 12000mm**
Triple Layer Thickness (mm) :	**16mm**
Triple Layer Widths (mm) :	**980mm, 1050mm, 1200mm, 1250mm**
Triple Layer Lengths (mm) :	**6000mm and 12000mm**

Acrylic

Acrylic Sheet, Rod and Tube Offerings

General Sheet Information .....7-2 to 7-3

Light Transmission Specs 7-4

Plaskolite OPTIX® .....7-5 to 7-7

Spartech Polycast® .....7-8 to 7-9

Plexiglas® Offerings 7-10

Avonite Offerings 7-11

Clear Acrylic Rod 7-12

Acrylic Tubing 7-13

Alro Online Store 7-14

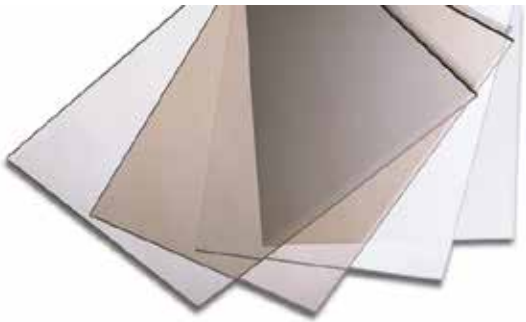
WARNING: These products can potentially expose you to chemicals including, 4-Dioxane, Acetaldehyde, Acrylonitrile, Bisphenol-A, Carbon Black, Chromium, Cumene, Dichloromethane, Ethyl Acrylate, Ethylbenzene, Ethylene Glycol, Formaldehyde, Glass Fibers, Hexachlorobenzene, Lead, Methanol, Nickel, Polyvinyl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

Acrylic

General Acrylic Overview

Acrylic plastic sheet, also known as PMMA is completely transparent, flexible and has great resistance to breakage. It is an excellent material which can replace glass for windows, doors, partitions, and skylights. Ideal for automotive and transportation it is lightweight, with only half the weight of glass, and it is virtually unaffected by nature.

Acrylic sheet is supplied in extruded, cast, continuous cast and recycled sheet formulated to meet specific physical requirements. Most formulations are supplied in a variety of transparent, translucent, and opaque colors as well as colorless transparent. The material is also supplied in a number of surface patterns. Acrylic plastic can be thermoformed or molded economically to create shapes suitable for a variety of applications.



Common Trade Names:

- Excelon® (TPI)
- Plexiglas® (Trinseo)
- Polycast® (Spartech)
- Optix® (Plaskolite, Inc.)

Advantages of Acrylic:

- **Ease of Fabrication** - When Acrylic is heated to its forming temperature (approximately 325°F) it becomes soft and pliable and can be formed into a variety of shapes. As the material cools in its formed state, it solidifies and holds the shape to which it has been formed. Because the material is formed at low pressure, molds can be made from plastic and low-cost wood. Acrylic can also be machined, drilled and sawed like wood or soft metals.
- **Excellent Electrical Properties -** Acrylic has certain unmatched electrical properties which are affected slightly by weathering or moisture. Its surface resistivity is higher than most plastic materials and its power factor decreases with increased frequency.
- **Lightweight -** Acrylic is less than 50% as heavy as glass, is 43% as heavy as aluminum and 70% as heavy as magnesium.
- **Impact Resistant** - Although it weighs less than half as much as glass, Acrylic has from 6 to 17 times greater impact resistance than ordinary glass in thicknesses of .125" to .250".
- **Weather Resistant** - Acrylic sheet withstands weather and sun exposure with almost no loss of light transmittance, clarity and strength in over a quarter century of usage.

Product Applications:

- Conveyor Shields
- Doors (entry/patio/shower/etc...)
- Electronic game faces
- Equipment enclosures
- Skylights / Sunscreens
- Printer covers
- Food sneeze guards
- Forklift shields
- Museum display cases
- Security barriers
- Vending machine windows
- Viewing ports

Acrylic

Acrylic Sheet Typical Properties

PROPERTY TESTED		ASTM	UNITS	ACRYLIC
PHYSICAL PROPERTIES				
Tensile Strength		D638	psi	10,000
Flexural Strength		D790	psi	17,000
Modulus of Elasticity		D790	psi	480,000
Compressive Strength @ yield		D695	psi	17,000
Izod Impact Strength (notch)		D256	ft•lbs/in	0.4
Hardness:	Rockwell	D785	M	93
	Barcol	D2583		48
Light Transmission		D1003	%	92
Specific Gravity		D792	1 = water	1.19
Water Absorption/Saturation		D570	%	0.2
THERMAL PROPERTIES				
Deflection Temp Under Load, 264 psi		D648	°F	195
Thermal Expansion		D696	in/in°F	.0004
Flammability/Burning Rate, 0.125"		D635	in/min	1.00
Self Ignition Temperature		D1929	°F	830
ELECTRICAL PROPERTIES				
Dielectric Strength (short time), 0.125"		D149	V/mil	430
Dielectric Constant	60 Hz	D150	---	3.6
	1000 Hz	D150	---	3.3
Dissipation Factor	60 Hz	D150	---	0.06
	1000 Hz	D150	---	0.04

Note: Values listed are typical and are meant only as a guide to aid in design. Values shown are for 0.250" thickness unless otherwise noted above. Some values will change with thickness.

Acrylic Sheet

Standard Thickness (inches) — **Extruded: 1/16" up to 1" thick**
Cast: 1/8" up to 2" thick

Standard Thickness (inches) for Whites and Solar Tints : — **1/8", 3/16" and 1/4" thick**

Standard Sheet Size (inches) : — **48" x 96" 60" x 96" 72" x 96"**

Acrylic

Light Transmission: Translucent & Transparent Colors

The light transmission of each white color decreases with an increase in the thickness of the material. Nominal thicknesses of a given translucent or transparent color have the same percentage of light transmission. This is apparent through the adjustment of the color concentration according to sheet thickness. If colors listed below are used for a sign application, check all samples under a reflective light for color clarity and light transmission. Some colors may appear analogous under reflected light but transmit light at different rates.

COLOR NUMBER	COLOR NAME	% REFLECTED FOR THICKNESSES:		
		1/8"	3/16"	1/4"
LIGHT TRANSMISSION OF WHITE TRANSLUCENT SHEET				
*2406	white	63	---	---
*2447	white	50	37	31
*7328	white	30	21	16
LIGHT TRANSMISSION OF COLORED TRANSLUCENT SHEET				
2157	red	2	2	2
2793	red	3	3	3
2283	red	12	12	12
2119	orange	6	6	6
2037	yellow	26	26	26
2108	green	2	2	2
7235	green	3	3	3
2114	blue	2	2	2
2050	blue	1	1	1
LIGHT TRANSMISSION OF COLORED TRANSPARENT SHEET				
*2064	grey	27	27	27
*2074	grey	13	13	13
*2404	bronze	49	49	49
*2412	bronze	27	27	27
2370	bronze	10	10	10

**Most readily available colors.*

Acrylic

Plaskolite OPTIX® Sheet Offerings

OPTIX® L Acrylic sheet

OPTIX® L is continuous cast acrylic sheet offered in thicknesses of .040" to 1.0" (1mm-25mm), in clear, colors and widths up to 104". OPTIX® combines high optical clarity with superior impact and weather resistance. The high molecular weight of OPTIX® acrylic sheet allows for ease in thermoforming, bending and flame polishing.

Typical Features:

- Dimensional stability
- Tough and durable
- Excellent clarity
- Heat and Impact resistant
- Lightweight
- Good U.V. factor
- Weather resistant
- Excellent fabrication characteristics

OPTIX® SR - Scratch Resistant sheet

The performance, durability and clarity of Plaskolite's OPTIX® SR Scratch Resistant acrylic sheets come shining through in everyday use—and even in the most rugged of conditions. Each sheet style offers maximum protection and resists wear and tear, maintaining its "like new" look that will hold up under all types of use, whether indoor or outdoor. The sheets are available with the OPTIX® SR coating on one or both sides. Plaskolite, Inc. is a leading supplier of acrylic sheets, and its products are known for their innovation and high quality.

OPTIX® NG - Non-Glare sheet

OPTIX® NG is a non-glare acrylic sheet that is ideal for glazing and picture frame applications. These sheets are formulated with a special coating to minimize the impact of various light sources on reflective surfaces. OPTIX® NG is lightweight and shatter resistant making it a great option for signage, silk-screening and POP displays as well. These sheets are available with a heavy matte finish in .060-.080 thickness or light matte finish in .080-.125 thickness. Typical sheets are 48 x 96, but custom sizes and colors available on request.

OPTIX® 95 - Matte finish, one side sheet

OPTIX® 95 acrylic sheet has a translucent matte finish on one side which provides both decoration and reductions in surface reflection. The matte finish is resistant to fingerprints and smudges. OPTIX® 95 is easily fabricated and ideal for many interior applications such as POP displays, pantry/cupboard doors and office partitions. This also makes it ideal for lighting and interior backlit signage applications.

Continued on the next page

Acrylic

Plaskolite OPTIX® Sheet Offerings

OPTIX® Frost - Frosted sheet

OPTIX® Frost has a frosting additive incorporated throughout the sheet, providing an elegant textured surface on both sides. OPTIX® Frost is the ideal choice for POP and store fixtures as it resists fingerprints, scratches and is virtually maintenance free.

OPTIX® G - Cell Cast sheet

OPTIX® G is a cell cast acrylic that offers excellent clarity and high light transmission. It is fabrication friendly and has an outstanding edge polishing reaction to laser cutting. It is ideal for aquarium, furniture and store fixtures applications.

OPTIX® R - Recycled sheet

OPTIX® R is an optically clear extruded sheet made with up to 95% post industrial recycled content. Optix R is used by many to reach their goals of being environmentally responsible through the use of sustainable products. It can be used in retail displays, POP signage and anywhere you would use acrylic sheet.

OPTIX® SG & LD - Sign Grade sheet

Plaskolite, Inc. offers Sign Grade **OPTIX® Acrylic** and **Duraplex®** impact modified acrylic in roll stock and oversized flat sheet sizes for the sign fabricating industry. Roll Stock provides unlimited lengths, reducing the number of seams and joints in a large sign face. It also provides efficient inventory space utilization and better total sheet usage. Plaskolite's acrylic sheet is offered in a wide range of sheet sizes, including "oversized", to best fit your production specifications.

OPTIX® DA - Digital Acrylic sheet

OPTIX® DA delivers all the benefits of continuously processed acrylic sheet providing superior strength specially formulated for printing. This sheet is designed to provide optimal adhesion of UV curing inks without adhesion promoters. Ideal for signage and graphics. It can be used in interior and exterior (outward facing non- printable side) applications.

OPTIX® E-DA - Erasable Digital Acrylic sheet

OPTIX® E-DA offers the same benefits as Optix DA sheet with direct-to-print sheets, but with anti-graffiti and markerboard capabilities. These sheets have abrasion and chemical resistance on one side and enhanced UV ink adhesion properties on the other. Ideal for offices, entertainment venues and high traffic areas.

Duraplex® Impact Modified Acrylic Sheet

Duraplex® offers superior impact strength for many applications including signage, displays, skylights, windows, doors and any interior or exterior application where durability is a requirement. It's an economical alternative to polycarbonate sheet providing superior weatherability and thermoforming capabilities.

Acrylic

Plaskolite OPTIX® Sheet Offerings

Fabback® Acrylic Mirror Sheet

Fabback® acrylic mirror is made from Optix continuously processed acrylic sheet. Fabback® has the industry's toughest protective back-coating, which protects against scratching during fabrication. Available in clear, textures and in over 17 vibrant colors, this durable acrylic mirror is ideal for slatwalls, point-of-purchase displays, casinos, children's toys, cosmetic displays and for applications in the food service industry.

Lighting Panels

Plaskolite, Inc. offers a variety of acrylic and styrene lighting panels for residential and commercial environments. Available in cracked ice, prismatic, prisma square, flat white mist and egg crate louver patterns.

PLASKOLITE, INC.

Plaskolite Run to Size Custom sheet

OPTIX® acrylic, Duraplex® impact-modified acrylic, Fabback® acrylic mirror or polystyrene sheet can be ordered to meet the specific size requirements of each application, reducing waste, cost and prolonging the life of your equipment. Plaskolite, Inc. is the only acrylic sheet manufacturer offering the flexibility of buying acrylic sheet literally run-to-size.

Saw cut and slitter/hot knife edges available. Sheet edges may vary, please specify preferred edge cut at the time of order. The turnaround time for Plaskolite's run-to-size program is the shortest in the industry.

Run-To-Size Minimum Sheet Widths & Lengths

Acrylic Thickness	Minimum Width	Minimum Length
.060"	5"	14"
.080"	5"	14"
.100"	5"	14"
.125"	5"	14"
.177"	28"	20"
.187"	28"	20"

Acrylic Thickness	Minimum Width	Minimum
.236"	28"	
.250"	28"	20"
.375"	28"	20"
.500"	30"	20"
.750"	30"	30"
1.00"	30"	30"
		30"

Clear acrylic 1,000 lb minimum. Colored acrylic 3,000 lb minimum.
20,000 lb minimum for production run and patterns.

Acrylic

Spartech Polycast® Acrylic Sheet

Spartech Polycast® is the world's largest manufacturer of specialty cell cast acrylic sheet and a leading supplier of aircraft transparencies, marine doors, tanning bed shields, optical & biomedical components, furniture, aquariums and transparent ballistic enclosures. PolyOne™ Polycast® offers a variety of specialty acrylic products for specific applications. Listed below are some of the grades they offer.

Aerospace Products

Spartech Polycast® is known, the world over, as a leading producer of cast acrylic sheet for aircraft cabin windows, fighter canopies, windscreens, wing-tip lenses, outer laminates and instrument panels for general aviation and military aircraft. Having been manufacturing cast acrylic sheet for over 30 years, Spartech Polycast® is presently the principal supplier meeting U.S. Military Specifications MIL-PRF-5425, MIL-PRF-8184 and MIL-PRF-25690 to the United States aerospace industry.

Light Transmitting and Filtering Sheet

Polycast® manufactures a number of different specialty acrylic sheet products for transmitting and filtering UV light. Ultraviolet Transmitting Sheet (UVT) provides increased transmission of ultraviolet wavelengths between 280 and 360 nanometers. Polycast offers a full line of UV filtering acrylics to help defend previous artwork and documents against the degradation caused by exposure to UV light.

Bullet Resistant Sheet

Despite all of the improvements in security technology, bullet resistant barriers have been proven to be the only measure that deters crime before it happens. Polycast® offers a solution to these problems when one considers the four most important characteristics in choosing bullet resistant sheet (adequate protection, weight, optical clarity and value) the choice is obvious.

Spartech Polycast® offers UL level 1, UL level 2, UL level 3 and UL level 6 grade sheets of acrylic security glazing for banks, convenience stores and other high-risk areas.

Acrylic

Spartech Polycast® SAR™ - Super Abrasion Resistant

Spartech Polycast® SAR™ (super abrasion resistant) acrylic sheet is produced by applying a very hard, highly crosslinked polysilicate (a silicon polymer or polysiloxane) coating to an acrylic substrate. This coating provides Polycast® SAR™ sheet with a surface that has 45 times the abrasion resistance of uncoated acrylic, making it an attractive material for applications requiring the safety, optical and aesthetic qualities of acrylic along with a highly abrasion resistant surface.

Lightweight and fabrication flexibility cut installation costs.

At half the weight of glass, Polycast® SAR™ makes handling easier and safer, and installation less costly and time consuming. It can be cut and fabricated at the installation site using power tools. In fact, Polycast® SAR™ is ideal for replacement installations; because it is readily fitted into existing frames.

Colors, Formulations and Finishes

Polycast® SAR™ is available in a wide variety of transparent, translucent and opaque colors including industry standards such as black, gray and bronze. Ultra-violet transmitting, ultra-violet filtering formulations (including Polycast UF96, UF3 and UF4) and coated one-side sheets are also available.

Spartech Polycast® SAR™ is tough, lightweight, weatherable, cleanable and offers excellent thermal insulation. It has an impact resistance that is five times that of glass and half the weight.

Optical clarity outshines other materials

Polycast® SAR™ in 1.250" thickness transmits 93% white light, compared to 66% for an all polycarbonate sheet and 55% for bullet-resistant glass. Also, its edges are clear, avoiding the massive appearance of thick glass with its greenish tinted edge. That adds up to the sparkling clear, open look that is more appealing to customers. Tough coating endures years of cleaning without hazing.

Polycast® SAR™ Sheets

Standard Thickness (inches) : **.060" up to 2.00"**

Standard Sheet Sizes (inches) : **48" x 72" and 72" x 120"**

Special thicknesses and sizes quoted upon request

Acrylic

Plexiglas® Sheet Offerings

Plexiglas® MC Acrylic Sheet

Plexiglas® MC is an economical sheet produced via a property process known as melt calendering. It offers many of the same high quality features as Plexiglas® G. In addition, it has exceptional thickness tolerance and can be thermoformed to greater detail.

Plexiglas® MC Matte Finish

An industry standard, Plexiglas® MC is a continuous process acrylic sheet that offers exceptional thickness tolerance. Now available in a Matte Finish, this versatile sheet offers more design possibilities. An alternative to P95, MC Matte Finish offers fabricators a wider range of sizes to improve yield and reduce costs. It is ideal for displays, point-of-purchase items, building applications and general fabricated parts.

Plexiglas® Frosted Acrylic Sheet

Designed for use in point-of-purchase displays, illuminated signage, and as a lighting diffuser, Plexiglas® Frosted sheet is made from an acrylic resin that incorporates a frosting mechanism that is integrated throughout the sheet structure. This mechanism provides a textured finish on all surfaces, requiring no secondary finishing. Unlike surface embossed textures, Plexiglas® Frosted sheet will retain its frosted look after thermoforming.

Plexiglas® T Acrylic Sheet Impact Series

Plexiglas® T high-clarity impact-resistant acrylic sheet is now available in three grades - T, T2 and T3. Each one offers outstanding aesthetics, rigidity and weatherability in POP and display environments. All grades provide designers with flexibility, surface hardness and versatile fabrication techniques. Aesthetic appeal is retained even with displays placed in high traffic areas.

Plexiglas® SG Plus (Sign Grade)

Designed exclusively for use in the sign market, SG sheet is made by the same proprietary continuous process used to make original Plexiglas® MC. This process ensures exceptional surface finish, optical quality and thickness uniformity in addition to enhanced solvent craze resistance.

Acrylic

Aristech Product Offerings

Aristech (now owned by Trinseo) runs a wide range of cell-cast and continuous-cast acrylic sheets. They produce modified and highly engineered specialty acrylic for the architectural, transportation and recreation industries. They provide a full range of sizes, thicknesses, colors, and patterns.

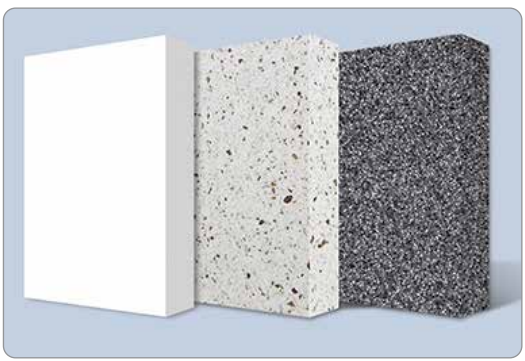
Avonite

Avonite is a solid surface acrylic blend material that has several features making it a popular choice for architects, engineers, and designers. It is thermoformable and hygienic due to its non-porous surface and seamless assembly. It is also both stain and chemical resistant. Avonite comes in a large variety of colors and textures. The material allows for careful cutouts as well as sanding which can enhance the surface sheen.

Avonite's Right Size program provides flexibility, cost savings and waste reduction. Avonite is also available in oversize sheets to reduce the number of seams, lowering adhesive and fabrication costs as well.

Product Applications:

- Countertops & Lab Tabletops
- Facades
- Furniture
- RV & Marine
- Wet Walls



Ice White, Alaskan Stone & Black Lava

Acrylic

Clear Acrylic Rod & Tube

Cast Acrylic rod has uncommon optical clarity, outstanding light transmission and excellent weatherability. It is not affected by sunlight, resists aging and keeps good stability under variable conditions of cold, heat, moisture and exposure, it will not warp, crack, craze or corrode. Cast Acrylic rod may be preferred for some industrial and commercial applications because it is more optically perfect than molded or extruded types of Acrylic products. It provides good tensile strength and excellent resistance to heat distortion.

This clear rod can be used for machining or cementing and will fabricate like wood, metal or other plastics with standard equipment. Cast Acrylic rod is half the weight of comparable glass and has good shatter resistance and durability.

Product Applications:

- P.O.P. Displays
- Electrical/Electronic parts
- Furniture components
- Lenses
- Models

Clear Acrylic Rod

Standard Diameter (inches) :	**.250" up to 9.00" diameter**
Standard Rod Length (feet) :	**.250 through 2.00 ..... 8 feet**
	2.125 through 3.00 ..... 6 feet
	3.25 through 6.00 ..... 4 feet
	6.50 through 8.00 ..... 3 feet
	9.00 ..... 2 feet
Standard Rod Tolerance(s) :	**.250 through .500 ..... +/-.005**
	.625 through 1.00 ..... +/-.010
	1.125 through 2.00 ..... +/-.015
	2.125 through 3.00 ..... +/-.030
	3.25 through 6.00 ..... +/-.045
	6.50 through 9.00 ..... +/-.050

Acrylic

Clear Acrylic Rod & Tube

Spartech cast acrylic clear rods and tubes are highly polished, crystal clear and can be manufactured to the most exact specifications. The standard material is a clear, ultraviolet absorbing acrylic with a maximum continuous service temperature of 150°F. Custom sizing and thickness are available to meet your exact specs. Acrylic tubing is manufactured in standard 6 foot lengths. Machining, drilling, milling, routing as well as many other operations are available upon request.

Typical Features:

- Crystal clarity
- Easily bonded
- Easily machined
- Transparent
- Very strong
- Weather resistant

Clear Acrylic Tube

Standard Outside Dia. (inches) :	1.25 1.50 1.625 1.75 1.875 2.00 2.25 2.375 2.50 2.625 2.75 2.875 3.00 3.125 3.25 3.375 3.50 3.625 3.75 3.875 4.00 4.125 4.25 4.375 4.50 4.625 4.75 4.875 5.00 5.25 5.50 5.625 5.75 6.00 6.093 6.25 6.50 6.75 7.00 7.25 7.50 7.625 8.00 8.25 8.50 8.75 9.00 9.125 9.25 9.50 10.00 10.50 10.625 11.00 11.50 11.75 12.00 13.625 14.00 15.00 16.00 18.00 24.00 27.625
Standard Wall Thickness (inches) :	.125 .187 .250 .375 .500
Standard Tube Length (feet) :	6 foot lengths
O.D. & Wall Tolerances (inches) :	1.25 to 3.00 ..... +/-.020 ..... 1/8 wall..... +/-.018 3.125 to 3.875 ..... +/-.030 ..... 3/16 wall ... +/-.019 4.00 to 6.00 ..... +/-.045 ..... 1/4 wall ..... +/-.025 6.25 to 12.00..... +/-.080 ..... 3/8 wall ..... +/-.035 12.25 to 27.625 .... +/-.090 ..... 1/2 wall ..... +/-.045

Acrylic Rod and Tube also offered in colors, please inquire about availability

Alro Online Store

MyAlro.com

Aluminum • Alloys • Carbon Steel • Stainless Steel • Red Metals • Plastics

Did you know Alro also offers online shopping and e-business solutions for all of our customers? Visit the Alro Online Store from your computer or mobile device 24 hours a day. Set up your company account and purchase metals and plastics from our vast inventory.

Alro utilizes systems technology to achieve the benefits of e-Business in raw material procurement processes.

- **Business to Business (B2B) – Helps reduce purchasing transaction costs.**
- **Web Ordering (MyAlro.com) – Helps with material selection, quoting and estimating.**
- **Automated Inventory Replenishment (APOS) – helps reduce Kan Ban replenishment costs**
- **Summary Billing – helps reduce admin costs of processing raw material payables**
- **Advance Shipping Notices – helps reduce receiving time**

Alro computers retrieve business information from customers/vendors computers via the internet. During the process we pickup and deliver electronic business documents. This process typically does not require any programming on the part of our customers, as Alro systems are designed to accept virtually any customer document format. Some examples of these documents are as follows:

- **Purchase orders**
- **Invoices**
- **Quotes**
- **POD - Electronic Proof of Delivery**
- **ACH Payment notifications**
- **Mill Certifications**
- **CAD drawings**
- **Burn prints**
- **Material releases**

Chemical & Corrosion

Chemical & Corrosion Resistant Plastics

PVC Type I and II .....8-2 to 8-3

Clear, Rigid PVC .....8-4 to 8-5

CPVC .....8-6 to 8-7

PVC & CPVC Sch 40 sizes 8-8

PVC & CPVC Sch 80 sizes 8-9

Expanded PVC Foam .....8-10 to 8-11

PVDF .....8-12 to 8-13

PalClad Pro Cracked Ice 8-14

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

PVC

Polyvinyl Chloride Type I and II

Polyvinyl Chloride is the plastic better known as PVC. This is the PVC from which pipes are made, and PVC pipe is everywhere. But there's more to PVC than just pipe. The "vinyl" siding used on houses is made of poly(vinyl chloride). PVC is useful because it resists two things that hate each other: fire and water. Because of its water resistance it's used to make raincoats and shower curtains, and of course, water pipes. It has flame resistance, too, because it contains chlorine. When you try to burn PVC, chlorine atoms are released, and chlorine atoms inhibit combustion.

PVC Type I: is a normal impact, corrosion-resistant material offering an excellent chemical resistance. It is highly recommended for applications where acid and alkalies are in high concentration, normal working temperatures are relatively low, 140°F or below, and the application environment is not subject to excessive physical abuse.

PVC Type II: is a uniquely adaptable polyvinyl chloride displaying excellent thermo-forming capabilities, contour definition and surface texture. Available finishes include matte and glossy. Type II is fashioned in the form of homogeneous sheets.

Typical Features:

- Great corrosion resistance
- Excellent chemical resistance
- Excellent thermoforming capabilities
- Easy to machine and fabricate

PVC Type I Applications:

- Dust collecting systems
- Ceiling materials
- Corrosion control equipment
- Flues and vents
- Lab equipment
- Acid fume hood and ducts
- Waterproof covers
- Storage tanks

PVC Type II Applications:

- Food Processing
- Anodizing
- Chemical Processing
- Waste water treatment
- Electronics
- Petroleum
- Transportation
- Pickling

PVC

Polyvinyl Chloride Type I and II

PVC Type I Sheet

Standard Thickness (inches) :	Gray - 1/16" up to 4" thick White - 1/16" up to 1" thick
Standard Sheet Size (inches) :	48" x 96"
Standard Sheet Colors :	Gray, White

PVC Type I Rod

Standard Diameter :	1/4" up to 9" diameter 254mm, 280mm, 300mm, & 350mm
Standard Rod Length :	inches - 10 feet mm - 2 feet
Standard Rod Color :	Gray

PVC Type II Sheet

Standard Thickness (inches) :	1/8" up to 1/2" thick
Standard Sheet Size (inches) :	48" x 96"
Standard Sheet Colors :	Gray, White

PVC Type II Rod

Standard Diameter :	3/8" up to 8" diameter
Standard Rod Length :	3/8" - 2" dia. 10 foot lengths 2-1/4" and up 5 foot lenghts
Standard Rod Color :	Dark Gray

PVC Type I Hollow Bar

Standard Diameter (inches) :	1.312" up to 8.625" O.D. 0.687" up to 5.750" I.D.
Standard Rod Length :	10 feet
Standard Rod Colors :	Gray

The heavy-wall hollows effect considerable savings in material when bored parts are required. In addition, some sizes are IPS O.D., and thus can be used as bushing stock or very heavy wall pipe which is not commercially available.

PVC, Clear Rigid

Clear, Rigid Polyvinyl Chloride

Clear Rigid PVC is versatile, high clarity, transparent PVC sheeting that can easily be embossed, thermoformed and printed. Clear Rigid PVC is highly resistant to chemicals, corrosion and impact. It is an affordable alternative to PETG and expensive polycarbonates. Clear PVC has inherent flame retardant properties unlike modified flame-retardant acrylics and polycarbonates that can be costly. It is rated UL94VO and UL945V, making it an excellent choice for back-lit signs and vending machine face-plates.

Additionally, Clear Rigid PVC is ideal to use for point of purchase (POP) displays, splash guards, skylights, protective headgear, glazing for pictures, display cases, bins, menu holders, and a variety of related fabricated parts. Clear Rigid PVC is available to meet high impact and UV resistant requirements. Thinner gauges of Clear Rigid PVC can be used to replace glass, acrylic, and other materials without sacrificing strength.

Typical Features:

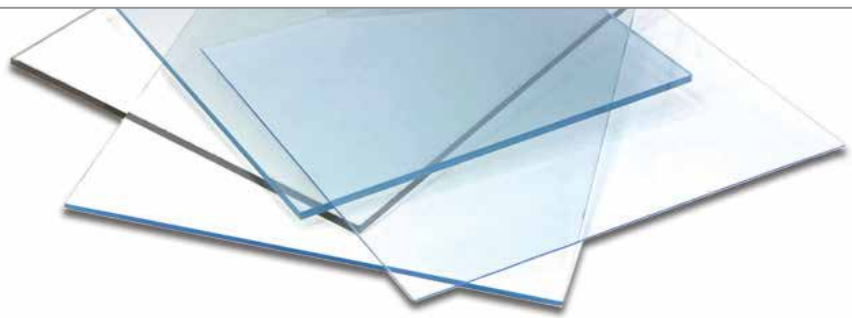
- Thermoformable
- Printable and paintable
- Impervious to a variety of corrosive chemicals
- Good impact resistance

Product Applications:

- Back-lit signs
- Vending machines
- P.o.P. Displays
- Splash guards
- Skylights
- Protective headgear
- Display cases
- Menu holders

Clear PVC Sheet

Standard Thickness (inches)	**0.040" up to 0.472" thick**
Standard Sheet Size (inches) :	**48 x 96**



PVC, Clear Rigid

Property Comparison - PVC Type I, Clear and Type II

PROPERTY TESTED	PVC Type I Versadur® 150 Series	Clear PVC Versadur® 151 Clear	PVC Type II Versadur® 250 Series
Density, D792, g/cc	1.41	1.37	1.38
Tensile Strength at yield, D638, psi	9,000	10,600	7,400
Tensile Modulus D638, psi	481,000	479,000	435,000
Izod Impact (notched), D256, ft.lbs./in.	0.80	0.52	14.0
Shore Hardness ISO 868	84	84	82
Coefficient of Thermal Expansion, D696, in./in./°C	8×10^{-5}	8×10^{-5}	8×10^{-5}
Heat Distortion Temp at 66 psi, D648, °F	172	144	165
Heat Distortion Temp at 264 psi, D648, °F	154	138	158
Temperature Range, n/a, °F	+32 to +140	+32 to +140	+32 to +140
Flammability D635	Self-extinguishing	Self-extinguishing	Self-extinguishing
UL 94	94V-O	94V-O	94V-O
FM 4910	---	---	---
FDA regulations 21 Chapter 1, part 1.77.2510 for contact with food stuffs.	---	---	---

CPVC

Chlorinated Polyvinyl Chloride

Although CPVC is based on PVC, and shares a few of the same characteristics, it is still a unique polymer. CPVC is a high temperature grade chlorinated polyvinyl chloride that provides excellent corrosion resistance, high heat resistance, chemical resistance, inherent flame resistivity, good tensile strength, weatherability and is easily fabricated. These characteristics make CPVC a useful material in a wide range of markets including the chemical processing and metal finishing industries. It can easily be machined with standard wood-working tools. In addition CPVC can be fiberglass backed, hot gas welded with rod, cemented, (solvent bonded) riveted and threaded.

Typical Features:

- Excellent corrosion resistance
- Good chemical resistance
- High heat resistance
- Easy to machine and fabricate

Product Applications:

- Chemical processing
- Fume scrubbing
- Metal anodizing
- Metal Finishing
- Pickling and Waste treatment

Typical Properties:

PROPERTY TESTED	ASTM	UNITS	CPVC
PHYSICAL PROPERTIES			
Specific Gravity	D792	1 = water	1.51
Tensile Strength	D638	psi	7,600
Elongation, ultimate	D638	%	37M
Flexural Strength	D790	psi	11,000
Flexural Modulus	D790	psi x 10^5	3.5
Impact Strength, Izod	D256	ft lbs/in notch	1.65
Hardness, Rockwell R	D785	R	118
Hardness, Durometer, Shore D	D2240	D	82
Compression Strength	D695	psi	11,400
Shear Strength	D732	psi	9.220
Weld Gas Recommended	---	---	Nitrogen
Water Absorption (24 hrs)	D570	%	.035
THERMAL PROPERTIES			
Thermal Expansion	D696	in/in/°C	7.97 x 10^{-5}
Heat Distortion*	D648	°F @ 264 psi	212
Thermal Conductivity	C177	BTU/hr/ft/°F/in	0.641
Specific Heat	C351	Cal/gm/°C	0.220
Flammability**	---	1/8" an over	94 V-0
Thermoformability	---	---	Fair

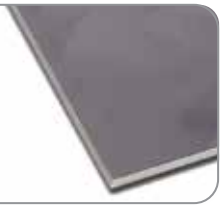
**Annealed sample. **Flammability ratings for PVC in accordance with UL94V.*

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

CPVC

Product Availabilty

CPVC Sheet



Standard Thickness (inches) :	**1/32" up to 2" thick**
Standard Sheet Size (inches) :	**48 x 96**
Standard Sheet Color :	**Gray**

CPVC Solid Rod

Standard Diameter (inches) :	**1/4" up to 8" diameter**
Standard Rod Length (feet) :	**1/4" up to 2 dia ..... 10 foot** **>2 up to 4-1/2" dia ..... 5 foot** **5" dia and up ..... 4 foot**
Standard Rod Color :	**Gray**

CPVC Hollow Bar

Min. O.D. (inches)	Max. I.D. (inches)	Min. O.D. (inches)	Max. I.D. (inches)
1.625	.562	3.563	1.500
2.125	.750	4.000	2.500
2.250	1.125	4.250	1.750
2.375	1.000	4.750	3.000
2.625	1.500	5.000	3.000
2.750	1.000	6.625	4.000
2.875	1.500	6.625	2.875
3.000	1.125		

Standard Tube Length :	**Please inquire with Sales Dept**
Standard Tube Color :	**Gray**

The heavy-wall hollows effect considerable savings in material when bored parts are required. In addition, some sizes are IPS O.D., and thus can be used as bushing stock or very heavy wall pipe which is not commercially available.

For a listing of current tolerance information please contact Alro Plastics.
NSF approved compounds are used in the manufacture of CPVC solid, round, hex, hollow, square and rectangular bar.
CPVC round bar and CPVC hollow bar meet L-P 1036(1).

PVC & CPVC

Schedule 40 Pipe Sizes & Weights

PVC and CPVC Pipe - Schedule 40					
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min. Wall Thickness (inches)	Inside Diameter (inches)	Weight (lbs./ft.)	
				PVC	CPVC
1/2	0.840	0.109	0.622	0.16	0.17
3/4	1.050	0.113	0.824	0.21	0.23
1	1.315	0.133	1.049	0.32	0.34
1-1/4	1.660	0.140	1.380	0.43	0.46
1-1/2	1.900	0.145	1.610	0.51	0.55
2	2.375	0.154	2.067	0.68	0.74
2-1/2	2.875	0.203	2.469	1.07	1.18
3	3.500	0.216	3.068	1.41	1.54
4	4.500	0.237	4.026	2.01	2.20
5	5.563	0.258	5.047	2.73	---
6	6.625	0.280	6.065	3.53	3.86
8	8.625	0.322	7.981	5.39	5.81
10	10.750	0.365	10.020	7.55	8.24
12	12.750	0.406	11.938	10.01	10.89
14	14.000	0.437	13.124	11.80	---
16	16.000	0.500	15.000	15.43	---

PVC & CPVC

Schedule 80 Pipe Sizes & Weights

PVC and CPVC Pipe - Schedule 80					
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min. Wall Thickness (inches)	Inside Diameter (inches)	Weight (lbs./ft.)	
				PVC	CPVC
1/2	0.840	0.147	0.546	0.20	0.22
3/4	1.050	0.154	0.742	0.27	0.30
1	1.315	0.179	0.957	0.41	0.44
1-1/4	1.660	0.191	1.278	0.52	0.61
1-1/2	1.900	0.200	1.500	0.67	0.74
2	2.375	0.218	1.939	0.95	1.02
2-1/2	2.875	0.276	2.323	1.45	1.56
3	3.500	0.300	2.900	1.94	2.09
4	4.500	0.337	3.826	2.75	3.05
5	5.563	0.375	4.813	3.87	---
6	6.625	0.432	5.761	5.42	5.82
8	8.625	0.500	7.625	8.05	8.83
10	10.750	0.593	9.564	12.00	13.09
12	12.750	0.687	11.376	16.50	18.00
14	14.000	0.750	12.500	19.30	---
16	16.000	0.843	14.314	25.44	---

Expanded PVC Foam

Foam PVC Sheet is a light, high-strength alternative, designed to eliminate heavy, hard to handle materials. Foam PVC Sheet is half the weight of solid PVC and handles the toughest jobs. It retains many of the same qualities as traditional PVC such as an outstanding strength-to-weight ratio, great flame-resistance, and excellent chemical resistance. Other characteristics of Foam PVC Sheet include its noise control, easily screened or painted, and is easily drilled, sawed, nailed, screwed or bonded. PVC foam board is a less dense form of traditional PVC, or polyvinyl chloride. However, because of its lower density, PVC foam board is significantly lighter; making it perfect for a wide variety of applications. Please contact us for custom sizes.

Common Trade Names:

- Celtec® (Vycom)
- Ex-Cel® (Jain Americas Inc.)
- KomaTex® (Kommerling USA)
- Palight® (Palram Americas)
- Sintra® (3A Composites)

Typical Features:

- Uniform fine closed cell structure
- Low flammability, self extinguishing
- Excellent impact resistance
- Inherent high rigidity
- Lightweight

Product Applications:

- Acoustical panels
- Display & exhibit materials
- P.o.P. Displays
- Indoor / Outdoor signs
- Model making
- Thermorforming
- Photo mounting
- Equipment enclosures

PVC Foam Sheet

Standard Thickness (mm) :	**1 mm up to 25 mm thick**
Standard Sheet Size (inches) :	**48" x 96"**
Standard Density :	**3 mm 41-44 lb/ft³** **10 mm 34-37 lb/ft³**
Standard Surface Finish :	**Semi-Gloss**

Available in seven standard colors, please inquire about availability

Expanded PVC Foam

EX-CEL FF (Free Foam) Classic PVC

EX-CEL Classic PVC sheets are a lightweight and durable fine cell structure sheet with a smooth matte surface finish. These sheets are easy to fabricate and digitally or screen print on making them ideal for merchandising applications and high-quality POP displays. EX-CEL Classic PVC sheets contain no heavy metals making them a great replacement for wood and safe for the environment.

Fabrication options include saw cut, routing, engraving, print, photo mount, heat bending/ forming paint, drill, rivet and die cut up to 3mm.

Typical Features:

- Chemical and moisture resistant
- Better insulator than wood
- Low flammability, UL 94 VO rated, self extinguishing
- Excellent impact strength
- Noncorrosive

Product Applications:

- Advertising signage
- P.O.P. displays
- Boat panels and cabins
- Digital printing
- Thermorforming
- Models & prototypes
- Furniture

EX-CEL FF Classic

Standard Thickness (mm) :	**1 mm up to 25 mm thick**
Standard Sheet Size (inches) :	**48 x 96, 48 x 120, 60 x 120**
Standard Sheet Color :	**Black & white plus 10 vibrant colors**

PVDF

Polyvinylidene Fluoride

Polyvinylidene fluoride, or polyvinylidene difluoride, (PVDF) is a highly non-reactive thermoplastic fluoropolymer produced by the polymerization of vinylidene difluoride. PVDF is a specialty plastic used in applications requiring the highest purity, as well as resistance to solvents, acids and bases. Compared to other fluoropolymers, like polytetrafluoroethylene (PTFE), PVDF has a low density (1.78 g/cm3).

PVDF exhibits greater strength, wear and creep resistance then PTFE and FEP. It has good weathering properties and resists most chemicals. It has a high dielectric constant and a high loss factor. Temperature range is -100°C to 150°C. It is marketed under the trade name of Kynar®, and is available in sheets, rods, tubes, pipes, valves, and fittings.

It is available as piping products, sheet, tubing, films, plate and an insulator for premium wire. It can be injected, molded or welded and is commonly used in the chemical, semiconductor, medical and defense industries, as well as in lithium-ion batteries. It is also available as a crosslinked closed-cell foam, used increasingly in aviation and aerospace applications.

Common Trade Names:

- Hylar® (Solvay Polymers)
- KF® (Kureha)
- Kynar® (Arkema)
- Solef® (Solvay)

Typical Features:

- High purity
- Flame resistant
- Easy to machine
- Excellent weatherability
- Superior chemical resistance
- FDA, USDA, USP Class VI, 3-A Dairy compliant

Product Applications:

- Chemical processing & storage
- Semiconductor equipment
- Fire-safe componentry
- Fluid handling
- DI water systems

PVDF Availability

Standard Thickness (inches) :	**0.031" up to 5" thick**
Standard Sheet Size (inches) :	**24 x 48 and 48 x 96** **Inquire on 48 x 120 (limited sizes)**
Standard Diameter (inches) :	**1/4" up to 10" diameter**
Standard Rod Length :	**4 ft, 8 ft and 10 ft (varies by diameter)**
Standard Color :	**Natural (off white)**

PVDF

Polyvinylidene Fluoride - Typical Properties

PROPERTY TESTED	ASTM	UNITS	PVDF
PHYSICAL PROPERTIES			
Tensile Strength, Ultimate	D638	psi	6,650
Tensile Modulus, 1% sec	D638	psi	348,000
Elongation, Ultimate	D638	%	80
Flexural Strength	D790	psi	10,750
Flexural Modulus, Tangent	D790	psi	391,500
Compressive Strength	D695	psi	11,600
Izod Impact, Notched .125"	D256	ft.•lb./in^2	1.90
Hardness, Rockwell	D785	R	R100
Coefficient of Friction @ 68oF	---	μ	0.30
Density	D792	lb./in^3	0.064
Water Absorption	D570	%	< 0.04
THERMAL PROPERTIES			
Deflection Temperature, 264 psi	D648	°F	235°
Melting Point	D3448	°F	352°
Thermal Expansion	D696	in/in °C	7.1 x 10^{-5}
Thermal Conductivity	C177	BTU-in./hr.•ft^2-°F	1.31
Flammability, .125", est. rating	UL94	---	V-0
ELECTRICAL PROPERTIES			
Dielectric Constant, 60 Hz, 73°F		---	9
Volume Resistivity		ohm-cm	5 x 10^{14}

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

Palclad Pro Cracked Ice

Wall and Ceiling Liner Panels

Palclad Pro Cracked Ice wall and ceiling liner panels are ideal for residential, industrial and commercial interior applications. These panels are light weight, easy to clean and easy to install. With the heavy cracked ice texture, they absorb scratches and resist marring making them great for high traffic areas. Palclad Pro Cracked Ice sheets meet the guidelines for USDA/FDA for incidental food contact making them ideal for restaurants. They also are safe for pets making them a great material for kennels, pet stores or animal hospitals.

Typical Features:

- 100% waterproof - no swelling or rotting
- Impact resistant
- Chemical resistant - not affected by acids, solvents or petroleum products
- USDA/CFIA approved
- 100% recyclable

Product Applications:

- Restaurant kitchens
- Gyms
- Showers
- Laundromats
- Locker rooms
- Commercial restrooms
- Food processing plants
- Hallways, waiting rooms

Palclad Pro Cracked Ice

Standard Thickness (inches) :	**0.090" thick**
Standard Sheet Size (inches) :	**48 x 96 and 48 x 120**
Standard Color :	**Bright White**

High Performance

Plastics Designed for Challenging Applications

High Performance Overview ..... 9-2 to 9-3

PAI, Polyamide-imide ..... 9-4 to 9-11

PBI, Polybenzimidazole ..... 9-12 to 9-13

PBT, Polybutylene Terephthalate ..... 9-14 to 9-19

PEEK, Polyether Ether Ketone ..... 9-20 to 9-29

PEI, Polyetherimide ..... 9-30 to 9-34

PET, Polyethylene Terephthalate ..... 9-35 to 9-37

PI, Polyimide ..... 9-38 to 9-41

PPO, Polyphenylene Oxide ..... 9-43 to 9-47

PPS, Polyphenylene Sulfide ..... 9-48 to 9-49

PPSU, Polyphenylsulfone ..... 9-50 to 9-52

PSU, Polysulfone ..... 9-53 to 9-55

PTFE, Polytetrafluoroethylene ..... 9-56 to 9-65

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

High Performance

What is High Performance?

In modern industry, "performance" is a must. It can cover many aspects concerning quality, efficiency, durability, speed, throughput or resistance to external factors. The aim is to have applications that run smoothly, with minimum maintenance, at the best cost to performance ratio. Within our material portfolio, you will certainly find the high performance plastics you need for your applications.

High performance plastics typically have a permanent operating temperature of more than 302°F. It is this material class that brings the superior properties of polymers - such as sliding friction characteristics, weight saving and chemical resistance - to bear, especially at high permanent operating temperatures. Using special reinforcing materials such as glass fiber, glass beads or carbon fiber, heat distortion resistance and rigidity can be increased even further. Additives such as PTFE, and graphite considerably improve the sliding and friction characteristics, and the addition of metal fibers and carbon black provide improved electrical conductivity.

Industries and Applications

High performance plastics are plastics that meet higher requirements than standard or engineering plastics. Generally, they are used in smaller amounts for critical applications such as aerospace, defense, medical or industrial applications.

Differences between Crystalline and Amorphous?

Amorphous polymers and crystalline polymers both refer to classes of polymers distinguished by their molecular arrangement and properties. Amorphous polymers are characterized by their disordered, random molecular structure. This randomness results in them having no clear melting point, but instead, they soften over a range of temperatures. Crystalline polymers, on the other hand, have a more organized and repeating structure. This orderly alignment gives them a sharp melting point, where they transition from a solid to a melt.

Please see the Polymer Pyramid on the following page for specific examples.

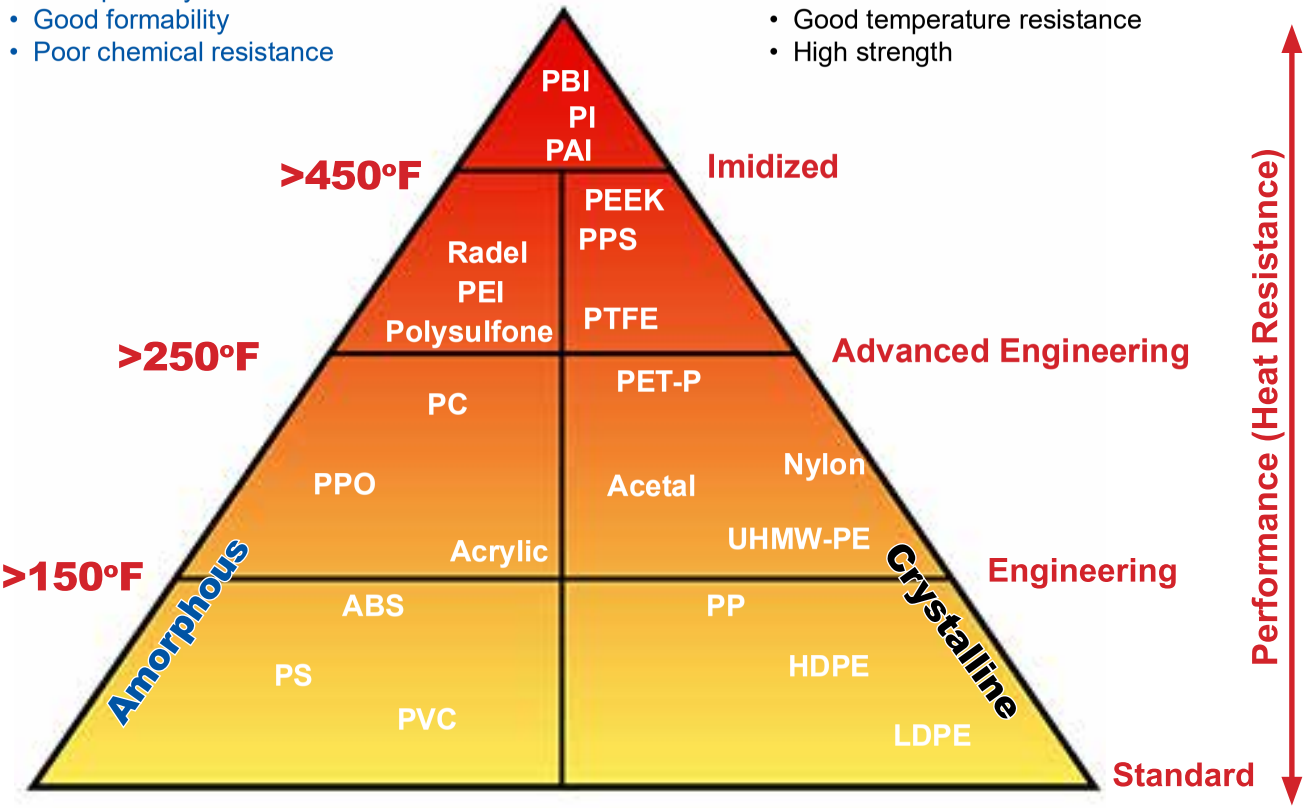
Polymer Pyramid

Amorphous

- Hot water and steam resistance
- Transparency
- Good formability
- Poor chemical resistance

Crystalline

- Bearing & wear performance
- Good chemical resistance
- Good temperature resistance
- High strength



PAI - Polyamide-Imide

Torlon® PAI

With its versatile performance capabilities and proven use in a broad range of applications, Torlon® polyamide-imide (PAI) shapes are offered in extruded, injection molded, and compression molded grades.

Torlon® PAI is the highest performing, melt processable plastic. It has 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.

Typical Features:

- Maintains stength and stiffness to 500 °F (260 °C)
- Minimal expansion rate to 500 °F (260 °C)
- Excellent wear resistance in bearing grades
- Able to endure harsh thermal, chemical and stress conditions

Torlon® PAI's extremely low coefficient of linear thermal expansion and high creep resistance deliver excellent dimensional stability over its entire service range. Torlon® PAI is an amorphous material with a Tg (glass transition temperature) of 537°F (280°C). Torlon® PAI stock shapes are post-cured using procedures developed jointly by BP Amoco and Mitsubishi Chemical Group. This eliminates the need for additional curing by the end user in most situations. A post-curing cycle is sometimes recommended for components fabricated from extruded shapes where optimization of chemical resistance and/or wear performance is required.

For large shapes or custom geometries like tubular bar, compression molded Torlon® PAI shapes offer designers the greatest economy and flexibility. Another benefit of selecting a compression molded grade is that resins are cured, or "imidized" prior to molding which eliminates the need to post-cure shapes or parts fabricated from compression molded shapes.

Popular extrusion and injection molding grades of Torlon® PAI are offered as compression molded shapes. Typically, you can identify a compression molded grade as having a second digit of "5" in the product name.

Torlon® PAI Grades:

- **Torlon® 4203 PAI**
- **Torlon® 4503 PAI**
- **Torlon® 4301 PAI**
- **Torlon® 4501 PAI**
- **Torlon® 4540 PAI**
- **Torlon® 5030 PAI**
- **Torlon® 5530 PAI**
- **Torlon® 7130 PAI**

PAI - Polyamide-Imide

Torlon® 4203 PAI & 4503 PAI

Torlon® 4203 PAI offers the best toughness and impact strength of all Torlon® PAI grades. This extruded grade is very popular for precision parts in high-tech equipment. In addition, its good electrical insulating ability provides numerous possibilities in the field of electrical components. Compression molded Torlon® 4503 PAI is similar in composition to Torlon® 4203 PAI, and is selected when larger shapes are required.

Torlon® 4503 PAI grade is commonly used for dies and patterns of formed metal parts or as thermal insulators. It is similar in composition to Duratron® T2503 PAI, and selected when larger shapes are required.

Product Applications:

- **High Temperature Electrical Connectors** - Torlon® 4203 PAI and Torlon® 5030 PAI provide outstanding electrical performance and high temperature stability.
- **Bearing Cages** - Torlon® 4203 and 4301 PAI's low expansion rate and excellent wear resistance enable manufacturers to increase bearing speeds and extend part life.
- **Can Mandrel** - Torlon® 4203 PAI's extraordinary compressive strength and abrasion resistance permit higher production rates, longer part life, and increased support of aluminum cans during printing.

Torlon® 4203 PAI pictured

Torlon® 4301 PAI & 4501 PAI

Torlon® 4301 PAI is primarily used for wear and friction parts. It offers a very low expansion rate, low coefficient of friction and exhibits little or no slip-stick in use. Torlon® 4301's flexural modulus of 1,000,000 psi, is higher than most other advanced engineering plastics. This grade excels in severe service wear applications such as non-lubricated bearings, seals, bearing cages and reciprocating compressor parts..

Torlon® 4501 PAI is well suited for general purpose wear and friction parts. It has a higher compressive strength and can therefore carry more load than Torlon® 4540. It is similar in composition to Torlon® 4301 PAI, and selected when larger shapes are required.

Product Applications:

- **Bearing Cages** - Torlon® 4203 and 4301 PAI's low expansion rate and excellent wear resistance enable manufacturers to increase bearing speeds and extend part life.

Torlon® 4301 PAI pictured

PAI - Polyamide-Imide

Typical Properties Comparison Torlon® PAI Grades

PROPERTY TESTED	ASTM	UNITS
MECHANICAL PROPERTIES		
Specific Gravity, 73°F	D792	g/cc
Tensile Strength, 73°F	D638	psi
Tensile Modulus, 73°F	D638	psi
Elongation (at break), 73°F	D638	%
Flexural Strength, 73°F	D790	psi
Flexural Modulus, 73°F	D790	psi
Shear Strength, 73°F	D732	psi
Compressive Strength, 73°F	D695	psi
Compressive Modulus, 73°F	D695	psi
Hardness, Rockwell M	D785	M
Hardness, Durometer, Shore "D"	D2240	D
Izod Impact (Notched)	D256A	ft-lb/in
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic
Limiting PV (4:1 safety factor)	QTM 55007	psi-ft./min.
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr
Relative Machinability	---	1=Easy, 10=Hard
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831	in/in-°F
Heat Deflection Temperature @ 264 psi	D648	°F
Melting Point (crystalline), Peak	D3418	°F
Continuous Service Temp in Air (Max)	Long Term	°F
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F
ELECTRICAL PROPERTIES		
Dielectric Strength, Short Term	D149	kV/inch
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	ohm/sq
Dielectric Constant,10^6Hz	D150	---
Dissipation Factor,10^6Hz	D150	---
Flammability @ 3.1 mm (1/8")	UL 94	---

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PAI - Polyamide-Imide

Typical Properties Comparison Torlon® PAI Grades

TORLON® 4203	TORLON® 4503	TORLON® 4301	TORLON® 4501
1.41	1.51	1.45	1.45
20,000	14,700	15,000	10,000
600,000	1,500,000	900,000	440,000
10.0 %	1.50 %	3.0 %	3.0 %
24,000	20,500	23,000	20,000
600,000	1,420,000	800,000	650,000
16,000	12,000	16,400	---
24,000	24,400	22,000	16,000
478,000	1,100,000	950,000	359,000
M 120	M 121	M 106	M 106
---	---	---	D 90
2.00	0.40	0.80	0.50
0.35	---	0.20	0.20
12,500	---	40,000	22,500
50	---	10	---
5	5	5	5
1.70×10^{-5}	1.10×10^{-5}	1.40×10^{-5}	2.00×10^{-5}
532°	410°	534°	534°
---	---	---	---
500°	480°	500°	500°
1.80	1.73	3.70	3.70
580	362	---	362
$> 10^{16}$	$> 10^{13}$	$> 10^{13}$	$> 10^{13}$
4.20	3.37	6.00	---
0.026	0.007	0.037	---
V-0	---	V-0	---

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PAI - Polyamide-Imide

Duratron® PAI

With its versatile performance capabilities and proven use in a broad range of applications, Duratron polyamide-imide (PAI) shapes are offered in extruded, injection molded, and compression molded grades.

Duratron® PAI is the highest performing, melt processable plastic. It has 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 Duratron stock shapes provide greater compressive strength and higher impact resistance than most advanced engineering plastics.

Duratron® PAI's extremely low coefficient of linear thermal expansion and high creep resistance deliver excellent dimensional stability over its entire service range. Duratron® PAI is an amorphous material with a Tg (glass transition temperature) of 537°F (280°C). Duratron® PAI stock shapes are post-cured using procedures developed jointly by BP Amoco and Mitsubishi Chemical Group. This eliminates the need for additional curing by the end user in most situations. A post-curing cycle is sometimes recommended for components fabricated from extruded shapes where optimization of chemical resistance and/or wear performance is required.

For large shapes or custom geometries like tubular bar, compression molded Duratron® PAI shapes offer designers the greatest economy and flexibility. Another benefit of selecting a compression molded grade is that resins are cured, or "imidized" prior to molding which eliminates the need to post-cure shapes or parts fabricated from compression molded shapes.

Popular extrusion and injection molding grades of Duratron® PAI are offered as compression molded shapes. Typically, you can identify a compression molded grade as having a second digit of "5" in the product name.

Typical Features:

- Maintains strength and stiffness to 500°F (260°C)
- Minimal expansion rate to 500°F (260°C)
- Excellent wear resistance in bearing grades
- Able to endure harsh thermal, chemical and stress conditions

Product Applications:

- Non-lubricated bearings
- Seals and valves
- Compressor parts
- Piston parts
- Bearing cages
- Electrical components
- High temperature seals

PAI - Polyamide-Imide

Duratron® PAI

Duratron® T4203 PAI

Duratron® T4203 PAI offers the best toughness and impact strength of all Duratron PAI grades. This extruded grade is very popular for precision parts in high-tech equipment. In addition, its good electrical insulating ability provides numerous possibilities in the field of electrical components. Compression molded Duratron® T4503 PAI is similar in composition to Duratron® T4203 PAI, and is selected when larger shapes are required.

Duratron® T4203 PAI pictured

Duratron® T4503 PAI

This grade is commonly used for dies and patterns of formed metal parts or as thermal insulators. It is similar in composition to Duratron® T2503 PAI, and selected when larger shapes are required.

Duratron® T4301 PAI

This Duratron® PAI is primarily used for wear and friction parts. It offers a very low expansion rate, low coefficient of friction and exhibits little or no slip-stick in use. Duratron® T4301's flexural modulus of 1,000,000 psi, is higher than most other advanced engineering plastics. This grade excels in severe service wear applications such as non-lubricated bearings, seals, bearing cages and reciprocating compressor parts.

Duratron® T4301 PAI pictured

Duratron® T4501 PAI

Duratron® T4501 PAI is well suited for general purpose wear and friction parts. It has a higher compressive strength and can therefore carry more load than Duratron® T4540. It is similar in composition to Duratron® T4301 PAI, and selected when larger shapes are required.

Duratron® T4540 PAI

This seal and bearing grade offers a very low coefficient of friction and good wear properties. It was developed specifically for use in rotating equipment. Its composition is the same as the former Duratron® T4340 PAI polyamide-imide and used when larger (especially tubular) shapes are required. Typical applications for Duratron® T4540 PAI include labyrinth seals, wear rings, bushings, and bearings of all types.

MITSUBISHI CHEMICAL GROUP

PAI - Polyamide-Imide

Typical Properties Comparison Duratron® PAI Grades

PROPERTY TESTED	ASTM	UNITS	DURATRON® T4203 PAI
MECHANICAL PROPERTIES			
Specific Gravity	D792	---	1.41
Tensile Strength	D638	psi	20,000
Tensile Strength at 300°F	D638	psi	15,000
Tensile Strength at 150°F	D638	psi	18,000
Tensile Modulus	D638	psi	600,000
Elongation (at break)	D638	%	10%
Flexural Strength	D790	psi	24,000
Flexural Modulus	D790	psi	600,000
Compressive Strength	D695	psi	24,000
Compressive Modulus	D695	psi	478,000
Hardness, Rockwell	D785	M (E)	120 (80)
Hardness, Durometer, Shore "D"	D2240	D	---
Izod Impact (Notched)	D256A	ft-lb/in	2.00
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic	0.35
Limiting PV (4:1 safety factor)	QTM 55007	psi-ft./min.	12,000
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	35 x 10^{-10}
THERMAL PROPERTIES			
Coefficient of Linear Thermal Expansion	E831	µin/in-°F	17.0
Deflection Temp. 264 psi	D648	°F (°C)	532° (278°)
Maximum Service Temp, Air	Long Term	°F (°C)	500° (260°)
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F	1.80
ELECTRICAL PROPERTIES			
Dielectric Strength, Short Term	D149	kV/inch	580
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	ohm	>=1.00e + 16
Dielectric Constant, 10^6Hz	D150	1 MHz	4.20
Dissipation Factor, 10^6Hz	D150	1MHz	0.026
CHEMICAL PROPERTIES			
Water Absorp Immersion, 24 hrs	D570(2)	%	0.40
Water Absorp Immersion, Saturation	D570(2)	%	1.70

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Continued on the next page

PAI - Polyamide-Imide

Typical Properties Comparison Duratron® PAI Grades

DURATRON® T4503 PAI	DURATRON® T4301 PAI	DURATRON® T4501 PAI	DURATRON® T4540 PAI
1.40	1.45	1.45	1.46
18,000	15,000	10,000	13,000
12,000	12,000	7,000	9,000
15,000	14,000	8,000	6,000
500,000	900,000	440,000	550,000
5%	3%	3%	3%
24,000	23,000	20,000	12,000
600,000	800,000	650,000	550,000
18,000	22,000	16,000	20,000
350,000	950,000	359,000	350,000
119 (80)	106 (70)	106 (70)	107 (66)
90	---	90	90
1.50	0.80	0.50	1.10
0.30	0.20	0.20	0.20
4,000	40,000	22,500	7,500
500 x 10^{-10}	10 x 10^{-10}	150 x 10^{-10}	315 x 10^{-10}
15.0	14.0	20.0	20.0
532° (278°)	534° (279°)	534° (279°)	534° (279°)
500° (260°)	500° (260°)	500° (260°)	500° (260°)
1.80	3.70	3.70	2.81
600	---	---	---
>=1.00e + 13	>=1.00e + 13	>=1.00e + 13	>=1.00e + 13
4.20	6.00	6.00	---
0.031	0.037	0.042	---
0.35	0.40	0.30	0.30
1.70	1.50	1.50	1.50

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Continued from previous page

PBI - Polybenzimidazole

Duratron® CU60 PBI

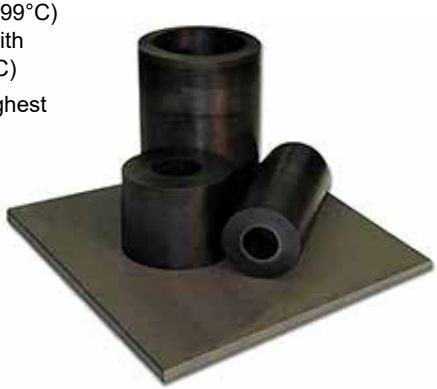
Duratron® CU60 PBI is the highest performance engineering thermoplastic available today. It offers the highest heat resistance and mechanical property retention over 400°F of any unfilled plastic. It has better wear resistance and load carrying capabilities at extreme temperatures than any other reinforced or unreinforced engineering plastic.

As an unreinforced material, Duratron® CU60 PBI is very “clean” in terms of ionic impurity and it does not outgas (except water). These characteristics make this material very attractive to semiconductor manufacturers for vacuum chamber applications. Duratron® CU60 PBI has excellent ultrasonic transparency which makes it an ideal choice for parts such as probe tip lenses in ultrasonic measuring equipment.

Duratron® CU60 PBI is also an excellent thermal insulator. Other plastics in melt do not stick to PBI. These characteristics make it ideal for contact seals and insulator bushings in plastic production and molding equipment.

Typical Features:

- Highest mechanical properties of any plastic above 400°F (204°C)
- Highest heat deflection temperature 800°F (427°C), with a continuous service capability of 750°F (399°C) in inert environments, or 650°F (343°C) in air with short term exposure potential to 1,000°F (538°C)
- Lowest coefficient of thermal expansion and highest compressive strength of all unfilled plastics.



Product Applications:

- High heat insulator bushings
- Electrical connectors
- Ball valve seats
- Clamp rings

Engineering Notes:

Duratron® CU60 PBI is extremely hard and can be challenging to fabricate. Polycrystalline diamond tools are recommended when fabricating production quantities. Duratron® tends to be notch sensitive. All corners should be readiused (0.040" min.) and edges chamfered to maximize part toughness. High tolerance fabricated components should be stored in sealed containers (usually polybags with desiccant) to avoid dimensional changes due to moisture absorption. Components rapidly exposed to temperatures above 400°F (204°C) should be "dried" prior to use or kept dry to avoid deformation from thermal shock.

PBI - Polybenzimidazole

Typical Properties for Duratron® CU60 PBI

PROPERTY TESTED	ASTM	UNITS	DURATRON® PBI
MECHANICAL PROPERTIES			
Specific Gravity	D792	---	1.30
Tensile Strength	D638	psi	20,000
Tensile Modulus	D638	psi	850,000
Elongation (at break)	D638	%	3
Flexural Strength	D790	psi	32,000
Flexural Modulus	D790	psi	950,000
Compressive Strength	D695	psi	50,000
Compressive Modulus	D695	psi	900,000
Hardness, Rockwell	D785	M (R)	125 (-)
Hardness, Durometer, Shore "D"	D2240	D	94
Izod Impact (Notched)	D256A	ft-lb/in	0.50
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic	0.24
Limiting PV (4:1 safety factor)	QTM 55007	psi-fpm	37,500
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	60
THERMAL PROPERTIES			
Coefficient of Linear Thermal Expansion	E831	10E-4/°F	.13
Deflection Temp. 264 psi	D648	°F	800°
Cont. Service in Air (Max)	Long Term	°F	600°
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F	2.8
ELECTRICAL PROPERTIES			
Dielectric Strength, Short Term	D149	Volts/mil	550
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	Ohm/Sq	1E+13
Dielectric Constant,10^6Hz	D150	1 MHz	3.20
Dissipation Factor,10^6Hz	D150	1MHz	.003
CHEMICAL PROPERTIES			
Water Absorp Immersion, 24 hrs	D570(2)	%	0.40
Water Absorp Immersion, Satur.	D570(2)	%	5.00

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PBT - Polybutylene Terephthalate

Hydex® 4101 and Hydex® 4101L

Hydex® 4101 and Hydex® 4101L (internally lubricated) represent a family of stock shape plastics with elevated performance over PET-P, Acetal and Nylon. Hydex® 4101 is a PBT Polyester with an outstanding set of properties that include; wear resistance, chemical resistance and toughness. Hydex® 4101L (Lubricated) is an enhanced version with improved wear, PV range and lubricity over Hydex® 4101. In direct comparison to other commonly used plastics, Hydex® 4101 and Hydex® 4101L have:

Product Applications:

- Bearings
- Bushings, Cams
- Cam rollers
- Conveyor components
- Conveyor wheels
- Dispensing components
- Filler components
- Fixturing blocks
- Food pistons
- Wear strips
- Impellers
- Manfolds
- Pump parts
- Scraper blades
- Timing screws
- Valve bodies & Gears

Food Processing Industry:

- Bakery
- Beverages / Soft drinks
- Candy / Confectionery
- Canned foods
- Dairy
- Frozen foods
- Ice cream
- Juices
- Meat & Meat by-products
- Poultry processing
- Processed & Snack foods

PBT - Polybutylene Terephthalate

Advantages of Hydex® 4101/4101L vs other materials

Improved Wear and Chemical Resistance versus Acetal

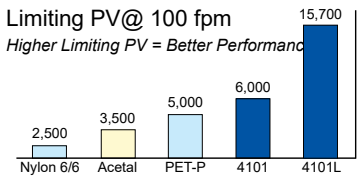
- Hydex® 4101 and 4101L are compatible with chemicals having a pH range of 2.0 - 9.0, Acetal's range is 4.0 - 9.0.
- Hydex® 4101 and 4101L can with stand repeated "CIP" chemical washdown without affecting material performance. Acetal degrades upon repeated contact with aqueous chlorine solutions.
- Hydex® 4101L has 30% higher limiting PV than Delrin® AF.
- Hydex® 4101L has about two times better wear factor than Acetal.
- Hydex® 4101L is approved for direct food contact, Delrin® AF is not.

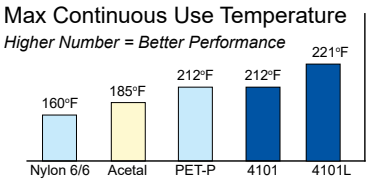
Superior Dimensional Stability over Nylon

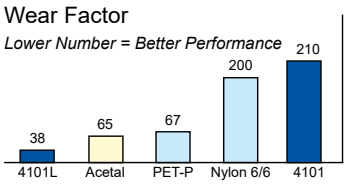
- Hydex® 4101 and 4101L have moisture absorption of 0.07%.
- Nylon has moisture absorption 15 times greater than Hydex®, and can exhibit significant dimensional changes in use.

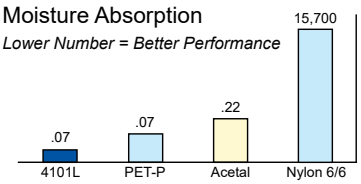
Best Wear and Lubricity when compared to PET-P

- Hydex® 4101 and 4101L have 20% greater impact strength than PET-P.
- Hydex® 4101L has about 50% better wear factor than PET-P.
- Hydex® 4101L has more than twice the LPV performance than PET-P.
- Hydex® 4101L has about 50% lower coefficient of friction than PET-P.



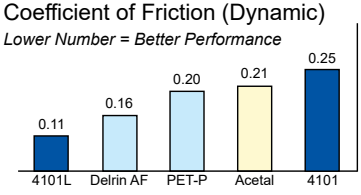






Chemical Resistance

HYDEX 4101 HYDEX 4101L	>	pH Range	2.0 - 9.0
PET-P	>	pH Range	2.0 - 9.0
Acetal	>	pH Range	4.0 - 9.0
Nylon 6/6	>	pH Range	2.0 - 10.0



PBT - Polybutylene Terephthalate

Hydex® 4101 and Hydex® 4101L

Hydex® 4101 & 4101L Sheet

Standard Thickness (inches) :	1/2 3/4 1 1-1/2 2 2-1/2 3 3-1/2 4
Standard Sheet Size (inches) :	12 x 24 and 12 x 48 (1/2" to 4" thick) 24 x 24 and 24 x 48 (1/2" to 2" thick)
Standard Sheet Tolerances :	Thickness ..... 1/2 to 7/8 ..... +.025" / -0 Thickness ..... 1 to 4 ..... +.050" / -0 Width ..... +.125" / -0 Length ..... +.500" / -0
Standard Sheet Color :	Natural and Black

Sheets / Slabs can be ground down to intermediate sizes

Hydex® 4101 & 4101L Rod

Standard Diameter (inches) :	1/4 1/2 3/4 1 1-1/4 1-1/2 2 2-1/4 2-1/2 3 3-1/2 4 4-1/2 5 5-1/2 6
Standard Rod Length (feet) :	1/4 to 1 dia ..... 5 and 10 ft ..... +.002" / -0 1-1/8 to 2 dia ..... 4 and 8 ft ..... +.005" / -0 2-1/8 to 2-1/2 dia ..... 2 and 4 ft ..... +.025" / -0 2-5/8 to 6 dia ..... 2 and 4 ft ..... Oversize
Standard Rod Color :	Natural and Black

Rods can be ground down to any intermediate diameter, pricing is based on next larger diameter rod plus grinding charge.

PBT - Polybutylene Terephthalate

Typical Properties for Hydex® 4101 & 4101L

PROPERTY TESTED	CONDITION	UNITS	HYDEX® 4101	HYDEX® 4101L
PHYSICAL PROPERTIES				
Chemical Designation	---	---	PBT	PBT
Filler	---	---	n/a	n/a
Density	---	g/cm	1.31	1.36
MECHANICAL PROPERTIES				
Tensile Modulus	@ 73°F	psi	425,000	380,000
Tensile Strength at Yield	@ 73°F	psi	9,400	7,200
Tensile Strength at Break	@ 73°F	psi	---	---
Shear Strength	@ 73°F	psi	---	---
Elongation at Yield	@ 73°F	psi	6	---
Elongation at Break	@ 73°F	%	50	40
Flexural Modulus	@ 73°F	%	420,000	390,000
Flexural Strength	@ 73°F	psi	12,000	14,000
Compressive Modulus	@ 73°F	psi	---	---
Compressive Strength	@ 73°F, 10% strain	psi	---	---
Izod Impact, Notched	@ 73°F	ft.-lb./in.	0.7	0.7
Rockwell Hardness	@ 73°F	M (R) Scale	---	---
Coefficient of Friction	Static	---	0.19	0.08
Coefficient of Friction	Dynamic, 40 psi	---	0.25	0.11
Wear (K) Factor	---	in-min/lb-ft-hr	210 x 10^{-10}	38 x 10^{-10}
Limiting PV	---	psi-fpm	6,000	15,700
THERMAL PROPERTIES				
Vicat Softening Point	---	°F	---	---
Melting Temperature	---	°F	437°	---
Heat Deflection Temperature	@ 66 psi	°F	310°	---
Heat Deflection Temperature	@ 264 psi	°F	200°	195°
Service Temperature	Intermittent	°F	---	---
Service Temperature	Long Term	°F	221°	221°
Thermal Expansion (CLTE)	---	in./in./ °F	6.1 x 10^{-5}	---
Thermal Conductivity	---	BTU-in./hr.-ft-°F	---	---
MISC PROPERTIES				
Moisture Absorption	24 hrs, @ 73°F	%	0.07	0.07
Moisture Absorption	Saturation @ 73°F	%	---	---
Flammability	UL 94	---	HB	---
Food Grade	---	---	Yes	Yes

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PBT - Polybutylene Terephthalate

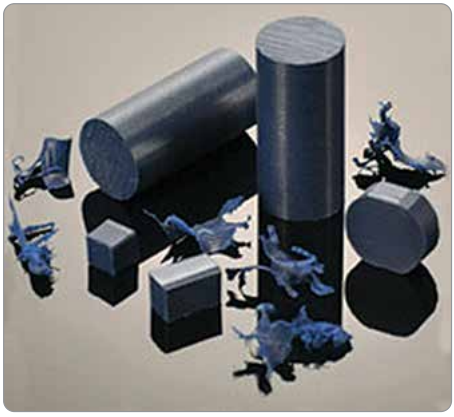
Hydex® UD Blue - Ultra Detectable grade of PBT

Hydex® 4101 UD Blue has been specifically designed for the demanding environment of the food processing industry. For several years, the industry has been moving towards materials used in equipment design that are detectable in some way; either visually, by metal or x-ray detection, in order to improve food safety, and reduce the possibility of product contamination. Hydex® 4101 UD Blue offers visibility for all three detection types with one material. The product's specially formulated fillers are detectable to both x-ray and metal detection systems, and its blue coloration is visible to optical inspection systems.

In addition, as part of the polyester family, HYDEX® 4101 UD Blue exhibits the very good physical properties typical of the family, as well as excellent resistance to chlorine and caustic cleaning solutions.

Typical Features:

- Resistant to cleaning agents
- Food grade blue color
- Good chemical resistance
- Good dimensional stability
- Good impact strength
- Metal detectable
- X-ray opaque



Product Applications:

- Food processing pump impellers
- Filler valve parts
- Food forming plates

Ensinger

Hydex® 4101 UD Blue

Standard Thickness (inches) :	**3/4" and 1" thick**
Standard Sheet Size (inches) :	**24" x 48"**
Standard Diameter (inches) :	**1", 1-1/2", 2" and 3" dia**
Standard Rod Lengths (inches) :	**120" long (10 feet)**
Hydex 4101 UD Blue Color :	**Food Grade Blue**

PBT - Polybutylene Terephthalate

Typical Properties for Hydex® UD Blue

PROPERTY TESTED	CONDITION	UNITS	HYDEX® UD BLUE
PHYSICAL PROPERTIES			
Chemical Designation	---	---	PBT
Filler	---	---	Detectable
Density	---	g/cm	1.59
MECHANICAL PROPERTIES			
Tensile Modulus	@ 73°F	psi	550,000
Tensile Strength at Yield	@ 73°F	psi	9,300
Tensile Strength at Break	@ 73°F	psi	---
Shear Strength	@ 73°F	psi	---
Elongation at Yield	@ 73°F	psi	---
Elongation at Break	@ 73°F	%	3.53
Flexural Modulus	@ 73°F	%	556,150
Flexural Strength	@ 73°F	psi	15,250
Compressive Modulus	@ 73°F	psi	346,360
Compressive Strength	@ 73°F, 10% strain	psi	13,760
Izod Impact, Notched	@ 73°F	ft.-lb./in.	0.58
Rockwell Hardness	@ 73°F	M (R) Scale	92
Coefficient of Friction	Static	---	---
Coefficient of Friction	Dynamic, 40 psi	---	---
Wear (K) Factor	---	in-min/lb-ft-hr	---
Limiting PV	---	psi-fpm	---
THERMAL PROPERTIES			
Vicat Softening Point	---	°F	---
Melting Temperature	---	°F	437°
Heat Deflection Temperature	@ 66 psi	°F	393°
Heat Deflection Temperature	@ 264 psi	°F	275°
Service Temperature	Intermittent	°F	---
Service Temperature	Long Term	°F	221°
Thermal Expansion (CLTE)	---	in./in./ °F	4.05×10^{-5}
Thermal Conductivity	---	BTU-in./hr.-ft-°F	---
MISC PROPERTIES			
Moisture Absorption	24 hrs, @ 73°F	%	---
Moisture Absorption	Saturation @ 73°F	%	---
Flammability	UL 94	---	---
Food Grade	---	---	Yes

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PEEK - Polyetheretherketone

PEEK (Polyetheretherketone) is a high-performance engineering plastic known for its durability in hostile environments. PEEK offers broad chemical resistance that makes it a great alternative to fluoropolymers when higher strength is needed; maintaining dimensional stability and excellent mechanical strength. PEEK offers superior wear resistance and can be used continuously to 480° F (250° C). It can also be used with hot water or steam without permanent loss in physical properties. PEEK carries a V-0 flammability rating in thinner gauges and exhibits very low smoke and toxic gas emission when exposed to flame. PEEK is available in unfilled, bearing grade and glass and carbon filled grades.

PEEK has proven success in challenging environments in the aerospace, oil & gas, pharmaceutical/medical, food processing and semiconductor industries. Our inventory is coded for full traceability with manufacturer material certifications. It is available in sheet, rod, tube, film, machined and molded parts. PEEK shapes are made from a variety of resins including Victrex™, KetaSpire® and VESTAKEEP®.

Common Trade Names:

- Ketron® (Mitsubishi Chemical Group)
- GEHR PEEK™ (GEHR Plastics, Inc.)
- SustaPEEK® (Rochling Sustaplast)
- ZL-1500 (ZL Engineering)

Typical Features:

- Excellent chemical resistance
- Excellent wear and abrasion resistance
- Very low moisture absorption
- FDA compliant grades
- Unaffected by continuous exposure to hot water or steam - autoclavable

Product Applications:

- Valve seats
- Pump gears
- High purity seals
- Wafer carriers
- Bushings & bearings
- Electrical connectors
- Screw and impellers
- Gears and wear blades
- Medical instruments
- Lab & analytical equipment

PEEK Availability

Standard Thickness (inches) :	**1/4" up to 4" thick**
Standard Sheet Size (inches) :	**24" x 48" 12" x 48" 48" x 96"**
Standard Diameter (inches) :	**1/4" up to 6" diameter**
Standard Rod Length (inches) :	**48" and 96" lengths**
Standard Color :	**Natural (Tan) and Black**

PEEK - Polyetheretherketone

PEEK Grades & Descriptions

PEEK 1000

This general purpose grade is unreinforced and offers the highest elongation and toughness of all PEEK grades. The newly available black PEEK 1000 is ideal for instrument components where aesthetics are important, as well as for seal components where ductility and inertness are important.

PEEK GF30 (30% Glass Reinforced)

The addition of glass fibers significantly reduces the expansion rate and increases the flexural modulus of PEEK. This grade is ideal for structural applications that require improved strength, stiffness or stability, especially at temperatures above 300°F (150°C).

PEEK CA30 (30% Carbon Fiber Reinforced)

The addition of carbon fibers enhances the compressive strength and stiffness of PEEK, and dramatically lowers its expansion rate. It offers designers optimum wear resistance and load carrying capability in a PEEK based product. This grade provides more thermal conductivity than unreinforced PEEK - increasing heat dissipation from bearing surfaces improving bearing life and capability.

PEEK HPV (Bearing Grade)

Carbon fiber reinforced with graphite and PTFE lubricants, our newest grade of PEEK offers the lowest coefficient of friction and the best machinability for all PEEK grades. An excellent combination of low friction, low wear, high LPV, low mating part wear and easy machining, make it ideal for aggressive service bearings.

PEEK IM (Injection Molded Grade)

Injection Molded PEEK advanced polymers shapes are ideal for machined back-up rings and v-seals. PEEK offers excellent chemical and wear resistance across a broad range of operating temperatures. In addition to the widely used PEEK 1000 grade, several specific grades are available that incorporate glass or carbon fibers, or wear resistant additives that increase the wear life of machined parts.

PEEK LSG (Life Science Grade)

This series of PEEK materials were developed specifically for Life Sciences applications and are pre-qualified biocompatible materials, helping to save precious time and money. Approved for both the United States Pharmacopeias (USP) and ISO 10993-1 by successfully passing a series of biocompability tests these products are implantable for up to 24 hours.

PEEK - Polyetheretherketone

Typical Properties Comparison PEEK grades

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Specific Gravity	D792	g/cc
Water Absorption, Immersion, 24 hours	D570(2)	%
Water Absorption, Immersion, at Saturation	D570(2)	%
MECHANICAL PROPERTIES		
Hardness Rockwell R (Shore D)	D785 (D2240)	---
Tensile Strength	D638	psi
Tensile Strength at 65°C (150°F)	D638	psi
Elongation at Break	D638	%
Tensile Modulus	D638	psi
Flexural Strength	D790	psi
Flexural Modulus	D790	psi
Compressive Strength, 10% Deformation	D695	psi
Compressive Modulus	D695	psi
Shear Strength	D732	psi
Izod Impact (Notched)	D256 Type A	ft.-lb./in.
Coefficient of Friction, Dynamic (Dry vs. Steel)	QTM 55007	---
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min./ft.-lb.-hr.
Limiting PV (with 4:1 safety factor applied)	QTM 55007	psi-ft./min.
ELECTRICAL PROPERTIES		
Surface Resistivity per Square	EOS/ESD S11.11	ohm
Dielectric Strength (Short Term)	ASTM D149	kV/in.
THERMAL PROPERTIES		
Coefficient of Linear Thermal Expansion	E831	µin./in.-°F
Thermal Conductivity	F433	BTU-in./hr.-ft^2-°F
Melting Point (Crystalline, Peak)	D3418	°F
Maximum Service Temp., Air (Long Term)	---	°F
Deflection Temp at 1.8 MPa (264 psi)	D648	°F
Flammability, UL94 (1/8", est. rating)	---	---
COMPLIANCE PROPERTIES		
3A-Dairy	---	---
Canada AG	---	---
FDA	---	---
NSF	---	---
USDA	---	---
USP Class VI	---	---

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

PEEK - Polyetheretherketone

Typical Properties Comparison PEEK grades

KETRON® PEEK 1000	KETRON® PEEK CA30	KETRON® PEEK GF30	KETRON® PEEK HPV	KETRON® PEEK IM
1.31	1.42	1.59	1.44	1.31
0.10	0.15	0.15	0.05	0.10
0.50	0.50	0.50	0.30	0.50
126 (85)	125 (91)	124 (88)	M85	127 (88)
16,000	16,000	7,400	11,000	16,000
12,000	12,000	5,000	9,000	---
40%	3%	1%	2%	40%
630,000	140,000	850,000	850,000	600,000
25,000	23,000	12,000	27,500	23,000
600,000	1,000,000	900,000	1,100,000	600,000
20,000	28,000	19,000	20,000	20,000
500,000	580,000	500,000	500,000	425,000
8,000	11,000	---	10,000	---
0.60	1.40	1.00	0.70	0.40
0.32	0.24	---	0.21	0.32
375×10^{-10}	102×10^{-10}	---	100×10^{-10}	375×10^{-10}
8,500	17,000	---	20,000	8,500
>= 1.00e + 13	>= 1.00e + 05	>= 1.00e + 13	<= 10,000	>= 1.00e + 13
480	---	550	---	480
26.0	23.0	14.0	17.0	26.0
1.75	6.37	2.98	1.70	1.75
644°	644°	654°	644°	654°
480°	480°	480°	482°	480°
320°	450°	450°	383°	320°
V-0	V-0	V-0	V-0	V-0
Yes	No	No	No	No
No	No	No	No	No
Yes	No	No	No	No
No	No	No	No	No
Yes	No	No	No	No
No	No	No	No	No

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

PEEK - Polyether Ether Ketone

SustaPEEK® XDT - X-ray Detectable PEEK

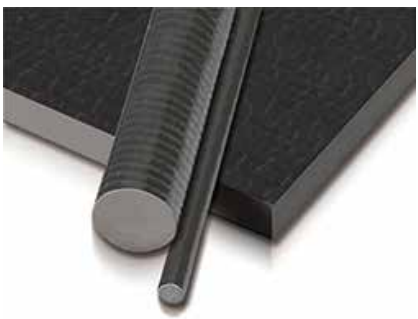
SustaPEEK® XDT offers the best balance of properties of all thermoplastic materials. In addition to outstanding mechanical properties, chemical resistance and thermal performance, SustaPEEK® XDT can withstand long term continuous temperatures of 480°F as well as exposure to hot water or steam with low moisture absorption which makes it the material of choice for high-temperature applications in the food processing industry.

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

SustaPEEK® XDT has been proven to be detected in a particle as small as a 3mm cube on production lines running as fast as 250 feet-per-minute. Together with the recently developed Polystone® M XDT (UHMW-PE) and Sustarin® C XDT (Acetal), Rochling now provides three of the most commonly used engineering plastics in the food processing industry in these special x-ray detectable grades.

Typical Features:

- Excellent chemical resistance
- Very low moisture absorption
- Outstanding rigidity at high temperatures
- Inherently good wear and abrasion resistance
- Unaffected by continuous exposure to hot water or steam
- X-ray detectable as small as 3mm cube



SustaPEEK® XDT

Standard Thickness (inches) :	**3/8" up to 4" thick**
Standard Sheet Size (inches) :	**Please inquire for sizes**
Standard Diameter (inches) :	**1/2" up to 6" diameter**
Standard Rod Length (inches) :	**Please inquire for lengths**
Standard Color :	**Dark Gray**

PEEK - Polyether Ether Ketone

Typical Properties for SustaPEEK® XDT

PROPERTY TESTED	ASTM	UNITS	SUSTAPEEK XDT
MECHANICAL PROPERTIES			
Specific Gravity	D792	---	1.32
Water Absorption (24 hrs)	D570	%	0.10
Water Absorption at Saturation	D570	%	0.50
Flammability	UL94	---	V-0
Tensile Strength	D638	psi	16,000
Elongation	D638	%	20
Modulus	D638	psi	500,000
Flexural Strength	D790	psi	25,000
Flexural Modulus	D790	psi	600,000
Izod Impact, Notched	D256	ft.-lb./in.	1.20
Rockwell Hardness	D785	M scale	M105
Heat Deflection Temp @ 264 psi	D648	°F	320°
Coefficient of Linear Thermal Expansion	D696	in./in./°F	2.6×10^{-5}
Dielectric Strength	D149	V/mil	480
Volume Resistivity	D257	ohm-cm	10^{15}
Dielectric Constant	D150	---	3.30

RÖCHLING Engineered Plastics

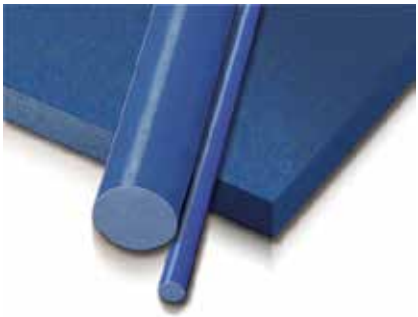
PEEK - Polyether Ether Ketone

TecaPEEK® UD Blue - Ultra Detectable PEEK

TecaPEEK® UD Blue is an "Ultra Detectable" PEEK designed specifically for high temperature applications in the food industry. It has the advantage of detect-ability by all 3 of the food product inspection technologies used in the food industry – optical, metal and x-ray detect-ability. Detection of particulate matter in food products is very important in food safety. It also offers the typical high performance advantages of excellent temperature, chemical, and wear resistance. All the components of TecaPEEK® UD Blue are FDA compliant.

Typical Features:

- Optical, Metal and X-ray detectable
- Excellent chemical resistance
- Very low moisture absorption
- Inherently good wear and abrasion resistance
- Unaffected by continuous exposure to hot water or steam
- FDA compliant



Product Applications:

- Valve seats
- Pump parts
- Filler valves
- Bushings & bearings
- Scraper blades
- Filler nozzles

TecaPEEK® UD Blue

Standard Thickness (inches) :	**1/4" up to 2" thick**
Standard Sheet Size (inches) :	**24" x 48"**
Standard Diameter (inches) :	**1/2" up to 4" diameter**
Standard Rod Length (inches) :	**120" (10 foot)**
Standard Color :	**Blue**

PEEK - Polyether Ether Ketone

Typical Properties for TecaPEEK® UD Blue

PROPERTY TESTED	ASTM	UNITS	TECAPEEK UD BLUE
MECHANICAL PROPERTIES			
Modulus of Elasticity (tensile test), 73°F	D638	psi	772,200
Tensile Strength, 73°F	D638	psi	12,750
Elongation at Yield, 73°F	D638	%	3.43%
Elongation at Break, 73°F	D638	%	4.13%
Flexural Strength, 73°F	D790	psi	21,230
Modulus of Elasticity (flexural test), 73°F	D790	psi	728,400
Compression Strength at 10% strain, 73°F	D695	psi	21,235
Compression Modulus, 73°F	D695	psi	536,730
Impact Strength (Izod), 73°F	D256	ft.-lb./in.	0.79
Rockwell Hardness, M Scale, 73°F	D785	M scale	M 101
THERMAL PROPERTIES			
Melting Temperature	---	°F	644°
Service Temperature, Long Term	---	°F	500°
Service Temperature, Short Term	---	°F	572°

This information reflects the current state of our knowledge and is intended only to assist and advise. It is given without obligation or liability. It does not assure or guarantee chemical resistance, quality of products or their suitability in any legally binding way. Values are not minimum or maximum values, but guidelines that can be used for comparitive purposes in material selection. They are within the normal range of product properties and do not represent guaranteed property values. Testing under individual application circumstances is always recommended. Data is obtained from extruded shapes materials unless otherwise noted. References to FDA compliance refer to the resins from which the products were made unless otherwise noted. All trade and patent rights should be observed. All rights reserved. Data sheet values are subject to periodic review, the most recent update can be found at www.ensinger-inc.com.

PEEK - Polyether Ether Ketone

SustaPEEK MG - Medical Grade PEEK

SustaPEEK MG (polyetheretherketone) offers the best balance of properties of all thermoplastic materials. In addition to outstanding mechanical properties, chemical resistance and thermal performance, SustaPEEK can withstand long term continuous temperatures of 480°F as well as exposure to hot water or steam with low moisture absorption.

SustaPEEK MG comes in 6 different colors, Natural, Black, Green, Red, Blue and Yellow.

Typical Features:

- Intrinsic flame retardancy
- Outstanding rigidity at high temperatures
- Continuous use temperature of 480°F
- Excellent hydrolysis resistance
- Excellent chemical resistance
- Good dimensional stability
- FDA compliant

Product Applications:

- Semiconductor applications
- Medical devices and instruments
- Surgical instruments
- Analytical instruments
- Pump rotors and housings
- Automotive thrust washers

Material Certifications:

- ASTM D6262
- FDA compliant
- USP Class VI & ISO 10993-5 compliant

SustaPEEK MG	
Standard Thickness (inches) :	**1/4" up to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**1/4" up to 6" diameter**
Standard Rod Length :	**Varies by diameter, please inquire**
Standard Colors :	**Natural, Black, Green, Red, Blue & Yellow**

PEEK - Polyether Ether Ketone

Ketron® PEEK LSG - Life Science Grade

Ketron® PEEK LSG natural / black stock shapes are produced from batches of Victrex PEEK. The composition of the resin used for the production of the Ketron® PEEK LSG stock shapes complies with the regulations that apply in the Member States of the European Union (Directive 2002/72/EC, as amended) and in the United States of America (FDA) for plastic materials and articles intended to come into contact with foodstuffs.

Ketron® PEEK LSG stock shapes have also been successfully type tested for their compliance with both United States Pharmacopeia (USP) and ISO 10993-1 guideline requirements for Biocompatibility Testing of Materials, and they come with full traceability from resin to stock shape.

These features, added to an excellent sterilizability by means of steam, dry heat, ethylene oxide, plasma and gamma irradiation, make Ketron® PEEK LSG stock shapes very suitable for applications in the medical, pharmaceutical and biotechnology markets.

Typical Features:

- Intrinsic flame retardancy
- Outstanding rigidity at high temperatures
- Excellent hydrolysis resistance
- Continuous use temperature of 480°F
- Excellent chemical resistance
- Good dimensional stability
- FDA compliant

Product Applications:

- Medical devices and instruments
- Surgical instruments
- Analytical instruments
- Pump rotors and housings
- Aircraft interior components
- Automotive thrust washers
- Semiconductor applications

Ketron® PEEK LSG	
Standard Thickness (inches) :	**1/4" up to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**1/4" up to 6" diameter**
Standard Rod Length :	**4 ft or 8 ft, varies by diameter**

PEI - Polyetherimide

Ultem™ PEI

Ultem™ PEI is an amorphous, high performance polymer known for its high strength and long term heat resistance. Its continuous use temperature of 340° F (170° C) is higher than that of general use plastics such as Nylon and Acetal. Ultem™ is inherently flame retardant, UL 94-V-0 rated, with low smoke output and is also RoHS compliant. PEI has excellent dimensional stability and is chemical resistant.

Ultem™ is commonly used in the electronics' market because of its good arc resistance and one of the highest dielectric strengths of any thermoplastic material. It is also a prime material for medical applications because of its ability to withstand multiple autoclave steam sterilization cycles. Ultem™ has exceptional mechanical, thermal, and electrical properties. Natural Ultem™ 1000 (unreinforced) is a translucent amber material. The addition of glass fiber reinforcement to PEI elevates the performance with the addition of higher tensile properties and higher thermal properties.

Common Trade Names:

- Duratron® U (Mitsubishi Chemical Group)
- SustaPEI® (Rochling)
- TecaPEI™ (Ensinger)
- Semitron® ESd PEI (Mitsubishi Chemical Group)
- ZL® 1000 PEI (ZL Plastics)

Typical Features:

- Extremely strong and stiff
- High dielectric strength
- Outstanding heat resistance
- Resistant to hydrolysis when exposed to hot water or steam
- Can tolerate repeated sterilization cycles in an autoclave
- UV resistant
- Easy to machine and finish
- Inherent flame resistance with low smoke evolution
- FDA & USDA Class VI compliant grades

Products Applications:

- Medical instruments and devices
- Semiconductor process equipment
- Analytical instruments
- Aerospace components
- Burn-in test sockets
- Electrical connectors
- Automotive components
- Insulators
- Electrical fittings & housings
- Structural probes
- Manifolds
- Valves & Clamps

PEI - Polyetherimide

Typical Properties for Ultem™ PEI grades

PROPERTY TESTED	ASTM	UNITS	ULTEM PEI 1000	ULTEM PEI 2300
MECHANICAL PROPERTIES				
Specific Gravity	D792	---	1.28	1.51
Tensile Strength	D638	psi	17,000	17,000
Tensile Modulus	D638	psi	500,000	800,000
Elongation (at break)	D638	%	60	3
Flexural Strength	D790	psi	20,000	27,000
Flexural Modulus	D790	psi	500,000	850,000
Compressive Strength	D695	psi	22,000	32,000
Compressive Modulus	D695	psi	480,000	---
Hardness, Rockwell	D785	M (R)	112 (125)	114 (127)
Hardness, Durometer, Shore "D"	D2240	D	86	---
Izod Impact (Notched)	D256A	ft-lb/in	0.500	1.00
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic	0.42	---
Limiting PV (4:1 safety factor)	QTM 55007	psi-ft/min.	1,875	---
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	2,900 x 10^{-10}	---
THERMAL PROPERTIES				
Coefficient of Linear Thermal Expansion	E831	µin/in-°F	31.0	11.0
Deflection Temp. 264 psi	D648	°F	400	410
Cont. Service in Air (Max)	Long Term	°F	---	340
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F	1.23	1.56
ELECTRICAL PROPERTIES				
Dielectric Strength, Short Term	D149	kV/in.	830	770
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	Ohm	>=1.00e +13	>=10.0e +12
Dielectric Constant,10^6Hz	D150	1 MHz	3.15	3.70
Dissipation Factor,10^6Hz	D150	1MHz	.0013	.002
CHEMICAL PROPERTIES				
Water Absorp Immersion, 24 hrs	D570(2)	%	0.25	0.18
Water Absorp Immersion, Satur.	D570(2)	%	1.25	0.90

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PEI - Polyetherimide

Ultem™ PEI

Ultem™ PEI is available in a variety of grades to to best suit the application at hand. The following list of grades is a quick overview, please inquire with your Alro representative on availability and any minimums that may apply.

- Ultem™ 1000 - Natural unfilled or black
- Ultem™ 2300 - 30% glass filled with improved strength and rigidity; exceptional strength -to- weight ratio. This is the most common grade of filled Ultem but custom runs of 10% and 20% are available with a minimum order requirement.
- Static Dissipative
- Conductive
- Medical
- FDA compliant colors available on a custom basis.

Chemical Resistance:

Complete specific information about the chemical resistance of thermoplastic polymers is impossible to present because of the great number of chemical media and the wide range of exposure combinations and conditions. In general Ultem™ displays excellent property retention and resistance to environmental stress cracking when exposed to most commercial automotive and aircraft fluids, fully halogenated hydrocarbons, alcohols and weak aqueous solutions. Exposure to partially halogenated hydrocarbons and strong alkaline environments should be avoided.

CHEMICAL RESISTANCE	
CHEMICAL	**RESULT**
Inorganic Acids	no effect
Alkalines	no effect
Alcohols	no effect
Ester	partly soluble, swells
Ketones	partly soluble, swells
Aliphatic Hydrocarbons	no effect
Aromatic Hydrocarbons	partly soluble, swells
Chlorinated Hydrocarbons	dissolves

Machining Recommendations:

Because of its exceptional combination of physical properties, Ultem™ can be readily machined with conventional metalworking tools. The resin permits high cutting speeds and feed rates for the production of precision parts with virtually no tool wear. Carbide tipped tools should be used when machining Ultem™ 2000 Series resins. The following guidelines are recommended for best results.

PEI - Polyetherimide

Ultem™ PEI

Ultem™ PEI Sheet

Standard Thickness (inches) : 1/32 1/16 3/32 1/8 3/16 1/4 3/8 1/2 3/4 1 1-1/2 2 3 4

Standard Sheet Size (inches) :
1/32 to 3/16 ..... 24 x 48
1/4 to 4 ..... 12 x 24 and 24 x 24
1/4 to 2 ..... 24 x 24 and 24 x 48

Standard Color(s) : Natural (Amber)

Material over 1/8" thick supplied as extruded - not finished

Ultem™ PEI Rod

Standard Diameter (inches) : 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 2 2-1/4 2-1/2 3 3-1/2 4 4-1/2 5 5-1/2 6

Standard Rod Length (feet) :
1/4 to 1 ..... 5 ft and 10 ft
1-1/8 to 2 ..... 4 ft and 8 ft
2-1/8 to 6 ..... 2 ft and 4 ft

Standard Color(s) : Natural (Amber)

Rods can be ground to any intermediate diameter, price is based on next larger diameter size plus grinding charge.

PEI - Polyetherimide

SustaPEI MG (Ultem™) - Medical Grade

SustaPEI (Ultem™ 1000) is an amorphous polyetherimide and is one of the most commonly used high performance materials. It offers excellent thermal performance and high mechanical strength and stiffness. It is inherently flame retardant, possesses good resistance to acids and is capable of operating continuously in steam and hot water.

SustaPEI MG comes in 5 different colors, Natural (Amber), Gray, Black, Blue & Green.

Typical Features:

- Capable of withstanding multiple autoclave cycles
- High strength & rigidity at elevated temperatures
- Continuous use temperature of 340°F
- Low thermal expansion
- High dielectric strength
- Inherently flame retardant
- Hydrolysis resistant
- Highly resistant to acid solutions

Product Applications:

- Fluid handling manifolds & connectors
- Electrical / electric components
- Semiconductor components
- Analytical instrumentation
- Medical devices

Material Certifications:

- ASTM D5205
- Meets FDA 210 CFR 177.1595
- USP Class VI & ISO 10993 compliant

SustaPEI MG

Standard Thickness (inches) :	**1/4" up to 4" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**3/8" up to 6" diameter**
Standard Rod Length :	**Varies by diameter, please inquire**
Standard Colors :	**Natural (Amber), Gray, Black, Blue & Green**

PET - Polyethylene Terephthalate

PET is a strong, stiff, semicrystalline performance plastic with excellent machining characteristics, chemical resistance, and bearing and wear properties. PET is often used for food processing machinery applications where low moisture absorption, low thermal expansion, resistance to staining, or resistance to cleaning chemicals is required. It is suitable for making precision mechanical part which are capable of sustaining high loads and enduring wear conditions. PET's continuous service temperature is 210 F (100 C) and its melting point is almost 150 F higher than acetal.

PET is FDA compliant in natural and black. Natural PET is also USDA, 3A-Dairy and Canada AG compliant.

Common Trade Names:

- Ertalyte® (Mitsubishi Chemical Group)
- Ertalyte® TX (Mitsubishi Chemical Group)
- Sustadur® (Rochling Plastics)
- TecaPET (Ensinger Plastics)
- ZL® 1400 (ZL Plastics)
- ZL® 1400T (ZL Plastics)

Typical Features:

- Good for both wet and dry environments
- High strength and rigidity - ideal for close tolerance parts
- Good wear resistance and excellent dimensional stability
- Excellent stain resistance
- Better resistance to acids than Nylon or Acetal

Product Applications:

- Cutting manifolds
- Food equipment components
- Carousel
- Resistant to many CIP (Clean in Place) wash down chemicals
- Filter track
- Locating disk and ring
- Distribution valves

PET - Polyethylene Terephthalate

Available Grades

Enhanced internally lubricated grades are available for improved wear. They are also FDA compliant and exhibit a lower wear rate and coefficient of friction than unmodified polyesters. Internally lubricated PET excels under high pressure and velocity conditions. It is also suited for applications involving soft metal and plastic mating surfaces. For instance, Ertalyte® TX reduces MRO costs, eliminates the need for lubrication, and is commonly used for applications where food compliancy, chemical resistance, and low wear are critical. Applications include rollers and wheels without bearings, liner bearings, wear and slide pads, dynamic seals, scraper blades, thrust washers, valve seats, journal bearings, and dosing piston and valve.

Ertalyte® and Ertalyte® TX

Ertalyte® PET-P Sheet :	**1/4" to 4" thick, 24" x 48" or 24" x 39" sheets**
Ertalyte® TX Sheet :	**.315" to 3.94" thick, 24" x 39" sheets**
Ertalyte® PET-P Rod :	**.375" to 8.27" Diameter, various lengths**
Ertalyte® TX Rod :	**10 mm to 160 mm Diameter, various lengths**
Ertalyte® PET-P Tube :	**.787" to 7.87" OD, .472" to 6.30" ID**
Ertalyte® TX Tube :	**.787" to 7.87" OD, .472" to 6.30" ID**

MITSUBISHI CHEMICAL GROUP

PET - Polyethylene Terephthalate

Typical Properties for Ertalyte® PET-P & TX

PROPERTY TESTED	ASTM	UNITS	ERTALYTE® PET-P	ERTALYTE® TX
MECHANICAL PROPERTIES				
Specific Gravity, 73°F	D792	---	1.41	1.44
Tensile Strength, 73°F	D638	psi	12,400	10,500
Tensile Modulus, 73°F	D638	psi	460,000	500,000
Elongation (at break), 73°F	D638	%	20	5
Flexural Strength, 73°F	D790	psi	18,000	14,000
Flexural Modulus, 73°F	D790	psi	490,000	360,000
Shear Strength, 73°F	D732	psi	8,000	8,500
Compressive Strength	D695	psi	15,000	15,250
Compressive Modulus	D695	psi	420,000	400,000
Hardness, Rockwell M	D785	M	M93	M94
Hardness, Rockwell R	D785	R	R125	---
Hardness, Durometer	D2240	D	D87	---
Izod Impact (Notched)	D256A	ft-lb/in	0.5	0.4
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic	.20	.19
Limiting PV (4:1 safety factor)	QTM 55007	psi-fpm	2,800	6,000
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	60	35
Relative Machinability	---	1 = easy	2	2
THERMAL PROPERTIES				
Coefficient of Linear Thermal Expansion	E831	in/in/°F	3.3 x 10^{-5}	4.5 x 10^{-5}
Deflection Temp. 264 psi	D648	°F	240°	180°
Melting Point (Crystalline) Peak	D3418	°F	491°	491°
Cont. Service in Air (Max)	long term	°F	210°	210°
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F	2.0	1.9
ELECTRICAL PROPERTIES				
Dielectric Strength, Short Term	D149	volts/mil	385	385
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	Ohm/Sq	> 10^{13}	> 10^{13}
Dielectric Constant, 10^6Hz	D150	---	---	3.60
Dissipation Factor, 10^6Hz	D150	---	---	0.02
Flammability @ 3.1mm (1/8")	UL 94	---	HB	HB

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PI - Polyimide

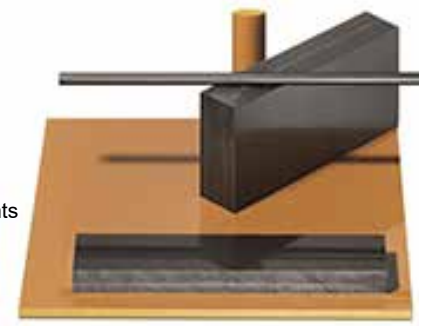
Tecasint™ - High Temperature Polyimides

The trend towards space and weight saving in modern mechanical and plant engineering applications results in higher density performance and consequently in increased thermal and wear resistance expectations in the material used. The characteristic profile of polyimides addresses these stringent demands with outstanding success.

Tecasint™ from Ensinger is a range of non-melting high-temperature polyimides which are characterized by the following properties:

Typical Features:

- High strength over a wide temperature range from -454° F to +572° F
- Glass transition temperature, depending on type, between +260° F to +400° F
- Extremely good long-term thermal stability
- Excellent resistance to wear under high surface area pressure, high sliding speeds
- Good cryogenic properties
- Inherently flame retardant (UL 94 VO)
- Minimimal thermal expansion
- Outstanding durability
- High pressure and creep strength
- High purity, low outgassing in vacuum
- Good chemical resistance to acids, fats and solvents
- Excellent electrical insulation properties
- Good thermal insulation
- High radiation resistance



The fields of application are many and varied: the mechanical engineering, automotive and gear manufacturing industries appreciate the outstanding sliding properties of the graphite/PTFE-modified Tecasint™ product types. In vacuum technology, or for use in dry gas atmospheres, the unreinforced or MoS2-modified product types (for sliding applications) are used. Its electrical insulating effect at high temperatures makes Tecasint™ also ideally suited for applications in the electrical and electronics industry. Tecasint™ has a very low ion content and is used in particular for applications in the field of ultra-clean-room technology, for example in the production of wafers.

PI - Polyimide

Tecasint™ - High Temperature Polyimides

Tecasint™ 1000
Extremely good dimensional stability. Good sliding properties and wear resistance as well as excellent radiation resistance.

Tecasint™ 2000
Enhanced thermal resistance. Lower moisture absorption. Enhanced sliding friction behaviour. High creep strength. Very good machining properties. Higher degree of toughness. Ideally suited for the direct forming method.

Tecasint™ 3000
Extreme thermostability. High degree of toughness. Easy to machine. Low water absorption. Currently only using the direct forming method. Semi-finished products in the development stage.

Tecasint™ 4000
Extreme toughness, minimal water absorption. Good tribological properties. Maximum stability against oxidation through air exposure. Improved chemical resistance.

Tecasint™ 5000
Non-melting high temperature polyamidimide (PAI). Extremely good dimensional stability and load capacity up to +300°C.

Tecasint™ 8000
PTFE material reinforced with organic HT plastics (PI powder). Reduced creep under load. Excellent sliding and friction properties. High chemical resistance and very good machining properties. Suitable for mating partners in soft materials (stainless steel, brass, aluminium, bronze).

Tecasint™ PI

Standard Thickness (mm) :	**5 mm up to 100 mm thick**
Standard Sheet Size (mm) :	**5 mm to 55 mm ..... 300 mm x 1,000 mm** **5 mm to 55 mm ..... 395 mm x 795 mm** **60 mm and up ..... 300 mm x 1,000 mm**
Standard Diameter (mm) :	**6 mm up to 100 mm diameter**
Standard Rod Length (mm) :	**6 mm to 12 mm ..... 395 mm long** **12.7 to 15 mm ..... 395 & 795 mm long** **16 mm and up ..... 395, 795 and 1,000 mm long**
Standard Color :	**Varies by grade, please inquire**

PI - Polyimide

Duratron® D7000 PI

Duratron® D7000 PI is an exceptional value for applications where thermal requirements exclude Duratron® PAI and do not require the extraordinary thermal resistance of Duratron® PBI. Duratron® PI is available in several grades for structural and wear applications and in the broadest range of shapes - particularly thick sheets, larger sheets geometries and heavy-wall tubes. It offers good mechanical performance for applications that demand higher temperature resistance.

Duratron® D7000 PI machinable shapes are ideal starting points for designs that reduce weight, extend length of service before maintenance or replacement and reduce overall cost by increasing process uptime. Duratron® PI materials are just one of the solutions in the machinable plastics industry's broadest product line.

Typical Features:

- Good performance at elevated temperature (>600°F)
- Good chemical resistance
- Easily machined from a broad range of shapes - rod, sheet, tubular forms
- High strength, tough and dimensionally stable

Product Applications:

- Valve and pump seats, seals, and wear surfaces
- Structural and wear parts for semiconductor and electronics manufacturing
- Fixtures and handling parts for glass and plastics manufacturing
- Metal replacement for aerospace components, lightweight, lubrication-free

Duratron® D7000 PI

Standard Thickness (inches) :	**1/4" to 1" (1/8" increments) 1-1/4" to 3" (in 1/4" increments)**
Standard Sheet Size (inches) :	**24 x 48, 28 x 57, 36 x 48, 48 x 120**
Standard Diameter (inches) :	**1" up to 13" diameter**
Standard Lengths (inches) :	**24" or 48", depending on diameter**

PI - Polyimide

Typical Properties for Duratron® D7000 PI

PROPERTY TESTED	ASTM	UNITS	DURATRON® D7000 PI
MECHANICAL PROPERTIES			
Specific Gravity	D792	---	1.37
Tensile Strength	D638	psi	17,500
Tensile Strength at 300°F	D638	psi	12,000
Tensile Strength at 150°F	D638	psi	16,000
Tensile Modulus	D638	psi	540,000
Elongation (at break)	D638	%	6%
Flexural Strength	D790	psi	25,000
Flexural Modulus	D790	psi	550,000
Compressive Strength	D695	psi	27,000
Compressive Modulus	D695	psi	380,000
Hardness, Rockwell	D785	R	128
Hardness, Durometer, Shore "D"	D2240	D	90
Izod Impact (Notched)	D256A	ft-lb./in.	1.00
Coefficient of Friction (Dry vs. Steel)	QTM 55007	Dynamic	0.29
Limiting PV (4:1 safety factor)	QTM 55007	psi-ft./min.	15,000
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	150 x 10^{-10}
THERMAL PROPERTIES			
Coefficient of Linear Thermal Expansion	E831	µin/in-°F	22.50
Deflection Temp. 264 psi	D648	°F (°C)	670° (354°)
Maximum Service Temp, Air	Long Term	°F (°C)	500° (260°)
Thermal Conductivity	F433	BTU-in/hr-ft^2-°F	1.50
ELECTRICAL PROPERTIES			
Dielectric Strength, Short Term	D149	kV/inch	395
Surface Resistance (EOS/ESD S11.11)	EOS/ESD	ohm	>=1.00e + 13
Dielectric Constant,10^6Hz	D150	1 MHz	3.20
Dissipation Factor,10^6Hz	D150	1MHz	<= 0.0050
CHEMICAL PROPERTIES			
Water Absorp Immersion, 24 hrs	D570(2)	%	0.70
Water Absorp Immersion, Satur.	D570(2)	%	3.80

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

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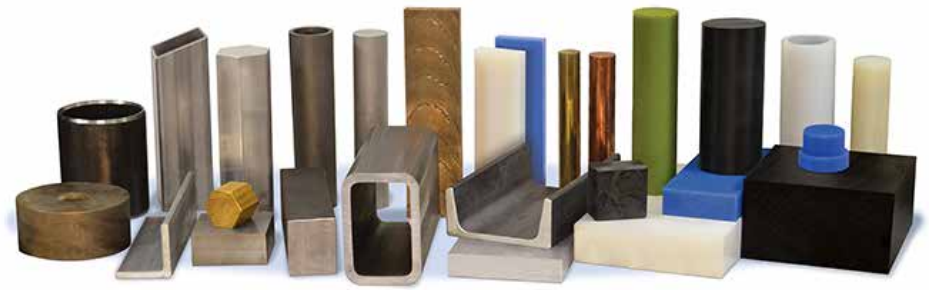

Did you know Alro also offers online shopping and e-business solutions for all of our customers? Visit the Alro Online Store from your computer or mobile device 24 hours a day. Set up your company account and purchase metals and plastics from our vast inventory.

Alro utilizes systems technology to achieve the benefits of e-Business in raw material procurement processes.

- **Business to Business (B2B) – Helps reduce purchasing transaction costs.**
- **Web Ordering (MyAlro.com) – Helps with material selection, quoting and estimating.**
- **Automated Inventory Replenishment (APOS) – helps reduce Kan Ban replenishment costs**
- **Summary Billing – helps reduce admin costs of processing raw material payables**
- **Advance Shipping Notices – helps reduce receiving time**

Alro computers retrieve business information from customers/vendors computers via the internet. During the process we pickup and deliver electronic business documents. This process typically does not require any programming on the part of our customers, as Alro systems are designed to accept virtually any customer document format. Some examples of these documents are as follows:

- **Purchase orders**
- **Invoices**
- **Quotes**
- **POD - Electronic Proof of Delivery**
- **ACH Payment notifications**
- **Mill Certifications**
- **CAD drawings**
- **Burn prints**
- **Material releases**

PPO - Polyphenylene Oxide

NORYL® PPO

NORYL® modified PPO is a strong, tough engineering plastic with outstanding mechanical, thermal, and electrical properties. Low moisture absorption and low thermal expansion make NORYL® one of the most dimensionally stable thermoplastics available.

NORYL® is widely used for electrical housings and structural components since it has excellent insulating properties, flame resistance, and dimensional stability over a wide range of service temperatures. NORYL® is often selected for fluid handling applications since it has low moisture absorption and excellent strength and stiffness. NORYL® is easy to fabricate, paint, and glue.

Typical Features:

- Excellent dimensional stability
- Low moisture absorption
- High dielectric strength
- Good impact resistance
- Excellent flammability rating
- Easy to fabricate, paint & glue
- Good strength and stiffness over a wide service range temperature

Product Applications:

- Manifolds
- Pump, valve & fittings
- Housings and covers
- Electrical components

Specific Applications:

- **NORYL® EN185** resin combines a heat deflection temperature of 180°F at 264 psi with excellent impact resistance even in thin walls. NORYL® EN185 resin is typically used in electronics housings, beverage cases, and for transportation component applications.
- **NORYL® EN212** resin extends the range of extruded thermoplastic applications to high-temperature environments that require both toughness and UL approval for use in communications and electronics housings.
- **NORYL® EN265** resin is ideal for higher temperature electrical housing applications where flame retardance is needed. Listed UL 94V-1 with a thermal index (continu ous use) temperature of 105°C, the material provides high mechanical strength, toughness and low water absorbtion.
- **NORYL® ENG265** resin is suitable for higher temperature applications where UL 94V-1 flame retardance is not required.

PPO - Polyphenylene Oxide

Typical Properties Comparison for NORYL® Grades

PROPERTY TESTED	ASTM	UNITS
PHYSICAL PROPERTIES		
Tensile Strength at Yield, Type I, .125"	D638	psi
Tensile Elongation at Break, Type 1, .125"	D638	%
Flexural Strength at Break, .125"	D790	psi
Flexural Modulus, .125"	D790	psi
Izod Impact, Notched, at 73°F	D256	ft.•lbs./in.
Izod Impact, Notched, at -40°F	D256	ft.•lbs./in.
Gardner Impact at 73oF	D3029	ft.•lbs.
Gardner Impact at -40oF	D3029	ft.•lbs
Hardness, Rockwell	D785	R
Specific Gravity, solid	D792	1 = Water
Water Absorption, 24 hours, 73oF	D570	%
Mold Shrinkage, flow, .125"	D955	in./in. E-3
THERMAL PROPERTIES		
Heat Deflection Temp. @ 66 psi, .250"	D648	°F
Heat Deflection Temp. @ 264 psi, .250"	D648	°F
Coefficient of Thermal Expansion, flow x E-5 -40°F to 200°F	E831	in./in.-°F
Thermal Index, Electrical Properties	UL 746B	°C
Thermal Index, Mech. Prop. w/Impact	UL 746B	°C
Thermal Index, Mech. Prop. w/o Impact	UL 746B	°C
ELECTRICAL PROPERTIES		
Dielectric Strength, in Oil	D149	V/mil
Dielectric Constant, 60 Hz	D150	---
Dissipation Factor, 60 Hz	D150	---
FLAME CLASS RATING*		
UL 94 HB Flame Class Rating	UL 94	in
UL 94 V-1 Flame Class Rating	UL 94	in
UL 94 V-0 Flame Class Rating	UL 94	in

** This rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.*

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

Two page chart, continued on the next page

PPO - Polyphenylene Oxide

Typical Properties Comparison for NORYL® Grades

NORYL® EN185	NORYL® EN212	NORYL® EN265	NORYL® ENG265
6,200	6,900	9,200	7,500
50.0	45.0	25.0	30.0
9,500	11,000	15,000	12,000
315,000	345,000	380,000	320,000
8.0	5.5	3.5	3.5
3.0	2.5	2.5	2.5
18	19	11	19
10	5	3	4
113	115	119	119
1.08	1.08	1.08	1.06
0.07	0.07	0.07	0.06
---	5 - 7	5 - 7	5 - 7
200°	230°	---	279°
180°	210°	254°	260°
4.10	3.80	3.30	3.30
50	95	110	105
50	80	105	90
50	95	110	105
630	400	500	500
2.80	2.65	2.69	2.65
0.0004	0.0007	0.0007	0.0004
---	---	---	0.058
0.058	0.060	0.058	---
---	0.240	0.240	---

** This rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.*

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

Two page chart, continued on from previous page

PPO - Polyphenylene Oxide

NORYL® PPO

NORYL® Sheet / Plate

Standard Thickness (inches) :	1/8 1/4 3/8 1/2 5/8 3/4 1 1-1/4 1-1/2 1-3/4 2 2-1/2 3
Standard Sheet Size (inches) :	12 x 48 24 x 48 48 x 48 48 x 96
Standard Sheet Tolerances :	Thickness ..... +/- 10%
Standard Sheet Color :	Black

NORYL® Rod

Standard Diameter (inches) :	1/8 3/16 3/8 1/4 1/2 5/8 3/4 7/8 1 1-1/4 1-3/8 1-1/2 1-3/4 2 2-1/2 3 3-1/2 4 5 6
Standard Rod Length (feet) :	1/16 to 1 dia ..... +.005" / -0 1-1/4 to 2 dia ..... +.010" / -0 2-1/4 to 3 dia ..... +.030" / -0 3 dia and Up ..... Oversized, as extruded
Standard Rod Color :	Black

PPO - Polyphenylene Oxide

SustaPPO MG (Noryl®) - Medical Grade

SustaPPO (modified polyphenylene oxide) is manufactured from Noryl® resin. This material has very low moisture absorption and exceptional dimensional stability making it suitable for electrical insulating applications. SustaPPO is a lightweight engineering plastic that withstands most acids bases and has excellent flame resistance.

SustaPPO MG comes in 5 different colors, Gray, Brown, Blue, Yellow and Green.

Typical Features:

- Continuous use temperature of 220°F
- Long term dimensional stability
- Excellent impact strength
- Resistance to acids and bases
- Low moisture absorption
- High dielectric strength
- Excellent hydrolytic stability

Product Applications:

- Electrical / electric components
- Pump and valve parts
- Manifolds and housings
- Analytical instrumentation
- Medical devices

Material Certifications:

- ASTM D4349
- FDA compliant
- ISO 10993 compliant

SustaPPO MG	
Standard Thickness (inches) :	**3/8" up to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**3/8" up to 6" diameter**
Standard Rod Length :	**Varies by diameter, please inquire**
Standard Colors :	**Gray, Brown, Blue, Yellow and Green**

PPS - Polyphenylene Sulfide

Techtron® PPS & HPV

PPS (polyphenylene sulfide) products offer the broadest resistance to chemicals of any advanced engineering plastic. They have no known solvents below 392°F (200°C) and offer inertness to steam, strong bases, fuels and acids. Minimal moisture absorption and a very low coefficient of linear thermal expansion, combined with Quadrant's proprietary stress relieving processes, make these PPS products ideally suited for precise tolerance machined components. In addition, PPS products exhibit excellent electrical characteristics and are inherently flame retardant.

Techtron® PPS

Unlike reinforced PPS products, Techtron® PPS is easily machined to close tolerances. It is ideal for structural applications in corrosive environments or as a PEEK replacement at lower temperatures. Techtron® PPS is off white in color.

Techtron® HPV

Techtron® HPV exhibits excellent wear resistance and a low coefficient of friction. It overcomes the disadvantages of virgin PPS caused by a high coefficient of friction, and of glass fibre reinforced PPS which can cause premature wear of the counterface in moving-part applications.

Typical Features:

- Excellent wear and frictional behavior
- Excellent chemical and hydrolysis resistance
- Very good dimensional stability
- Good electrical insulating and dielectric properties
- Excellent resistance against high energy radiation
- Inherent low flammability

Product Applications:

- Pump housings
- Lantern rings
- Retaining rings
- Chip nests
- HPLC

Techtron® PPS

Standard Thickness (inches) :	**1/4" up to 4" thick**
Standard Sheet Size (inches) :	**1/4" to 2" ..... 24 x 48** **2-1/4" to 4" ..... 12 x 48**
Standard Diameter (inches) :	**3/16" up to 6" diameter**
Standard Rod Length :	**96" (8 ft) or 120" (10 ft) long**
Standard Color :	**Natural (off white)**

PPS - Polyphenylene Sulfide

Typical Properties for Techtron® PPS & HPV

PROPERTY TESTED	ASTM	UNITS	PPS	HPV
MECHANICAL PROPERTIES				
Specific Gravity	D792	---	1.35	1.43
Tensile Strength	D638	psi	13,500	10,900
Tensile Modulus	D638	psi	500,000	540,000
Elongation at Break	D638	%	15%	5%
Flexural Strength	D790	psi	21,000	10,500
Flexural Modulus	D790	psi	575,000	535,000
Shear Strength	D732	psi	9,000	---
Compressive Strength, 10% Def.	D695	psi	21,500	15,500
Compressive Modulus	D695	psi	430,000	342,000
Hardness, Rockwell	D785	R/M	R 125	M 84
Hardness, Durometer	D2240	D scale	D 85	---
Izod Impact, Notched .125"	D256 "A"	ft.•lb./in.	0.60	1.40
Coefficient of Friction (D vs S)	QTM 55007	Dynamic	0.40	0.20
Limiting PV (4:1 Safety)	QTM 55007	psi-fpm	3,000	8,750
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	2,400	62
THERMAL PROPERTIES				
Coefficient of Linear Thermal Expansion	E831	10E-4/°F	0.28	0.33
Deflection Temp. at 264 psi	D648	°F	250°	240°
Melting Point (crystalline), peak	D3418	°F	540°	536°
Cont. Service in Air (max)	Long Term	°F	425°	430°
Thermal Conductivity	F433	BTU-in./hr.•ft^2-°F	2.00	2.10
ELECTRICAL PROPERTIES				
Dielectric Strength, short term	D149	Volts/mil	540	500
Surface Resistance	EOS/ESD	ohm/sq	1E +13	1E +13
Dielectric Constant, 10^6 Hz	D150	---	3.00	---
Dissipation Factor, 10^6 Hz	D150	---	0.0013	---
Flammability @ 3.1mm	UL94	---	5 (V-0)	5 (V-0)
FDA Compliant	---	---	Yes	Yes

PPSU - Polyphenylsulfone

Radel® R - PPSU

Stock shapes extruded from Radel® R resins offer a superior combination of high performance properties that include excellent thermal stability, outstanding toughness and good environmental stress cracking resistance. These properties make Radel® R stock shapes attractive for a variety of demanding applications.

Radel® polyphenylsulfone (PPSU) delivers the highest performance of our sulfone polymers, offering better impact resistance and chemical resistance than polysulfone (PSU) and polyetherimide (PEI). The high heat resistance and excellent hydrolytic stability of Radel® PPSU make it an excellent choice for hot water fittings and medical devices requiring repeated steam sterilization.

Radel® R series products are targeted at a number of industries and applications. The initial target market is the medical industry. Radel® R is used in applications for surgical tools and instruments because of its resistance to autoclave sterilization damage. A second market for Radel® R is electronics because of its temperature resistance and dielectric properties.

Typical Features:

- High HDT of 405°F (207°C)
- Superior toughness and impact strength
- Inherently flame retardant
- Transparent
- Exceptional long-term hydrolytic stability
- Better chemical resistance than PSU and PEI
- Withstands over 1,000 cycles of steam sterilization without any significant loss of properties

Product Applications:

- Acid tank/ lineup
- Battery cases
- Cutting boards
- Fume hoods
- Machined parts
- Metal plating barrels
- Orthopedic appliances
- Plating modules

Radel® R PPSU

Standard Thickness (inches) :	**1/32" up to 2" thick**
Standard Sheet Size (inches) :	**24" x 48"**
Standard Diameter (inches) :	**1/4" up to 8" diameter**
Standard Rod Length (inches) :	**48" and 96", varies by diameter**
Standard Color :	**Off White**

PPSU - Polyphenylsulfone

Typical Properties for Radel® R PPSU

PROPERTY TESTED	ASTM	UNITS	RADEL R 5500
PHYSICAL PROPERTIES			
Specific Gravity	D792	lb./in^3	0.0466
Water Absorption, immersion, 24 hrs	D570(2)	%	0.37
Water Absorption, immersion	D570(2)	%	1.10
MECHANICAL PROPERTIES			
Hardness, Rockwell, R	D785	---	120
Hardness, Shore D	D2240	---	80
Tensile Strength, Ultimate	D638	psi	11,000
Elongation at Break	D638	%	30%
Tensile Modulus	D638	psi	340,000
Flexural Modulus	D790	psi	345,000
Flexural Yield Strength	D790	psi	15,500
Compressive Strength	D695	psi	13,400
Compressive Modulus	D695	psi	280,000
Shear Strength	D732	psi	9,000
Izod Impact, Notched .125"	D256, Type A	ft.•lb./in.	2.50
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	EOS/ESD S11.11	ohm	Min 1e+013
Dielectric Constant @ 1MHz	D150	---	3.44
Dielectric Strength, Short Term	D149	V/mil	360
Dissipation Factor, 1 MHz	D150	---	0.0017
THERMAL PROPERTIES			
Coefficient of Therm Exp, Linear 68°F	E831	µin/in-°F	31
Thermal Conductivity	F433	BTU-in./hr.•ft^2-°F	2.40
Maximum Service Temp., Air	Long Term	°F	300°
Deflection Temp at 1.8 MPa (264 psi)	D648	°F	405°
Glass Temperature	D3418	°F	---
Flammability, UL 94, .125" thick	Est. Rating	---	V-0

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

PPSU - Polyphenylsulfone

Sustason PPSU MG (Radel®) - Medical Grade

Sustason PPSU (polyphenolsulfone) is produced from Radel® R resin. It is an amorphous product that offers improved chemical resistance and thermal stability over most amorphous thermoplastics. Sustason PPSU has the added advantage of superior impact resistance over polycarbonate. It is preferred over all other amorphous thermoplastics, including PEI (Ultem®), where added thermal performance impact resistance and a high number of steam sterilization cycles is desired.

Typical Features:

- Excellent thermal stability
- High impact resistance
- Resistance to hydrolysis
- Continuous use temperature of 320°F
- Outstanding steam autoclaving resistance
- FDA and USP Class VI compliant
- Custom colors available by request

Product Applications:

- Sizing trials for joint implants
- Dental handles and instruments
- Medical device components
- Lab animal cages

Material Certifications:

- ASTM D6394
- FDA compliant
- USP Class VI & ISO 10993 compliant

Sustason PPSU MG

Standard Thickness (inches) :	**3/8" up to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**3/8" up to 6" diameter**
Standard Rod Length :	**Varies by diameter, please inquire**
Standard Colors :	**Natural, Gray, Black and Blue**

PSU - Polysulfone

Polysulfone is a transparent, heat resistant, ultra-stable high performance amorphous engineering thermoplastic. It has low flammability and smoke emission. The material also has good impact and electrical properties. Polysulfone can be processed on conventional equipment, however, the material must be dried before processing. It can be compounded with fillers like glass beads, glass fiber, or TFE.

Made from UDEL® polysulfone resin, these stock shapes remain stable, resisting creep and deformation under continuous load and elevated temperatures. They have high tensile strength and, as temperatures increase, flexural modulus remains high. Polysulfone products will withstand exposure to soap, detergent solutions and some hydrocarbon oils, even at elevated temperatures under moderate stress levels.

Typical Features:

- Hot water & steam performance to 300°F (150°C)
- Excellent mechanical & electrical properties
- Dimensionally stable
- Low outgassing levels
- Radiation stability
- Easily machined
- FDA compliant
- Transparent grades available

Product Applications:

- Float switches
- Membrane cartridge filter system
- Solenoid valve body
- Dairy connector
- Manifolds
- Distributor valves
- Medical equipment components
- Steam cleaning equipment inserts

Polysulfone - PSU

Standard Thickness (inches) :	**3/8" up to 4" thick**
Standard Sheet Size (inches) :	**3/8" to 4" ..... 12 x 24 and 12 x 48** **3/8" to 2" ..... 24 x 24 and 24 x 48**
Standard Diameter (inches) :	**1/4" up to 6" diameter**
Standard Rod Length :	**1/4" to 1" ..... 5 ft and 10 ft** **1-1/8" to 2" ..... 4 ft and 8 ft** **2-1/8" to 2-1/2" ..... 2 ft and 4 ft** **2-5/8" to 6" ..... 2 ft and 4 ft**
Standard Color :	**Natural (amber)**

All Polysulfone material supplied as extruded, not finished

PSU - Polysulfone

Typical Properties for Polysulfone

PROPERTY TESTED	ASTM	UNITS	PSU 1000
PHYSICAL PROPERTIES			
Specific Gravity	D792	g/cc	1.24
Water Absorption, immersion, 24 hrs	D570(2)	%	0.30
Water Absorption, immersion	D570(2)	%	0.60
MECHANICAL PROPERTIES			
Hardness, Rockwell M, (R)	D785	---	82 (128)
Hardness, Shore D	D2240	---	80
Tensile Strength, Ultimate	D638	psi	10,200
Elongation at Break	D638	%	30%
Tensile Modulus	D638	psi	390,000
Flexural Modulus	D790	psi	400,000
Flexural Yield Strength	D790	psi	15,000
Compressive Strength	D695	psi	13,000
Compressive Modulus	D695	psi	375,000
Shear Strength	D732	psi	9,000
Izod Impact, Notched .125"	D256, Type A	ft.•lb./in.	1.30
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	EOS/ESD S11.11	ohm	Min 1e+013
Dielectric Constant @ 1MHz	D150	---	3.14
Dielectric Strength, Short Term	D149	V/mil	425
Dissipation Factor, 1 MHz	D150	---	0.0008
THERMAL PROPERTIES			
Coefficient of Therm Exp, Linear 68°F	E831	µin/in-°F	31
Thermal Conductivity	F433	BTU-in./hr.•ft^2-°F	1.80
Maximum Service Temp., Air	Long Term	°F	300°
Deflection Temp at 1.8 MPa (264 psi)	D648	°F	340°
Glass Temperature	D3418	°F	374°
Flammability, UL 94, .125" thick	Est. Rating	---	HB

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

MITSUBISHI CHEMICAL GROUP

PSU - Polysulfone

Sustason PSU MG - Medical Grade

Sustason PSU (polysulfone) is a semi-transparent amorphous thermoplastic with an amber tint. It is a logical progression from standard transparent plastics such as polycarbonate when improved chemical or higher temperature resistance is required by an application. Sustason PSU can be used continuously in hot water and steam sterilization and has excellent chemical resistance to acidic salt solutions.

Sustason PSU MG comes in 2 different colors, White and Natural (Amber).

Typical Features:

- Excellent electrical properties
- Continuous use temperature of 300°F
- Heat deflection temperature of 345°F
- Water, food and medical compliance
- Stiffness, strength & dimensional stability
- Maintains its properties over a wide temp range
- Autoclavable

Product Applications:

- Electrical / electric components
- Inspection glasses
- Manifolds and housings
- Medical devices

Material Certifications:

- ASTM D6394
- FDA compliant
- USP Class VI & ISO 10993 compliant

Sustason PSU MG

Standard Thickness (inches) :	**3/8" up to 2" thick (standard increments)**
Standard Sheet Size (inches) :	**24 x 48**
Standard Diameter (inches) :	**3/8" up to 6" diameter**
Standard Rod Length :	**Varies by diameter, please inquire**
Standard Colors :	**White and Natural (Amber)**

PTFE/TFE - Polytetrafluoroethylene

PTFE or TFE - polytetrafluoroethylene is a very dense material having a density of 2.13 - 2.19 grams/cc. PTFE is well known for its chemical resistance. It is insoluble in all organics with the exception of a few exotics. Electrical properties are excellent. Impact strength is high but its resistance to wear, tensile strength and creep resistance are low in comparison to other engineering materials. PTFE has one of the lowest coefficients of friction of any solid.

In industrial applications, owing to its low friction, PTFE is used for applications where sliding action of parts is needed: plain bearings, gears, slide plates, etc. In these applications, it performs significantly better than nylon and acetal; it is comparable to ultra-high-molecular-weight polyethylene (UHMWPE). Although UHMWPE is more resistant to wear than PTFE, for these applications, versions of PTFE with mineral oil or molybdenum disulfide embedded as additional lubricants in its matrix are being manufactured. Its extremely high bulk resistivity makes it an ideal material for fabricating long-life electrets, useful devices that are the electrostatic analogues of magnets.

Mechanical properties can be improved by adding fillers such as glass fibers, bronze, carbon, and graphite. PTFE has an extremely low coefficient of friction. Very few materials will stick to it. It has useful properties from cryogenic temperatures up to 260°C (550°F).

Common Trade Names:

- Dyneon® (3M)
- Enflon® (Enflo)
- Neoflon® (Daikin)
- Polyflon® (Polyflon Company)
- Teflon® (DuPont)

Typical Features:

- Excellent electrical properties
- High impact strength
- Great chemical resistance
- Wide range of temperatures
- Extremely low coefficient of friction

Product Applications:

- Bushings and bearings
- Conveyor rollers
- Doctor blades
- Gaskets and seals
- Coil separators
- Conductor, layer, ground insulation
- Tank liners and washers
- Lab splash pans

PTFE/TFE - Polytetrafluoroethylene

Typical PTFE Enhanced Fillers

TFE fluorocarbon resin performs will in many applications without fillers. In fact, fillers can lessen its outstanding electrical and chemical properties. In mechanical applications, however compounds of PTFE and inorganic fillers offer improved wear resistance, reduce creep and initial deformation and increased stiffness and conductivity. Hardness is increased and the coefficient of thermal expansion is decreased. Compounds can therefore make it possible to gain the advantages of PTFE in applications where the unfilled resin cannot be used.

Glass Fiber - Glass in the form of short fibers is the most widely used filling material. The most popular compounds are 15% or 25% glass (by weight). It is sometimes combined with graphite of MoS_2. Glass has little effect on most of the electrical properties of PTFE. It resists acids and oxidation, but it can be attacked by alkali.

Carbon - A typical carbon filler is high-purity coke powder. It is often used in combination with graphite in concentrations of 25% to 35% by weight. Compounds of PTFE and carbon have excellent wear resistance, both dry and in water. They are compatible with most chemicals and can carry heavy loads under rubbing contact.

Graphite - This crystalline form of carbon is used alone or in combination with glass or amorphous carbon. A typical compound is 15% graphite by weight. The addition of graphite helps reduce the wear of soft metal mating parts and improves frictional and wear properties when mixed with other fillers. Like other forms of carbon, it serves well in corrosive environments.

Bronze - Round or irregularly-shaped bronze particles are often used at 60% by weight, or 55% with 5% MoS_2. Compounds of bronze and PTFE are creep-resistant and easily machined. They deliver good wear performance, low friction and relatively high thermal conductivity.

MoS_2 - Used in concentrations of approximately 5% by weight in compounds with glass or bronze. MoS_2 can increase surface hardness and lower coefficient of friction and wear rate.

PTFE MATERIAL	VIRGIN	RE-PROCESSED	VIRGIN PTFE / TFE				
FILLER	none	none	Glass Fiber	Bronze	Graphite	Carbon	Glass, MoS_2
Filler Content by Weight	0%	0%	25%	40%	10%	10%	23% 2%
PHYSICAL PROPERTIES							
Specific Gravity	2.16	2.16	2.22	3.30	2.13	2.13	2.16
Tensile Strength Break (psi)	3,000	1,500	2,500	2,300	2,700	2,800	2,500
Elongation @ Break	200%	75%	50%	60%	60%	50%	50%
Shore Hardness	54	56	63	65	57	62	64
Deformation Under Load (% @ 1200 psi)	6.20%	6.00%	4.90%	3.60%	4.00%	3.70%	2.70%
Limiting PV @ 100 FPM (psi x fpm)	2,200	1,500	11,000	12,000	15,000	15,000	12,000

PTFE/TFE - Polytetrafluoroethylene

Virgin PTFE Sheet

Standard Thickness (inches) :	1/16 3/32 1/8 3/16 1/4 3/8 1/2 5/8 3/4 1 1-1/4 1-1/2 1-3/4 2 3 4
Standard Sheet Size (inches) :	24 x 24 36 x 36 48 x 48
Standard Sheet Color :	Natural (White)

Note: PTFE is also available in thin gage films starting at 0.010" thick, please call for inquiries on thin gage PTFE film, fabric and tape.

Virgin PTFE Rod

Standard Diameter (inches) :	1/8" up to 5" diameter (Extruded)
Standard Rod Length :	6 feet and 12 feet (Extruded)
Standard Tolerances :	1/8" to 1" dia ..... +.002"/-.000" 1-1/8" to 2" dia ..... +.010"/-.000" 2-1/8" and over ..... +.002"/-.000"
Standard Diameter (inches) :	1-1/2" up to 12" diameter (Molded)
Standard Rod Length (inches) :	12" long (Molded)

PTFE Heavy Wall Tube

Standard Diameters (inches) :	3/16" up to 1" O.D. 1/16" up to 7/8" I.D.
Standard Wall Thickness :	.063" thick wall
Standard Length :	Random coil lengths, 25 ft or longer
Standard Tube Color :	Natural (White)

PTFE/TFE - Polytetrafluoroethylene

Thin Wall PTFE Tubing

With its high lubricant performance, high melting temperature, biocompatibility, and super precision extruded tolerances, PTFE Thin Wall Tubing is the best choice for your demanding application. It is chemically resistant to all common solvents, acids and bases, and lowest coefficient of friction of all polymers. PTFE also has excellent dielectricinsulation properties.

Paste extruded PTFE tubing can be used in a temperature range from -200°C (-392°F) up to 250°C(482°F) in static conditions. These can be used in an extremely wide range of applications: Biomedical, Aerospace, Electrical, Electronics, Household Appliances, CPI and Automotive. Market demand of superior quality PTFE tubing is increasing more and more. GAPI production systems and control can ensure the highest quality and consistency in terms of properties and performance.

PTFE Thin Wall Tubing can be supplied in different colours and with special fillers. Special dimensions and tolerances can be produced on request.

SIZE (inches) O.D.	TOLERANCE (inches) O.D. (+/-)	SIZE (inches) I.D.	SIZE (inches) WALL	TOLERANCE (inches) WALL (+/-)	BURST PRESSURE PSI @ 75°F(*) Pounds/Foot
1/16	.004	1/32	.016	.003	1595
3/16	.008	1/16	.062	.001	3220
1/8	.005	1/16	.031	.005	1610
5/32	.005	3/32	.031	.005	1050
3/16	.008	1/8	.031	.005	795
1/4	.008	1/8	.062	.010	1595
1/4	.008	5/32	.047	.007	955
1/4	.008	3/16	.031	.005	530
5/16	.010	3/16	.063	.010	1065
5/16	.010	1/4	.031	.005	395
3/8	.010	1/4	.062	.010	800
3/8	.010	5/16	.031	.005	320
7/16	.020	5/16	.062	.010	635
7/16	.010	3/8	.031	.005	265
1/2	.010	3/8	.062	.010	530
1/2	.010	7/16	.031	.005	225
9/16	.010	1/2	.031	.005	200
5/8	.010	1/2	.062	.010	400
5/8	.010	9/16	.031	.005	176
11/16	.020	5/8	.031	.005	155
3/4	.020	11/16	.031	.005	145
13/16	.020	11/16	.062	.010	290

(*) The burst pressure values indicated in this chart art theoretical and indicated only as a guideline for the designers. For critical applications it will be strictly necessary to make appropriate tests.

PTFE/TFE - Polytetrafluoroethylene

Fluorosint® - Enhanced PTFE Materials

Fluorosint's unique properties are the result of a proprietary process in which synthetically manufactured mica is chemically linked to PTFE. This bonding results in properties not normally attainable in reinforced PTFE. Fluorosint® grades offer an excellent combination of low frictional properties and dimensional stability.

Mitsubishi Chemical Advanced Materials developed the Fluorosint range of enhanced PTFE materials to fill the performance gaps where unfilled and low-tech, filled PTFE based polymers underperform. Each Fluorosint material was specifically developed to excel in demanding bearing and seal applications. While each of these materials possess the chemical resistance and compliance of PTFE, each material offers some special benefits that give the designer clear performance advantages.

Fluorosint® 207

Fluorosint® 207's unmatched dimensional stability, excellent creep resistance and white color uniquely position this material to serve FDA regulated applications. It is non-permeable in steam and complies with the FDA's regulation 21 CFR 175.300. Its relative wear rate is 1/20 the rate of PTFE below 300°F (150°C) making it an excellent choice for aggressive service bearings and bushings.

Typical Features:

- Chemical resistance parallels PTFE
- Continuous use temperature to 500ºF (260ºC)
- Compared to other PTFE –based products :
  - Higher load carrying capabilities
  - 1/9 the deformation under the load
  - Lower coefficient of thermal expansion

Product Applications:

- Seals
- Mixers
- Appliances
- Pumps
- Bearings
- Valve seats

Fluorosint® 207	
Standard Thickness (inches) :	**1/4" up to 3" thick**
Standard Sheet Size (inches) :	**12" x 12"**
Standard Diameter (inches) :	**1/2" up to 8-3/4" diameter**
Standard Rod Length (inches) :	**Please inquire, varies by diameter**
Standard Tube Diameter (inches) :	**1-1/4" up to 12" OD, inquire on wall thickness**
Standard Tube Length (inches) :	**Please inquire, varies by diameter**
Fluorosint® 207 Color :	**White and Light Gray**

PTFE/TFE - Polytetrafluoroethylene

Fluorosint® - Enhanced PTFE Materials

Fluorosint® 500

Fluorosint® 500 has nine times greater resistance to deformation under load than unfilled PTFE. Its coefficient of linear thermal expansion approaches the expansion rate of aluminum, and is 1/5 that of PTFE - often eliminating fit and clearance problems. It is 1/3 harder than PTFE, has better wear characteristics and maintains low frictional properties. Fluorosint® 500 is also non-abrasive to most mating materials.

Typical Features:

- Chemical resistance parallels PTFE
- Continuous use temperature to 500°F (260°C)
- Compared to other PTFE –based products :
  - Higher load carrying capabilities
  - 1/9 the deformation under the load
  - Lower coefficient of thermal expansion

Product Applications:

- Split and one-piece seals
- Valve seats
- Shrouds
- Slide bearings
- Wear strips
- Sacrificial, abradable seals
- Thrust washers

Fluorosint® 500	
Standard Thickness (inches) :	**1/4" up to 3" thick**
Standard Sheet Size (inches) :	**12" x 12"**
Standard Diameter (inches) :	**1/2" up to 8-3/4" diameter**
Standard Rod Length (inches) :	**Please inquire, varies by diameter**
Standard Tube Diameter (inches) :	**1-1/4" up to 12" OD, inquire on wall thickness**
Standard Tube Length (inches) :	**6" or 12", varies by diameter**
Fluorosint® 500 Color :	**Tan / Gray**

PTFE/TFE - Polytetrafluoroethylene

Fluorosint® - Enhanced PTFE Materials

Fluorosint® HPV

FDA compliant Fluorosint® HPV is a high performance bearing grade of Fluorosint® - optimized for high PV and very low "K", or wear factor. Fluorosint® HPV was developed for bearing applications where other, low-tech PTFE formulations exhibit premature wear or simply cannot perform. FDA compliance gives food and pharmaceutical equipment manufacturers new design options and all benefit from its excellent load bearing and wear characteristics.

Product Applications:

- Bearings
- Wear guides
- Thrust washers
- Commercial food equipment
- High performance seals

Fluorosint® MT-01

Fluorosint® MT-01 is an extreme service grade developed specifically for applications where the benefits of PTFE-based materials also require strength, stiffness and stability. Fluorosint® MTR-01 delivers high mechanical performance at elevated temperature and as a result is often specified in seat, seal and wear applicstions where extreme conditions are present.

Product Applications:

- High temperature seals
- Linear guides
- Wear bands
- Ovens and dryers

Fluorosint® HPV & MT-01

Standard Thickness (inches) :	**1/4" up to 3" thick (HPV only)**
Standard Sheet Size (inches) :	**12" x 12" (HPV only)**
Standard Diameter (inches) :	**1/2" up to 8-3/4" diameter**
Standard Rod Length (inches) :	**Please inquire, varies by diameter**
Standard Tube Diameter (inches) :	**1-1/4" up to 12" OD, inquire on wall thickness**
Standard Tube Length (inches) :	**Please inquire, varies by diameter**
Fluorosint® HPV Color :	**Light Tan & Gray**
Fluorosint® MT-01 Color :	**Dark Gray**

PTFE/TFE - Polytetrafluoroethylene

Fluorosint® - Enhanced PTFE Materials

Fluorosint® HPV

Fluorosint® 135 is a polytetrafluoroethylene (PTFE) material uniquely designed to provide the lowest coefficient of friction and deformation of seals, bearings and washer applications. Engineered for superior performance and value, Fluorosint® 135's machinability and stability offers the best protection against wear and breakdown. Even at extreme temperatures and pressures, Fluorosint® 135 continues to protect and reduce the risk of malfunction due to corrosive chemicals.

Typical Features:

- Lowest wear rate
- Lowest coefficient of linear thermal expansion
- Lowest coefficient of friction
- Lowest deformation
- Counter surface has little effect on performance
- No excessive run in period
- Extremely chemically inert

Product Applications:

- Compressor, pump and valve wear parts
- Seals, bearings, thrust washers and sealts
- Insulating blocks and fixtures in diagnostic equipment
- Compressor piston rings, rider bands & packing sets
- Lubricated or non-lube dry running applications
- Typical air, hydrogen nitrogen refrigerant gas service
- Service temperatures of 450°F / 232°C

Fluorosint® 135

Standard Thickness (inches) :	**1/4" up to 3" thick**
Standard Sheet Size (inches) :	**12" x 12"**
Standard Diameter (inches) :	**1/2" up to 8-3/4" diameter**
Standard Rod Length (inches) :	**Please inquire, varies by diameter**
Standard Tube Diameter (inches) :	**1-1/4" up to 12" OD, inquire on wall thickness**
Standard Tube Length (inches) :	**6" or 12", varies by diameter**
Fluorosint® 135 Color :	**Dark Gray**

PTFE/TFE - Polytetrafluoroethylene

Typical Properties Comparison Fluorosint® Grades

PROPERTY TESTED	ASTM	UNITS	FLUOROSINT® 207
PHYSICAL PROPERTIES			
Specific Gravity	D792	g/cc	2.30
Water Absorp. Immersion, 24 hrs	D570(2)	%	0.030
Water Absorp. Immersion, Saturation	D570(2)	%	0.20
Deformation	2000 psi, 122°F	%	1.1
MECHANICAL PROPERTIES			
Hardness, Rockwell R	D785	---	50
Hardness, Shore D	D2240	---	65
Tensile Strength	D638	psi	1,500
Tensile Strength at 300°F	D638	psi	500
Tensile Strength at 150°F	D638	psi	1,000
Tensile Modulus	D638	psi	250,000
Elongation (at break)	D638	%	50%
Flexural Strength	D790	psi	2,000
Flexural Modulus	D790	psi	350,000
Compressive Strength	10% Def.; D695	psi	3,800
Compressive Modulus	D695	psi	225,000
Shear Strength	D732	psi	1,700
Izod Impact, Notched	D256, Type A	ft.-lb./in.	1.00
Coefficient of Friction, Dynamic (Dry vs. Steel)	QTM 55007	---	0.10
Wear Factor "k" x 10^{-10}	QTM 55010	in^3-min/lb-ft-hr	85 x 10^{-10}
Limiting PV (4:1 safety factor)	QTM 55007	psi-ft./min.	8,000
ELECTRICAL PROPERTIES			
Surface Resistivity per Square	EOS/ESD S11.11	ohm	>= 1.00e + 13
Dielectric Constant (at10^6Hz)	D150	Freq at 1e+6 Hz	2.65
Dielectric Strength	Short Term; D149	kV/in.	200
Dissipation Factor (at 10^6Hz)	D150	Freq at 1e+6 Hz	0.0080
THERMAL PROPERTIES			
Coefficient Therm Exp, Linear	E831	µin/in-°F	57.0
Thermal Conductivity	---	BTU-in/hr-ft^2-°F	3.05
Melting Point	D3418	°F (°C)	621° (327°)
Maximum Service Temp, Air	Long Term	°F (°C)	500° (260°)
Deflection Temp at 1.8 MPa (264 psi)	D648	°F (°C)	210° (99°)
Flammability, UL94	1/8" (Est Rating)	---	V-0

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

Two page chart, continues on the next page

PTFE/TFE - Polytetrafluoroethylene

Typical Properties Comparison Fluorosint® Grades

FLUOROSINT® 500	FLUOROSINT® HPV (PTFE)	FLUOROSINT® MT-01 (PTFE)	FLUOROSINT® 135
2.32	2.06	2.27	1.91
0.10	0.15	0.10	0.10
0.30	0.43	---	0.30
5.0	3.2	0.20	---
55	44	74	80
70	61	---	74
1,100	1,450	2,100	1,300
500	500	500	---
1,000	1,000	1,500	---
300,000	210,000	326,000	370,000
30%	65%	40%	3%
2,200	2,500	4,000	2,500
500,000	165,000	485,000	300,000
4,000	3,000	3,400	7,000
250,000	110,000	250,000	200,000
2,100	2,500	2,600	2,500
0.90	1.80	---	0.50
0.15	0.15	0.18	<= 0.15 (dynamic) <= 0.20 (static)
600 x 10^{-10}	38 x 10^{-10}	200 x 10^{-10}	32 x 10^{-10}
8,000	20,000	4,500	14,300
>=1.00e + 13	>=1.00e + 13	>=1.00e + 6	>=1.00e + 05
2.85	---	---	---
275	---	---	---
0.0080	---	---	---
25.0	49.0	30.0	25.0
5.30	---	---	---
621° (327°)	621° (327°)	---	621° (327°)
500° (260°)	500° (260°)	600° (316°)	500° (260°)
270° (132°)	180° (82°)	200° (93°)	220° (104°)
V-0	V-0	V-0	V-0

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

Two page chart, continued from previous page

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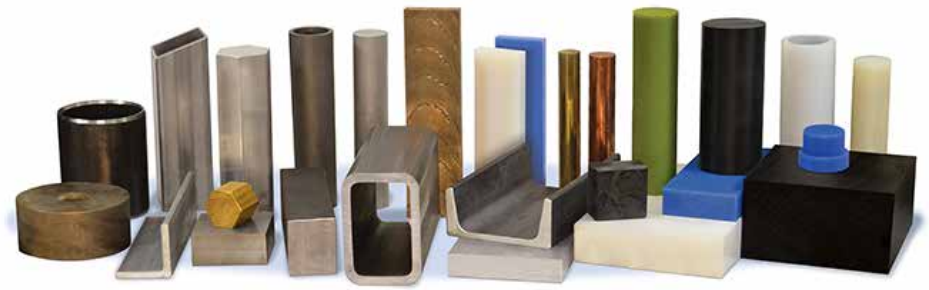


Did you know Alro also offers online shopping and e-business solutions for all of our customers? Visit the Alro Online Store from your computer or mobile device 24 hours a day. Set up your company account and purchase metals and plastics from our vast inventory.

Alro utilizes systems technology to achieve the benefits of e-Business in raw material procurement processes.

- **Business to Business (B2B) – Helps reduce purchasing transaction costs.**
- **Web Ordering (MyAlro.com) – Helps with material selection, quoting and estimating.**
- **Automated Inventory Replenishment (APOS) – helps reduce Kan Ban replenishment costs**
- **Summary Billing – helps reduce admin costs of processing raw material payables**
- **Advance Shipping Notices – helps reduce receiving time**

Alro computers retrieve business information from customers/vendors computers via the internet. During the process we pickup and deliver electronic business documents. This process typically does not require any programming on the part of our customers, as Alro systems are designed to accept virtually any customer document format. Some examples of these documents are as follows:

- **Purchase orders**
- **Invoices**
- **Quotes**
- **POD - Electronic Proof of Delivery**
- **ACH Payment notifications**
- **Mill Certifications**
- **CAD drawings**
- **Burn prints**
- **Material releases**

Other Plastics

Miscellaneous Plastic Products

PETG ..... 10-2 to 10-4

PET Polyester Film 10-5

Corrugated Plastic Sheet ..... 10-6 to 10-7

ABS Products ..... 10-8 to 10-11

Boltaron® ..... 10-12 to 10-17

Engraving Sheet ..... 10-18 to 10-19

Polystyrene (HIPS) ..... 10-20 to 10-21

ACM Products 10-22

Alumalite 10-23

Tooling Board ..... 10-24 to 10-27

Urethane/Rubber ..... 10-28 to 10-31

Injection Molded 10-32

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

PETG

Polyethylene Terephthalate-Glycol

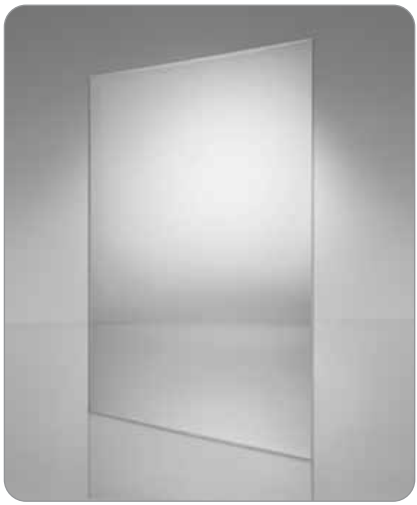
PETG offers formability to complex shapes, precise details, deep draws, and compound curves with significant durability. PETG sheet has the impact strength and fabrication ease far superior to that of acrylic with the durability to significantly reduce your packaging and shipping costs. It gives you many advantages of polycarbonate without the high material costs.

Common Trade Names:

- Eastar™ (Eastman Chemical)
- Prime PETG 14471 (Primex)
- Spectar™ (PolyOne)
- Ultros™ (PolyOne)
- Vipet® (Mulford Plastics)
- VIVAK® (Plaskolite)

Typical Features:

- High impact strength
- Excellent clarity
- Extremely durable
- FDA approved
- Die-cuts and punches easily
- Virtually odorless
- Easily forms at low temperatures



Product Applications:

- Electronic packaging
- Food packaging
- Food handling trays
- Graphic devices
- Medical lab equipment
- Merchandise displays
- Interior signs

PETG Availability

Standard Thickness (inches) :	**.020" up to .500" thick**
Standard Sheet Size (inches) :	**48" x 72" and 48" x 96"**
Standard Color :	**Clear (A00)**

PETG

Typical Properties - VIVAK® PETG

PROPERTY TESTED	ASTM	UNITS	VIVAK® PETG
PHYSICAL PROPERTIES			
Specific Gravity	D792	---	1.27
Water Absorption 24 hrs, @73°F	D570	%	0.20
Light Transmission	D1003	%	86
Refractive Index	D542	---	1.57
Haze	D1003	%	1.0
MECHANICAL PROPERTIES			
Tensile Strength, Ultimate	D638	psi	7,700
Tensile Modulus	D638	psi	320,300
Flexural Strength	D790	psi	11,200
Flexural Modulus	D790	psi	310,000
Shear Strength	D732	psi	9,000
Compressive Strength	D895	psi	8,000
Izod Impact, Notched .125" @ 73°F	D256	ft.•lb./in.	1.70
Izod Impact, Notched .125" @ 32°F	D256	ft.•lb./in.	1.20
Drop Dart Impact .250"	D3763	ft.•lb./in.	22
Rockwell Hardness	D785	R scale	115
THERMAL PROPERTIES			
Heat Deflection Temp @ 264 psi	D648	°F	157
Heat Deflection Temp @ 66 psi	D648	°F	164
Coefficient of Thermal Expansion	D696	in./in./°F	3.8×10^{-5}
Glass Transition Temperature	D3418	°F	178
ELECTRICAL PROPERTIES			
Dielectric Constant @ 1kHz	D150	---	2.60
Dielectric Constant @ 1mHz	D150	---	2.40
Dielectric Strength	D149	V/mil	410

Forming & Fabrication:

PETG sheet may be fabricated using conventional thermoforming equipment. It can be used under conditions similar to acrylic sheet for both forming and secondary operations such as cutting, routing, and drilling. The material is also compatible with conventional decorating and mechanical fastening systems.

SHEET TEMPERATURE		
TYPICAL	**OPTIMUM**	**MOLD TEMP.**
250°F - 320°F	260°F - 300°F	130°F - 140°F

PETG

VIVAK® PETG Sheet

Plaskolite, Inc.'s Vivak® is a transparent, thermoplastic sheet used widely in the point of purchase industry. Vivak® is the brand and market leader for PETG products.

VIVAK® PETG sheet is a transparent co-polyester sheet product that offers a unique balance of physical properties and ease of fabrication. It is ideally suited for complex parts requiring fabrication, including deep thermoforming draws and precise molded-in details.

In addition, VIVAK® sheet is produced using resin that complies with FDA regulations for food contact applications. It is easily decorated by painting, silk screening, or hot stamping. Applications include shelving, greeting card displays, revolving merchandise racks, indoor signs, point of purchase displays, menu boards, photo frames, and slat wall fixtures. Heavy gauge VIVAK® sheet is also used in prosthetic applications.

Typical Features:

- Superior impact strength over Acrylic
- Cost effectiveness compared to Polycarbonate
- Deep draws, complex die-cuts and precise molded-in details
- Die-cuts and punches easily
- Can be bonded or fastened with adhesives
- Easy to fabricate, form, bond and decorate

Product Applications:

- Greeting card and P.o.P. displays
- Merchandise racks
- Store shelving
- Menu boards / Indoor signs
- Photo frames
- Slat wall fixtures

Vivak® PETG	
Standard Thickness (inches) :	**.020" up to .500" thick**
Standard Sheet Size (inches) :	**48" x 72" and 48" x 96"**
Standard Color :	**Clear (A00)**

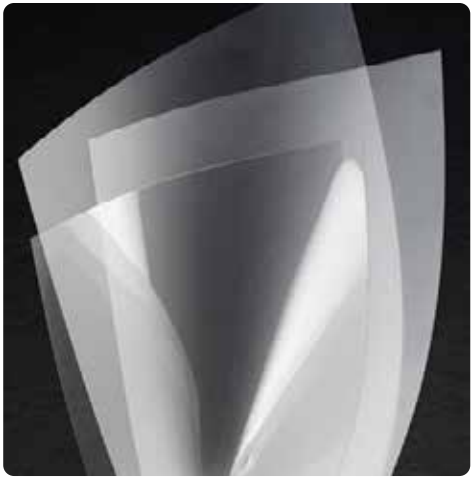
PET

Polyester Film

Polyester film is known for having outstanding mechanical strength, dimensional stability, and chemical resistance. Polyester films have a clear glossy appearance which offers crystal clear transparency. It is easily thermoformed and can be bent into different shapes for packaging applications. It is also available in print treated, slip treated and hard coated 1 side making it ideal for a wide variety of applications.

Common Trade Names:

- Mylar® (Dupont)
- Skyrol® (Monsanto Chemical Corp)
- Melinex® (Dupont)



Typical Features:

- Strong and stiff
- Dimensionally stable
- Transparent
- Good chemical resistance

Product Applications:

- Labels
- Control panels & touch pads
- Membrane swich overlays
- Face shields
- Flexible packaging
- Shims, spacers & gaskets

Polyester Film

Standard Thickness (inches) :	**.001" up to .014" thick**
Standard Sheet Size (inches) :	**24" x 48" or in roll form**
Standard Finish :	**Gloss & high haze**
Standard Color :	**Clear, natural, white & hazy**

Corrugated Plastic Sheet

Corrugated Plastic Sheet is the material of choice for today's market. This twin-wall sheet plastic is opening fresh horizons of features and benefits. Corrugated Plastic Sheet explores new directions of advantages with its strength, durability, light weight and low cost. It enhances profitability and is a superior alternative to other materials such as cardboard, plywood, metal and rigid plastic.

Typical Features:

- Available in solid or translucent colors
- Can be made to FDA requirements
- Can be made flame retardant
- Can be made anti-static or conductive
- Can be made with U.V. inhibitors
- Easy to print on
- Easily fabricated - can be die cut, sewn, sawed, scored, folded, drilled, stapled,nailed and spot or heat-welded
- More durable than cardboard
- Stronger than cardboard
- Lightweight
- Low cost
- Reusable
- Resists water, tear and punctures
- Unaffected by most chemicals

Typical Applications:

- **Tote Bins** - Corrugated plastic sheet can be fabricated into custom totes and bins for your special demands.
- **Protective Packaging** - It can be manufactured to a wide range of specialty packaging assemblies for all types of industries. Configurations can be met to your exact specifications.
- **Agricultural** - All types of produce are collected and shipped in custom corrugated plastic sheet containers. It's lightweight, mildew resistant, waterproof and long lasting.
- **Graphic Arts** - Corrugated plastic sheet is the ideal substrate for outdoor and indoor printing and display requirements. It is weatherproof, durable, lightweight and does not absorb water.
- **ESD Packaging (Electro Static Discharge)** - Electronic components require special packaging to protect against rough handling *and* damage from static electricity. Corrugated plastic sheet is available with "anti-static" and "conductive" properties for these types of applications.
- **Consumer Products** - Corrugated plastic sheet can be die cut, assembled and printed into products that are attractive and easy to sell. There is unlimited potential in new product applications.
- **Construction and Home Use** - Corrugated plastic sheet is ideal for covering a broken window and for making general repairs around the house. In general construction it is used for window protection, temporary enclosures and as a moisture barrier.

Corrugated Plastic Sheet

Product Specifications

RESIN	Polypropylene and polyethylene are both available.
COLORS	White, Ivory, Yellow, Gray, Orange, Blue, Red, Green, Brown and Black.
PRINTABILITY	All corrugated polypropylene is corona treated to accept printing.
OUTDOOR DURABILITY	All U.V. enhanced sheet is guaranteed for three years against breakdown. Corrugated plastic sheet is not affected by normal extremes of heat or cold.
FLAMMABILITY	Corrugated plastic sheet is a combustible material which can be easily extinguished with conventional types of fire extinguishers. Flame retardant additives can be added to the sheet to give it a V-2 rating.
WATER RESISTANCE	Corrugated plastic sheet is not affected by water.
CHEMICAL RESISTANCE	Polypropylene and polyethylene are chemically inert and will not react with most chemicals.
SPECIAL ADDITIVES	Ultra violet stabilizers • Conductive and Anti-Static Static-Free (corona) • Non-Skid coating
FABRICATION	Corrugated plastic sheet can be fabricated using conventional fabrication techniques associated with corrugated fiberboard.

Corrugated Plastic Sheet

Standard Thickness (mm) : 2mm to 25mm thick

Standard Sheet Size (inches) : 48" x 96"

ABS

Acrylonitrile-Butadiene-Styrene

The ABS thermoplastic family bridges the gap between standard plastics and high-performance engineering thermoplastics. The versatility of ABS is found within its basic 3 monomer system, acrylonitrile, butadiene and stryrene. Acrylonitrile enhances heat stability and chemical resistance, butadiene gives impact strength and toughness, while styrene allows for good formability and rigidity. ABS is defined typically by a good cost/performance balance, colorability, toughness, high gloss and good processability. ABS can be processed by a variety of methods, including, injection molding, thermoforming, blow molding, extrusion and structural foam. ABS also adapts well to bonding, fastening, painting, plating and machining.

Typical Features:

- High impact strength & rigidity
- Creep resistance
- Excellent ductility
- Excellent electrical properties
- Excellent formability
- Excellent high and low temperature performance
- Abrasion resistance
- Easy to paint and glue
- High tensile strength & stiffness
- Resistant to inorganic salts, alkalies & acids
- Resistant to several chemicals & plasticizers
- Good machinability

Product Applications:

- Architectural Models
- Automotive Components
- Construction Applications
- Engineering Prototypes
- Machine Housing/Parts
- Splash Guards
- Wall Coverings
- Tote bins & trays
- Aircraft interior trim
- Industrial enclosures

PROPERTY TESTED	ASTM	UNITS	UNFILLED	FR
PHYSICAL PROPERTIES				
Compressive Strength	D695	psi	---	7,650
Flexural Modulus	D790	psi	340,000	330,000
Flexural Strength at Yield	D790	psi	10,500	9,500
Hardness, Rockwell	D785	---	R105	R97
Izod Impact Strength, Notched @ -40°F	D256	ft•lbs/in	2.7	1.0
Izod Impact Strength, Notched @ 78°F	D256	ft•lbs/in	7.7	4.0
Tensile Modulus	D638	psi	310,000	320,000
Tensile Strength at Yield	D638	psi	6,100	5,500
THERMAL PROPERTIES				
Flammability Rating-UL94 at .058"	---	---	HB	V-0
Flammability Rating-UL94 at .108"	---	---	---	5V-A
Heat Deflection Temp at 66 psi	D648	°F	214°	190°
Heat Deflection Temp at 264 psi	D648	°F	203°	162°
ELECTRICAL PROPERTIES				
Dielectric Strength	D149	V/mil	400	400
MISC PROPERTIES				
Specific Gravity	D792	---	1.04	1.21

ABS

Product Availability

Extruded Sheet

Standard Thickness (inches) :	.062 .093 .125 .187 .250
Standard Sheet Size (inches) :	48" x 96"
Standard Sheet Color(s) :	Black or White
Standard Sheet Finish :	Haircell one side Smooth both sides

Special alloys, plateable grades, flame retardant and colors quoted on request

Compression Molded Sheet

Standard Thickness (inches) :	1/4" up to 6" thick
Standard Sheet Size (inches) :	24" x 48", 48" x 96" and 48" x 120"
Standard Sheet Color(s) :	Black or Natural (Tan)
Standard Sheet Finish :	Smooth both sides

Rod / Round Stock

Standard Diameters (inches) :	1/4" up to 10" diameter
Standard Rod Length (inches) :	48" and 96", varies by dia.
Standard Rod Color(s) :	Black or Natural (Tan)

Rod can be ground to any intermediate diameter, additional charge may apply

ABS

King KPC ABS

The advantage of King KPC ABS is that this material combines strength and rigidity of the acrylonitrile and styrene polymers with the toughness of the polybutadiene rubber. A variety of modifications have been made to improve impact resistance, toughness and heat resistance. The impact resistance does not fall off rapidly at low temperatures and stability under load is excellent with limited loads. KPC ABS is considered superior for its hardness, gloss, toughness, and electrical insulation properties. KPC ABS is easily machinable and available in smaller sizes. It is extensively used in prototyping, the modeling industry and other mechanical applications.

A growing outlet for ABS is the electronics industry where it is used in business machines, computers, radios, monitors and cell and smart phones. An important market is the automobile sector where it is used in instrument panels, consoles, radiator grills, headlight housings and interior trim parts with growing use in recreational vehicles.

Product Applications:

- Automotive parts
- Industrial enclosures
- Machine parts
- Prototype modeling
- Short run production parts

King KPC ABS

Standard Thickness (inches) :	**1/16" up to 4" thick**
Standard Sheet Size (inches) :	**24" x 48" and 48" x 96"**
Standard Sheet Colors :	**Black or Natural (Light Tan)**
Thickness Tolerance(s) :	**1/16" through 1-1/4" thick = +/- 10%** **1-1/2 and over = + tolerance only**

King Plastic Corporation
Our Innovation. Your Imagination.®

ABS

King KPC ABS FR - Flame Retardant

The advantage of King KPC ABS Black FR is that this material combines strength and rigidity of the acrylonitrile and styrene polymers with the toughness of the polybutadiene rubber. A variety of modifications have been made to improve impact resistance, toughness and heat resistance. The impact resistance does not fall off rapidly at low temperatures and stability under load is excellent with limited loads. King KPC ABS Black FR is considered superior for its hardness, gloss, toughness, and electrical insulation properties. KPC ABS Black FR is easily machinable and is available in smaller sizes. It is extensively used in prototyping, the modeling industry and other mechanical applications.

Product Applications:

- Air conditioning components
- Industrial enclosures
- Transformer housings
- Shelving
- Switches

King KPC ABS FR

Standard Thickness (inches) : 1/2" up to 3" thick

Standard Sheet Size (inches) : 48" x 96"

Standard Sheet Color(s) : Black

Thickness Tolerance(s) : 1/2" through 1-1/4" thick = +/- 10%
1-1/2 and over = + tolerance only

King KPC ABS Comparison

PROPERTY TESTED	ASTM	UNITS	KPC ABS BLK/NAT	KPC ABS FR (BLK)
PHYSICAL PROPERTIES				
Density	D1505/D792	g/cc	1.03	1.19
Tensile Strength at Yeild	D638	psi	>6,000	>6,400
Elongation at Break	D638	%	40	20
Flexural Modulus	D790	psi	300,000	377,000
Flexural Strength	D790	psi	10,700	---
Durometer	D785	R scale	102	97
Izod Impact	D256	ft.lbs./in.^{2}	7.70	5.51
Vicat Softening Temperature	D1525	°C (°F)	104°C (219°F)	83°C (181°F)
Heat Deflection Temperature, 66 psi	D648	°C (°F)	94°C (201°F)	87°C (189°F)
Flammability	UL94	Rating	HB	V-0

Boltaron®

Specialized PVC, PVC-alloy and CPVC performance sheet

Boltaron® is a specialized PVC, PVC-alloy and CPVC performance sheet for thermoforming, fabricating and membrane pressing of Aircraft interior components, Rail/Mass Transit interior components and Commercial/Industrial components. Over 50 specialized grades offer a combination of fire ratings, durability, colors, textures and gauges unavailable from any other film and sheet producer.

Product Features:

- PVC, PVC/Acrylic alloy and CPVC film and sheet, extruded, calendered and press-laminated in gauges from .003 to 3.00 inch
- FAR 25.853 (a) and (d), MVSS Docket 90 and 90A, UL 94 V-0 and 5V, Class 1-A, ASTM E-84 and FM 4910 fire ratings
- Clear, white and unlimited integral colors with low minimums
- Scratch-resistant metallics in unlimited colors with low minimums
- 16 standard surface textures, and custom textures with low minimums
- Impact resistance to 20 ft-lbs/in
- Extreme formability with uniform wall thickness

This combination of advantages is unique to Boltaron because no other producer in the USA offers calendering, extrusion and press laminating under one roof. Each of these processes produces a range of film and sheet products having distinct qualities. As importantly, sheet produced using more than one of these processes can be fused in-line or off-line (with low minimums) to create an unlimited selection of ultra-high performance composite sheet products impossible to achieve using any single production process.

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Boltaron®

Cross Reference Chart - Boltaron®, KYDEX® and Royalite®

For customers using similar products from KYDEX® and Royalite® we have a handy cross reference chart that shows which Boltaron® products are equivalent to their competitors products. Please use the chart below when trying to determine which Boltaron® product will replace your current product.

Boltaron® 1165	KYDEX® V	Royalite® R 559
Boltaron® 4205	KYDEX® 6185	n/a
Boltaron® 4330	KYDEX® 100	Royalite® DKE 400
Boltaron® 4330M	KYDEX® 110	n/a
Boltaron® 4335	KYDEX® T	Royalite® R 52
Boltaron® 4343/4353	KYDEX® 150/160	n/a
Boltaron® 4800	KYDEX® 6200	Royalite® R 61
Boltaron® 6530	KYDEX® 430	Royalite® R 59 / R 57 / R 86
Boltaron® 6540	KYDEX® 430	Royalite® R 59 / R 57 / R 86
Boltaron® 6800E	n/a	Royalite® R 60
Boltaron® 9200/9200C	KYDEX® 6185	n/a
Boltaron® 9230/9230C	KYDEX® 6185	n/a
Boltaron® 9250/9250C	KYDEX® 6185	n/a
Boltaron® 9815	KYDEX® 6565	n/a
Boltaron® 9815D	KYDEX® 6565D	n/a
Boltaron® 9815E	KYDEX® 6565	Royalite® R722
Boltaron® 9815M	KYDEX® 6565D	n/a
Boltaron® 9815P	KYDEX® 6565	n/a
Boltaron® 9915FSTH	KYDEX® FST	n/a

Boltaron® 1165

Economical, Recycled Grade

Boltaron® 1165 sheet, extruded from select aircraft and electrical grade recycled trim and resin, provides an exceptional combination of UL 94 V-0 compliance, physical properties, consistent thermoforming and low cost compared with other flame rated sheet products.

Intended for general-purpose housings and interior components, this proprietary thermoplastic alloy sheet material is available in black, in custom textures and widths to 60 inches.

Typical Features:

- High impact strength
- Meets UL 94 V-0
- Low cost; uses recycled aircraft grade trim
- Thermoforms consistently

Product Applications:

- Electrical equipment housings
- Internal insulating panels
- Vending machine components
- Parts requiring painting

Typical Properties:

PROPERTY TESTED	TEST METHOD*	TYPICAL VALUES	
Specific Gravity	ASTM D792	1.47	1.47
Tensile Strength	ASTM D638	5,200 psi	35.9 MPa
Flexural Strength	ASTM D790	8,800 psi	60.7 MPa
Flexural Modulus	ASTM D790	330,000 psi	2,275 MPa
Izod Impact, Notched at 73°F	ASTM D256	10 ft-lb/in.	534 J/m
Hardness Rockwell	ASTM D785	108 - 111	108 - 111
Heat Deflection (annealed)	ASTM D648	160°F @ 264 psi	71°C @ 1.8 MPa
Flammability - UL	UL 94	V-0[1]	V-0[1]
Forming Temperature	---	335 - 385°F	168 - 196°C

[1] Values based on minimum thickness of 0.040 in. (1.1 mm), UL File #E54688
** Independent lab tests. All tests at 73°F (22.8°C) in dry conditions unless otherwise noted.*

Boltaron® 1165

Standard Thickness (inches) : 0.028 up to 0.250 (0.71 to 6.35 mm)

Standard Sheet Size (inches) : Widths to 60" (1,524 mm)
Lengths to 120" (3,048 mm)

Standard Sheet Color : Black

Standard Sheet Finish : Industry's widest range of textures

Custom sizes, gauges available upon request, minimums may apply please inquire

Boltaron® 4330

FAR- and UL-Rated Ultra High Impact Sheet

Compared to other FAR 25.853(a) rated thermoplastic alloy sheet products, Boltaron® 4330 offers an exceptionally high Izod impact strength of 18 ft-lb/in. (953 J/m) for longer service life in aircraft interior components.

This proprietary extruded thermoplastic alloy sheet also expands design freedom with a full range of colors and the widest range of textures in thermoplastic alloy materials. Boltaron's unique custom production capabilities also include the ability to manufacture cost-effective low minimums with fast turnaround.

Boltaron® 4330 also features consistently uniform surface quality, and maintains its wall thickness during thermoforming even in deep draws and sharp corners.

Overall, it offers an unequalled combination of performance and design freedom coupled with both FAR 25.853(a) and UL 94 V0 flammability ratings. Its versatility makes it ideal for applications from aircraft interiors to electrical enclosures, especially in damage-prone environments.

Typical Features:

- Izod Impact 18 ft-lb/in. (953 J/m)
- FAR 25.853 (a) Compliance
- Uniform high quality appearance
- Wall thickness integrity in deep draw forming
- Full range of colors, widest range of textures
- Lot-to-lot color consistency

Product Applications (Aircraft interiors):

- Instrument panel housings
- Class dividers, bulkhead laminates
- Gally and lavatory components
- Bull noses, gap covers, moldings
- Sidewall and kick panels
- Window reveals
- Seat parts, backs, tray tables
- Passenger Service Units (PSU's)
- Light housings, air ducts
- Video monitor shrouds
- Life vest shrouds

Product Applications (Electrical):

- Equipment enclosures, housings
- Medical, analytical equipment
- Insulating panels

Boltaron® 4330

Standard Thickness (inches) :	**0.028 up to 0.250 (0.71 to 6.35 mm)**
Standard Sheet Size (inches) :	**Widths to 60" (1,524 mm)** **Lengths to 120" (3,048 mm)**
Standard Sheet Color :	**Full range of colors**
Standard Sheet Finish :	**Industry's widest range of textures**

Custom sizes, gauges available upon request, minimums may apply please inquire

Boltaron® 4335

Fire Rated Sheet for Thermoforming & Fabricating

Boltaron® 4335 is a proprietary, fire retardant, extruded thermoplastic alloy offering extreme durability, chemical resistance, and a UL 94 V-0 rating while exhibiting exceptional physical properties. It offers Izod Impact resistance of .65 ft-lb/in (34 J/m), significantly improving the durability of thermoformed components versus FR-ABS and other competitive sheet.

In addition, Boltaron® 4335 is non-hygroscopic, eliminating the time and costs associated with pre-drying other thermoplastics. It also offers other exceptional physical properties, extreme formability and consistent surface quality, and is available in unlimited custom colors with low minimums and fast turnarounds.

Typical Features:

- Provides superior durability in use
- Extremely cleanable
- Chemical and impact resistant
- Easy, consistent fabrication
- Won't craze when bent, not notch sensitive

Product Applications:

- Medical device enclosures
- Electronic equipment housings
- Kiosk housings
- Store fixtures and displays
- Kennel housings

Boltaron® 4335

Standard Thickness (inches) :	**0.040 up to 0.472 (1 mm to 12 mm)**
Standard Sheet Size (inches) :	**Widths to 48" (1,220 mm)** **Lengths to 96" (2,440 mm)**
Standard Sheet Color :	**Clear with slight blue tint**
Standard Sheet Finish :	**Smooth**

Custom sizes, gauges available upon request, minimums may apply please inquire

BOLTARON
A SIMONA Group Company

Boltaron® 9815E

FAR-Rated High Impact Resistant Sheet for Aircraft Interiors

Boltaron® 9815E meets FAR 25.853(a) and FAR 25.853(d) for smoke density and heat release required for aircraft interior components. It offers far higher notched Izod impact strength of 5.0 ft-lb/in. (265 J/m) vs. other 65/65 rated thermoplastic products that measure 3.0 ft-lb/in. (159 J/m). The result: more durability and longer service life for panels, window reveals, seat backs and other thermoformed components.

This proprietary extruded thermoplastic alloy sheet also expands design freedom with a full range of colors and the widest range of texture options in thermoplastic alloy materials. Boltaron's unique custom production capabilities also include the ability to manufacture cost-effective low minimums with fast turnaround.

In thermoformed parts, Boltaron® 9815E maintains wall thickness integrity even in deep draws and sharp corners. The consistently uniform quality of the extruded sheet also ensures optimum appearance in flat surfaces and complex formed parts.

Typical Features:

- 66% greater impact resistance than other 65/65 thermoplastic alloy sheet
- FAR 25.853 (a)(d) Compliance
- Uniform high quality appearance
- Wall thickness integrity in deep draw forming
- Full range of colors, widest range of textures
- Lot-to-lot color consistency

Product Applications (Aircraft interiors):

- Instrument panel housings
- Class dividers, bulkhead laminates
- Gally and lavatory components
- Bull noses, gap covers, moldings
- Sidewall and kick panels
- Window reveals
- Seat parts, backs, tray tables
- Passenger Service Units (PSU's)
- Light housings, air ducts
- Video monitor shrouds
- Life vest shrouds
- Air ducts

Boltaron® 9815E

Standard Thickness (inches) :	**0.040 up to 0.250 (1.02 to 6.35 mm)**
Standard Sheet Size (inches) :	**Widths to 60" (1,524 mm)** **Lengths to 120" (3,048 mm)**
Standard Sheet Color :	**Full range of colors**
Standard Sheet Finish :	**Industry's widest range of textures**

Custom sizes, gauges available upon request, minimums may apply please inquire

Engraving Sheet

Rowmark LaserMark® Engraving Plastic

LaserMark® engraving sheets are a 2 ply acrylic sheet specially designed for a crisp, clean burn. The LaserMark® products give you the ability to create ultra-fine laser lettering, logos, and vector cutouts for sign making designs. These sheets are ideal for indoor use and are laserable, rotary and front engravable, and UV-LED printable. *Not recommended for harsh or high humidity indoor or outdoor applications.

LaserMark® has the capabilities of being beveled, drilled, hot stamped, bonded, heat bendable, laser vector cuts and screen printed.

Product Applications:

- Interior signage
- Industrial signage/tags
- Personal identification
- Safety signage
- Trophies, awards and plaques

Typical Features:

- Easy to create ultra-fine detals
- Crisp, clean burn
- Great for indoor use

LaserMark®

Standard Thickness (inches) :	**.052" thick**
Standard Sheet Size (inches) :	**24-1/8" x 48-3/4" (613 mm x 1238 mm)**
Standard Sheet Finish :	**Matte, non-glare, brushed metal, patterned & gloss**
Engraving Depth :	**.003" deep**

Wide range of color combinations, see website for more information

Engraving Sheet

Rowmark DurMark Engraving Sheet

DurMark engraving sheets are a 2 ply sheet made with a tough 100% acrylic chemical resistant cap layer. These sheets can be easily laser or rotary engraved. The cap layer is a matte finish pressed to an acrylic core making it very durable. DurMark sheets are ideal for outdoor usage because of their ability to withstand increased wear and having great UV resistance. DurMark sheets are laserable, rotary and front engravable, UV-LED printable, UV stable and outdoor weatherable.

DurMark has the capabilities of being beveled, drilled, hot stamped, bonded, heat bendable, laser vector cuts and screen printed.

Typical Features:

- Excellent impact strength
- Chemical resistant
- UV stable

Product Applications:

- Control panels
- Exterior signage
- Industrial signage/tags
- Safety signage
- Recreational signage

DurMark

Standard Thickness (inches) :	**1/16" and 1/8" thick**
Standard Sheet Size (inches) :	**24" x 48"**
Standard Sheet Finish :	**Matte, non-glare**
Engraving Depth :	**.005" deep**

Colors: **Blue/white, yellow/black, pine green/white, dark grey/white, white/red, white/blue**

Polystyrene - HIPS

High Impact Polystyrene Sheet

High impact polystyrene (or styrene) is a thermoplastic resin widely used for its easy processing characteristics and low cost. The addition of copolymers may give this material enhanced physical and thermal properties. This thermoplastic is used in disposable items, automobiles, packaging, electronics, housewares and construction. Polystyrene can be extruded, thermoformed and injection molded, and holds its dimensions well under normal use, however should not be used outdoors on a continual basis. Most foods, drinks and typical household acids, alcohol, vinegar and oils have no effect on polystyrene, but most polystyrenes are attacked by citrus fruit, rind oil, turpentine, gasoline, cleaning solutions and nail polish/remover.

Advantages of High Impact Polystyrene :

- **Die Cuttable** - High impact polystyrene is easily die cut into a variety of shapes for many different applications. Typical applications for die cut polystyrene include point of purchase displays, counter cards and record dividers.
- **Thermoformability** - Thermoforming is one of the major consumers of high impact polystyrene. This diverse material can be formed into "popcorn" for packaging, fast-food containers, cups, meat trays and egg cartons. Other uses include building panels and insulation.
- **Offset Printable** - The surface texture and printability characteristics of high impact polystyrene make it an excellent product for many types of offset printing processes.
- **Screen Printable** - High impact polystyrene is a good material for screen printing due to its excellent ink adhesion properties, color quality, low cost and absence of size limitations. Some end uses for printing on high impact polystyrene include, display materials, posters, game boards and signs.

Typical Features:

- Die cut capabilities
- Excellent ink drying surface
- Excellent printing characteristics
- Good thermal & dimensional stability
- Thermoformable
- High degree of hardness
- Low moisture absorption
- Superior air cushioning and static inhibiting surface
- Good combination of surface tension and grain

Polystyrene Sheet

Standard Thickness (inches) :	**.015" up to .220" thick**
Standard Sheet Size (inches) :	**48" x 72", 48" x 96" and 48" x 120"**
Roll Stock Available (inches) :	**.015 mil and .080 mil**
Standard Color :	**Black or white**

Custom colors, impact modified grades, surface finishes and specialty grades quoted upon request. Please inquire with your Alro Plastics representative.

Polystyrene - HIPS

High Impact Polystyrene Typical Properties

PROPERTY TESTED	ASTM	UNITS	GEN PURPOSE	IMPACT MODIFIED
PHYSICAL PROPERTIES				
Tensile Strength	D638	psi	5,000-12,000	1,500-7,000
Elongation	D638	%	0.50 - 2.00	2.00 - 60.00
Tensile Modulus	D638	10^5 psi	4.0 - 6.0	1.4 - 5.0
Flexural Strength	D790	psi	8,000 - 17,000	3,000 - 12,000
Flexural Modulus	D790	10^5 psi	4.0 - 4.7	1.5 - 4.6
Izod Impact, Notched	D256	ft.•lb./in.	0.20 - 0.45	0.50 - 4.00
Hardness, Rockwell	D785	M	65 - 80	10 - 90
Specific Gravity	D792	---	1.04 - 1.09	1.03 - 1.10
Specific Volume	D792	in^3/lb.	26.0 - 25.6	28.1 - 25.2
Water Absorption, 24 hrs, .125"	D570	ft.•lbs.	0.03 - 0.10	0.05 - 0.60
THERMAL PROPERTIES				
Thermal Conductivity	C177	---	2.40 - 3.30	1.00 - 3.00
Coefficient of Thermal Expansion	D696	---	3.30 - 4.40	1.90
Deflection Temperature at 264 psi	D648	°F	190° - 220°	160° - 200°
Deflection Temperature at 66 psi	D648	°F	180° - 230°	180° - 220°
Flammability, UL94 (1/8")	---	---	HB	HB
ELECTRICAL PROPERTIES				
Dielectric Strength, short term	D149	V/mil	500 - 700	300 - 600
Dielectric Constant @ 1kHz	D150	---	2.40 - 2.65	2.40 - 4.50
Dissipation Factor @ 1kHz	D150	---	0.0001 - 0.0003	0.0004 - 0.0020
Volume Resistivity, 50% RH	D257	ohm-cm	10^{17} - 10^{19}	10^{16}
Arc Resistance	D495	---	60 - 135	20 - 100
OPTICAL PROPERTIES				
Refractive Index	D542	---	1.60	---
Transmittance	D1003	%	87 - 92	35 - 57

**10-20% V-2, V-1, and V-0 grades are also available.*

The numbers supplied for the testing of this product came directly from the manufacturer of this material. These numbers should be used as a reference only, they are not to replace the actual testing of the material in your specific application. Test results may vary from application to application.

ACM

Aluminum Composite Material

ACM is a flat, rigid 3-layer panel consisting of two aluminum sheets bonded to a polyethylene core. ACM is an excellent choice for indoor or outdoor applications that require dimensional stability and low weight.

Typical Features:

- Excellent rigidity and dimensionally stable
- Lightweight; half the weight of aluminum
- Remains flat; doesn't give ripple appearance
- Moisture, corrosion, and chemical resistant
- Available in multiple colors and metallic finishes; single or double-sided
- Can be cut, routed, v-grooved, folded and formed
- Alternative core options with corrugated polypropylene, plywood, or insulated foam core panels

Product Applications:

- Clean Rooms
- Agricultural Grow Rooms
- Industrial Packaging and Equipment
- Equipment Enclosures
- Partitions, Dividers, Kiosks and Barriers
- Exhibits & Displays
- Garage Doors
- Marine
- Recreation vehicles
- Motorsports
- Automotive Aftermarket

ACM Sheets

Standard Thickness (mm) :	**3 mm and 6 mm thick**
Standard Sheet Size (inches) :	**48" x 96" and 60" x 120" Other sizes available by request, minimums apply**

Note: Skin thicknesses of aluminum layers vary by application. Flat applications will use thinner skin sheet. If bending or fabricating, skin thickness should be .008 or .012.

Alumalite® Standard

Aluminum Composite Sheet Material

Alumalite® Standard is an aluminum composite sheet with a high density, corrugated polypropylene core. It features double sided aluminum for stability and strength. Alumalite® Standard sheets will not swell, corrode, rot, or delaminate even in prolonged water exposure. Alumalite® Standard sheets have been field tested through extensive freeze/thaw cycling tests with not significant structural panel failure.

These sheets are a high-quality, low-cost choice for interior and exterior signage applications making them ideal for paints, digital inks(both UV and solvent cured), screen print inks and pressure-sensitive vinyl

Typical Features:

- Class A flame spread rating ASTM E84
- UL recognized component
- Strong and lightweight
- Routs and cuts easily with standard carpentry tools
- Bends around corners

Product Applications:

- Billboards
- Canopies
- Architectural signage
- Scoreboards
- POP/POS displays and signs
- Tradeshow exhibits

Alumalite® Standard

Standard Thickness (mm) :	**6 mm and 10 mm thick**
Standard Sheet Size (inches) :	**48" x 96", 48" x 120", 60" x 96", 60" x 120"**
Standard Colors :	**White, red, blue, green, yellow, black, silver metallic, ivory, bronze & sand beige**

Tooling Board

Alro Plastics offers a full line of Tool Chemical Composites CNC Tooling Planks for computer generated shapes such as models, fixtures, foundry patterns, core boxes, stretch-press dies, stamping dies and prototype tools. These materials are available in a wide range of densities to best fit the task at hand. Several shared characteristics of these planks are excellent dimensional stability, high wear resistance, ease of machining, no grain and low dust when machining.

M700 (Modeling Board)

Medium density,44#, polyurethane tooling board. Easy to machine, seal and to varnish. It is very dimensionally stable and has low dust formation when milled. Ideal for use in data control models and cubings, master moulds and negatives, moulds for low pressure (RIM) casting and vacuum forming moulds for lower number of pieces.

- Thickness : 1.97", 2.95" and 3.94" thick
- Slab Size : 19.7" x 59.1"
- Color : Light Brown

PP-1052 (Pattern Plank)

The “Red Stuff” is a polyurethane board designed for machining extremely durable & wear resistant foundry patterns, core boxes and other tools that require high wear and impact resistance.

- Thickness : 1", 2", 3", 4", 5" & 6" thick
- Slab Size : 16" x 60", 24" x 60"
- Color : Red

Lab 850

This red pattern board is a proven material for medium-volume foundry patterns, core boxes, gating & risers. It is often used for metal forming, stamping and stretch press dies.

- Thickness : 2", 3" and 4" thick
- Slab Size : 24" x 60"
- Color : Red

Tooling Board

DP-1051 (Die Plank)

An aluminum filled polyurethane board designed for CNC machining of production fixtures capable of withstanding extended use and handling.

- Thickness : 2", 3" and 4" thick
- Slab Size : 16" x 60", 24" x 60"
- Color : Gray

Typical Properties Comparison

PRODUCT NAME	M700	PP-1052	Lab 850	DP-1051
Color	Lt Brown	Red	Red	Gray
Density	0.7 g/cm^3	71 lbs/ft^3	74 lbs/ft^3	52 lbs/ft^3
Hardness at 75°F	64 Shore D	80 Shore D	80 Shore D	75 Shore D
Heat Deflection Temp (264 psi)	172°F	192°F	n/a	188°F
CTE (in/in/°F)	---	3.55 x 10^{-5}	5.30 x 10^{-5}	2.75 x 10^{-5}
Flexural Strength	25 MPa	12,800 psi	8,300 psi	7,180 psi
Flexural Modulus	1,100 MPa	331,000 psi	203,000 psi	317,000 psi
Tensile Strength	---	8,900 psi	5,100 psi	4,820 psi
Compressive Strength	---	10,700 psi	5,900 psi	7,420 psi
Machinability (Cardbide)	Excellent	Excellent	Excellent	Excellent

Tooling Board

Precision Board Plus High Density Urethane
PBLT (Low Temp) and PBHT (High Temp)

Precision Board Plus High Density Urethane is a “closed cell” rigid polyurethane product made specifically for applications of up to 200°F continuous exposure. PBLT High Density Urethane is available in a wide range of standard sheet sizes and standard densities and can be cut or bonded into a variety of shapes for final machining or shaping.

The tighter cell structure of the new Precision Board Plus High Density Urethane has produced improved machining characteristics, resulting in more chips and less dust during cutting and machining, making for a better working environment. Higher machine feed rates are easily achieved compared to wood, epoxy or alloy substrates.

Typical Features:

- Less dust, more chips for a better working environment
- Last up to 10x longer than wood
- Closed cell structure, won't absorb anything
- Will not crack, rot or peel
- Easily cut or machined with standard HSS cutting tools
- Meets flammability burn test requirements of ASTM D-1692-74, Far 25.853, Mil-P-26514 and ASTM D635

Product Applications:

- Prototype machining
- Thermoforming
- Vacuum form tooling
- Pattern making
- Soft tooling, all types
- Prepreg composite layup tooling
- Tool proofing
- Master model making
- Indoor & Outdoor signage
- Sculptures & carvings

Precision Board Plus

Standard Thickness (inches) :	**1/2" up to 24" thick**
Standard Sheet Size (inches) :	**20" x 60" 24" x 60" 30" x 80" 48" x 60" 48" x 96" 48" x 120" 60" x 96" 60" x 120"**
Standard Densities* :	**4 lb/ft³ 6 lb/ft³ 8 lb/ft³ 10 lb/ft³ 12 lb/ft³ 15 lb/ft³ 18 lb/ft³ 20 lb/ft³ 30 lb/ft³ 34 lb/ft³ 40 lb/ft³ 48 lb/ft³ 60 lb/ft³ 70 lb/ft³ 75 lb/ft³**

** Densities are in pounds per cubic foot. Custom densities are available upon request.*

Tooling Board

Precision Board Material Selection Guide

Precision Board Low Temperature - For 200° and below usages

Precision Board High Temperature - For 200° and above usages

Lower Densities

	4 lb.	6 lb.	8 lb.	10 lb.	12 lb.	15 lb.	18 lb.
Dimensional Signage (indoor)	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Dimensional Signage (outdoor)		PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Landmark Signage				PBLT	PBLT	PBLT	PBLT
Sculpture / Carvings	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Theme Park Creations / Caricatures	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Topographical & Architectural Models				PBLT	PBLT	PBLT	PBLT
Composite Layup Tools				PBLT	PBLT	HT LT	HT LT
Aerospace Layup Tools				PBLT	PBLT	HT LT	HT LT
Automotive Layup Tools				PBLT	PBLT	HT LT	HT LT
Foundry Patterns						PBLT	PBLT
Prototype Patterns						PBLT	PBLT
Vacuum Form Models							
Autoclave Tools							

Higher Densities

	20 lb.	30 lb.	40 lb.	48 lb.	60 lb.	70 lb.	75 lb.
Dimensional Signage (indoor)	PBLT	PBLT					
Dimensional Signage (outdoor)	PBLT	PBLT					
Landmark Signage							
Sculpture / Carvings	PBLT	PBLT					
Theme Park Creations / Caricatures	PBLT	PBLT					
Topographical & Architectural Models	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Composite Layup Tools	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT
Aerospace Layup Tools	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT
Automotive Layup Tools	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT
Foundry Patterns	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Prototype Patterns	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT	PBLT
Vacuum Form Models	PBHT	PBHT	PBHT	PBHT	PBHT	PBHT	PBHT
Autoclave Tools	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT	HT LT

The information in the chart above represents PBLT and PBHT densities most commonly used for a particular application. Because performance requirements for each specific project vary based on considerations such as, the need for impact and abrasion resistance; compression, shear and tensile strength required; degree of edge detail needed; level of surface smoothness required; and weight (among others), Coastal Enterprises is providing this information to serve only as a general guide. Please contact us, our product experts will be happy to help you make the right product selection.

Urethane / Rubber

Polyurethane / Urethane

Polyurethane is a unique material that offers the elasticity of rubber combined with the toughness and durability of metal. Because urethane is available in a very broad hardness range (eraser-soft to bowling-ball-hard), it allows the engineer to replace rubber, plastic and metal with the ultimate in abrasion resistance and physical properties.

Polyurethane can reduce plant maintenance and OEM product cost. Many applications using this ultra-tough material have cut down-time, maintenance time and cost of parts to a fraction of the previous figures. Polyurethane can be cast to size or to print using a mold. It is available in a wide range of colors and hardnesses.

Typical Features:

- Superior cut and abrasion resistance
- Lightweight, ability to "self-heal"
- Can be formulated to possess specific properties (i.e. coefficient of friction, resiliency and compression set can be formulated high or low
- Excellent resistance to ozone and aging
- Can be molded and bonded to a variety of substrates
- Resistant to many oils and solvents
- Outstanding low temperature properties

Product Applications:

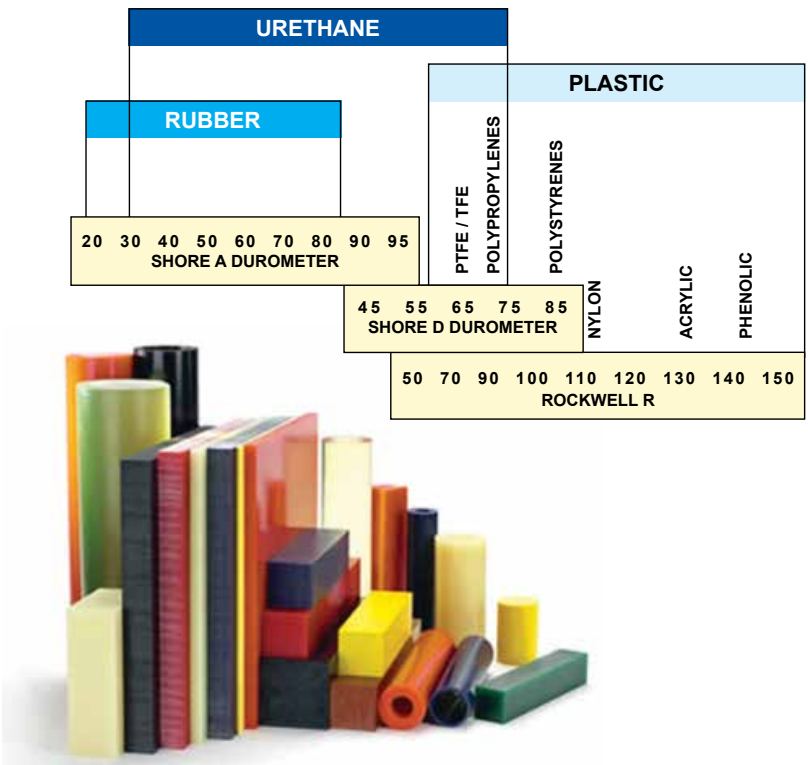
- Bumper pads
- Chutes & hopper liners
- Cutting surfaces
- Drive belts
- Gaskets & gears
- Impact absorption
- Machinery mounts
- Metals forming pads
- Rollers & covers
- Sound-dampening pads
- Truck beds
- Wear pads

Urethane / Rubber

Polyurethane / Urethane

PROPERTY TESTED	ASTM	80A	90A	95A	60D	75D
Modulus, 100%, psi	D412	800	1,100	1,800	3,000	5,070
Modulus, 300%, psi	D412	1,500	2,200	4,300	6,100	---
Tensile, psi	D412	5,000	5,500	6,500	7,300	7,120
Elongation, %	D412	490	430	380	330	230
Tear, PLI	D470	75	90	130	120	117
Tear, Die, C, PLI	D624	530	600	700	800	---
Bashore Rebound, %	D2632	58	42	40	45	47
Compression Set: 22 hours/158°F, Method B, %	D395-B	25	30	36	40	---
Bell Brittle Point, °F	D2137	-80	-80	-80	-80	-64

Hardness Scales:

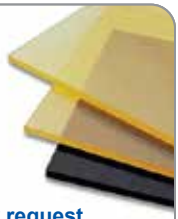


Urethane / Rubber

Open Cast Urethane Sheet and Slab

Our standard flat polyurethane sheet stock material is abrasion resistant, chemical resistant and can be custom made for specific applications. Urethane flat sheet stock material can easily be water-jet cut into custom parts as well. Polyurethane sheet stock has very consistent thicknesses throughout the entire sheet with square corners making water-jet setup and cutting easy. Open cast sheet and slabs can, in most cases, be produced to exact sizes, resulting in 0% scrap.

Urethane Sheet



Standard Thickness (inches) :	**1/4" up to 8" thick**
Standard Sheet Size (inches) :	**24" x 48,** **48" x 96",** **48" x 120"**
Standard Color(s) :	**Natural (Amber) & Black, colors by request**

Custom colors available upon request, minimums may apply, please inquire

Solid Cast Urethane Rod

Our polyurethane rod is cast in bored and honed molds to ensure the precise roundness and consistent diameter you need for rollers, bumpers, mount and other parts. Rod is available in hardnesses from 40A to 75D. We're happy to provide larger diameters and custom lengths.

Urethane Rod

Standard Diameter (inches) :	**1/4" up to 6" dia.**
Standard Rod Length (inches) :	**36" (3 feet)**
Standard Color(s) :	**Natural (Amber) & Black**

Custom colors available upon request, minimums may apply, please inquire

Urethane / Rubber

Precision Cast Urethane Tube

Our standard polyurethane tube is available in a variety of I.D./O.D. combinations and lengths. We also offer a wide range of hardnesses from 40A up to 75D. Polyurethane tubing is ideal for rollers, bumpers and impact sleeves. Please contact your Alro representative for specific sizes, colors and hardness.

Urethane Tube

Standard Outside Dia. (inches) :	**1" O.D. up to 6-1/2" O.D.**
Standard Inside Dia. (inches) :	**3/8" I.D. up to 5" I.D.**
Standard Tube Length(s) (inches) :	**36" long (3 feet)**
Standard Color(s) :	**Natural (Amber)**

Custom colors available upon request, minimums may apply, please inquire

Custom Molded Urethane Parts

In addition to the standard sheet, rod and tube shapes, we can provide urethane in virtually any shape or size for engineering parts in grain, mining, sand and gravel, crushed stone, aggregate mixing, general bulk handling and other industrial applications. Also available is FDA urethane for food processing parts and the capabilities to make parts for the Aerospace industry. Simply provide Alro Plastics with your print and quantity and let Alro supply you with finished parts. Tooling or mold charges may apply as these are custom parts to print.

Injection Molding

Custom Parts per Print

We partner with injection molders that offer mold and tooling design allowing us to be a single source supplier. Depending on the run of parts injection molding can be a significant cost savings over time making it a short term investment for a long term savings.

Injection molded parts can be used in applications for the wastewater industry, food processing, packaging, forest products, agricultural, manufacturing, maintenance, and many others. Examples of some injection molded materials we can use are UHMW, HDPE, polypropylene, ABS, polyurethane, nylon, acetal, ultem and peek. Reach out for other materials to see if we have a solution for your application.

Please inquire with your Alro Plastics representative today!

Fiberglass

Safety Grating, Structurals and Specialty Items

Grating, Pultruded .....11-2 to 11-7

Grating, Molded .....11-8 to 11-10

Extren® Structural Shapes .....11-11 to 11-13

Specialty Products .....11-14 to 11-15

Ballistic & Storm Panels 11-16

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

Fiberglass Grating - Pultruded

Duradek® (standard) **and Duragrid®** (custom)

Duradek® and Duragrid® are high strength pultruded bar type gratings that can be designed and used like traditional metal grates but have inherent benefits of fiberglass. These problem solving products are ideal replacements for steel or aluminum gratings in corrosive environments or anywhere frequent grating and walkway replacements costs are unacceptable.

Duradek® is a standard product made by Strongwell and stocked by Alro Plastics. It is available with individual bearing bars in either 1" or 1-1/2" thick "I" shapes or a 2" thick "T" shape. Duradek® is a flame retardant product utilizing a polyester or vinyl ester resin. The bearing bars are assembled into 12 panel sizes 3-, 4-, 5- foot widths in each of 8-, 10-, 12-, and 20- foot lengths. Standard panels come with cross-rod spacings of 8" on center.

Duragrid® custom grid or grating systems are designed to accomodate specific applications that cannot effectively be met by standard fiberglass grating. Duragrid® offers the customer options such as selection of open space, bar shape, cross-rod replacement, custom fabrication, custom resin and color. Because Duragrid® is a custom grid, there is a lead time involved in designing and running it. Alro Plastics does stock Duragrid® I-6000 with 6" cross rods as our standard. Please contact Alro Plastics for your custom run inquiries.

Why use Duradek® or Duragrid® grating? Duradek® and Duragrid® are lightweight, which saves on freight and makes installation easier. The unique cross-bar construction of Duradek® and Duragrid® allows the grating panels to be easily cut and modified to fit almost any plant requirment.

Typical Features:

- High impact and fatigue strength
- Cracking and chipping resistant
- Low thermal conductivity
- Low electrical conductivity
- Easy to fabricate and install
- Structurally strong
- Corrosion resistant
- Skid resistant
- Low maintenance
- Lightweight

Product Industries:

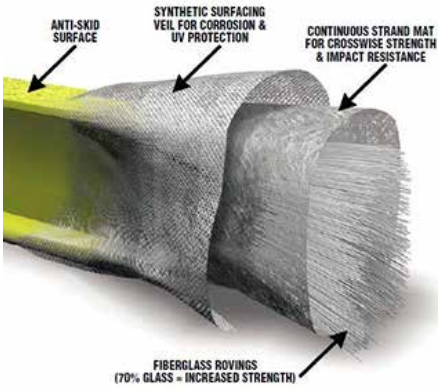
- Mining / Processing
- Chemical & Power plants
- Oil and Gas facilities
- Building construction
- Fire equipment
- Wastewater plants
- Agricultural
- Food and beverage
- Metal finishing
- Railroad / Transportation
- Pollution control
- Marine / Offshore
- Pulp and paper
- Electrical / Radar

Fiberglass Grating - Pultruded

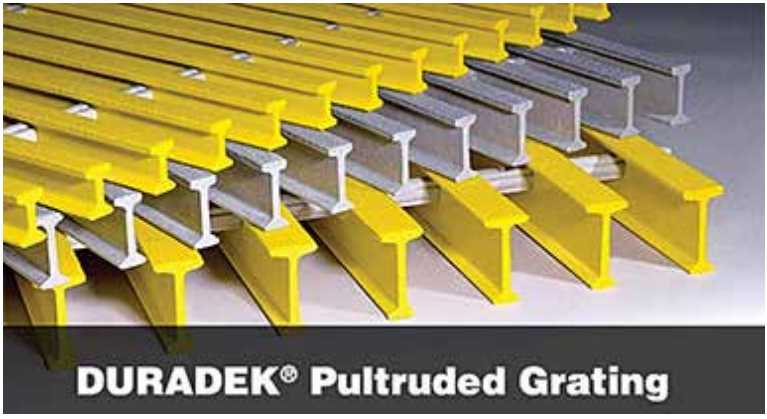
Duradek® (standard) **and Duragrid®** (custom)

Duradek® and Duragrid® fiberglass gratings are a composite of fiberglass reinforcements (fibers and mat) and a thermosetting resin system, produced by the poltrusion process. The poltrusion manufacturing process produces many of the outstanding characteristics of the product.

The bearing bars use both longitudinal (glass roving) and multidirectional (glass mat) reinforcements as well as a synthetic surfacing veil to provide unequaled strength and corrosion resistance. The densley packed core of continuous glass rovings gives the bar strength and stiffness in the longitudinal direction while the continuous glass mat provides stength in the transverse direction and prevents chipping, cracking and lineal fracturing. The synthetic surfacing veil provides a 100% pure resin surface for added corrosion resistance and UV protection.



The patented 3-piece cross-rod assembly used in Duradek® and Duragrid® grating forms a strong, unified panel that can be cut and fabricated like a solid sheet. This unique system consists of two continuous, pultruded spacer bars and a center core wedge. The spacers are notched at each bearing bar so that the bars are both mechanically locked and chemically bonded to the web of each bearing bar. This seperates and affixes the bearing bars firmly in position and distributes concentrated loads to adjacent bars. The resulting panel can be easily fabricated with standard carpenters' tools with abrasive cutting edges. Ask your Alro Plastics Sales representative for the Grating Field Farbication Guide for further details.



STRONGWELL

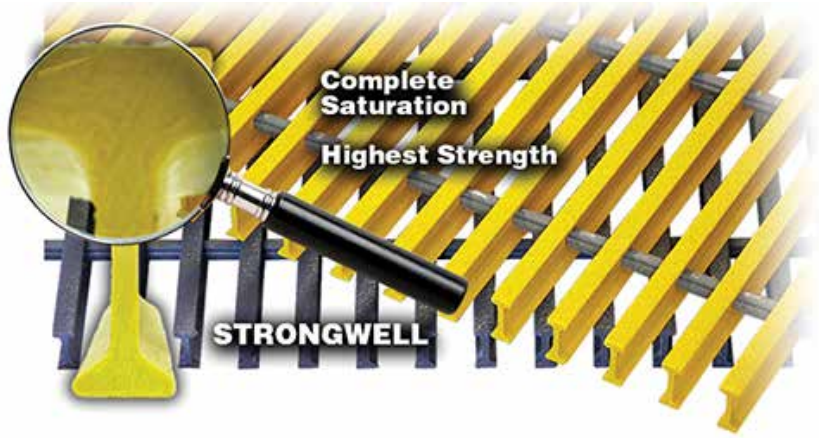
Fiberglass Grating - Pultruded

Duradek® (standard) **and Duragrid®** (custom)

Custom Grating Options

A wide variety of bearing bar shapes along with various bearing bar and cross-rod spacings are available depending on the design requirements. The traditional "I" bar shape provides maximum flexibility in design. It is available in 1", 1-1/4" and 1-1/2" depths. The "T" bar shape provides a more solid walking surface and prevents catching high heels and other objects between the bars. It is available in 1", 1-1/2" and 2" depths. The Economy series offers a lighter weight bearing bar.

Strongwell's Duragrid® Heavy Duty (HD) solid bar grating has been designed to take heavy wheel traffic such as forklifts, tow motor and truck traffic. Because of a variety of wheel types and loading, please contact Alro Plastics or Stongwell's engineering department to determine the series of heavy duty grating to use. It is available in 1", 1-1/4", 1-1/2", 1-3/4", 2", 2-1/4" and 2-1/2" depths.



Fiberglass grating panels can be made to exact sizes to eliminate waste and fabrication costs in the field. The maximum panel weight is 500 lbs. and the maximum panel size is 60" x 240".

The bearing bars can be UV coated for added protection and color stability for outdoor applications. Grids can be ordered with or without an anti-skid grit surface. A variety of grit material and textures can be ordered.

The two standard colors are Gray and Yellow. Other colors can be quoted upon request. A small inventory is also maintained of 1" thick "I" and "T" bars in White non-fire retardant polyester resin.

The standard polyester resin used in Duradek® is fire retardant and meets the requirements for a Class 1 flame rating of 25 or less per ASTM E-84 and meets the self-extinguishing requirements of ASTM D-635. The resin also contains a UV inhibitor. Duragrid® offers a wide selection of resin options including polyester, vinyl ester, phenolic, modar, etc. Other choices include fire retardant, UV inhibitors, colors and specialized additives.

STRONGWELL

Fiberglass Grating - Pultruded

Duradek® (standard) **and Duragrid®** (custom)

How to Specify Duradek® and Duragrid®

Fiberglass grating shall be (select one of the following...)

- **Duradek®** Series (I-6500 1"thk) (I-6500 1-1/2"thk) (T-5800 2" thk)
- **Duragrid®** Grating panels shall be made of (1") (1-1/4") (1-1/2") (2") deep pultruded (T) (I) bars.
- **Duragrid®** Heavy Duty grating panels shall be made of (1") (1-1/4") (1-1/2") (1-3/4") (2") (2-1/4") (2-1/2") deep pultruded (HD) bars.

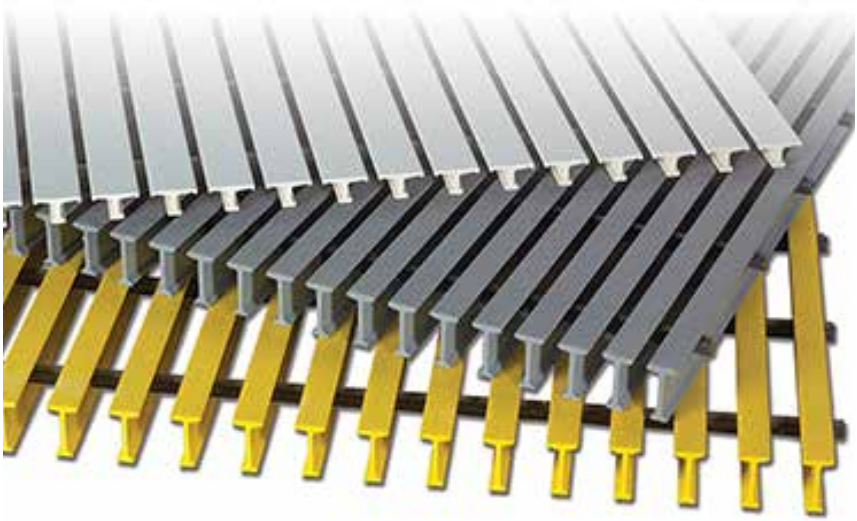
The resin shall be fire retardant (polyester) (vinyl ester) meeting the requirements of a Class 1 rating of 25 or less per ASTM E-84 and meets the self-extinguishing requirements of ASTM D-635. The color shall be (Gray) (Yellow). Resin shall be UV inhibited and the composite shall include a veil on all exposed surfaces. Panels shall be assembled into the sizes ordered using a 3-piece pultruded cross-rod system.

The cross-rods shall consist of a center core wedge and 2 spacer bars that are notched at each bearing bar so that each bearing bar is both mechanically locked and chemically bonded to the web of each bearing bar. The spacer bars shall be continually bonded to the center core wedge. The cross-rods shall be spaced a maximum of (6", 8" or 12") in the panel. The top of the panels (shall) (shall not) be covered with a bonded grit anti-skid surface.

NOTE: If special options are required that are not stated in the above specification, fill in your special requirement in the appropriate section.

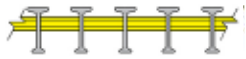
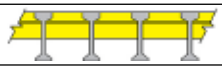
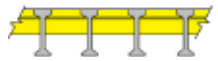
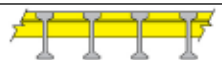
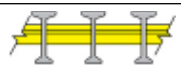
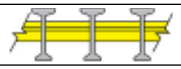
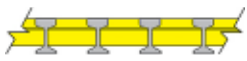
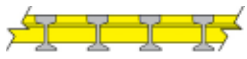
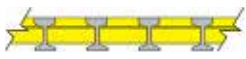
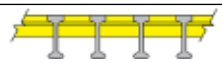
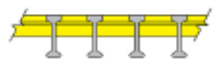
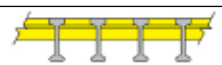
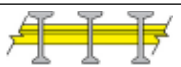
When ordering **Duradek®** or **Duragrid®**, make sure the bearing bars in the panel are oriented in the correct direction for the application. Bearing bars should traverse from support to support. Cross-rods are not intended to be applied in the span direction.

NOTE: Width is the measurement from end to end of the cross-rods. Length is ALWAYS the bearing bar length.



Fiberglass Grating - Pultruded

Typical Properties

END VIEW	SERIES	OPEN AREA %	DEPTH, INCHES	WIDTH OF TOP FLANGE INCHES
	I-6500	65%	1"	0.60
	I-6500	65%	1-1/2"	0.60
	T-5800	58%	2"	1.00
	I-4000	40%	1"	0.40
	I-4000	40%	1-1/4"	0.40
	I-4000	40%	1-1/2"	0.40
	T-1800	18%	1"	1.63
	T-3300	33%	2"	1.00
	HD-6000	60%	1"	0.60
	HD-6000	60%	1-1/4"	0.60
	HD-6000	60%	1-1/2"	0.60
	HD-6000	60%	1-3/4"	0.60
	HD-6000	60%	2"	0.60
	HD-6000	60%	2-1/4"	0.60
	HD-6000	60%	2-1/2"	0.60

COLORS
Standard colors are safety yellow and gray for all isophthalic and vinylester products. Special colors will be quoted upon request.

STANDARD PANEL SIZE (feet)

3'-0 x 20'-0	4'-0 x 20'-0	*4'-0 x 8'-0
3'-0 x 10'-0	4'-0 x 10'-0	*4'-0 x 12'-0

Two page chart, continues on the next page

Fiberglass Grating - Pultruded

Typical Properties

FLUSH TOP	WIDTH OF OPEN SPACE INCHES	BEARING BARS PER FOOT	APPROX. WEIGHT SQFT.	RESIN	COLOR Y=YELLOW G=GRAY
YES	0.90	---	2.40	ISO FR VE FR	Y & G
YES	0.90	---	2.92	ISO FR VE FR	Y & G
NO	1.00	---	3.00	ISO FR VE FR	Y & G
YES	0.40	---	3.40	ISO FR VE FR	Y & G
YES	0.40	---	3.85	ISO FR VE FR	Y & R
YES	0.40	---	4.20	ISO FR VE FR	Y & G
NO	0.38	6	2.61	ISO FR VE FR	Y & G
NO	0.50	8	3.94	ISO FR VE FR	Y & G
YES	0.90	---	4.90	ISO FR VE FR	Y & G
YES	0.90	---	5.90	ISO FR VE FR	Y & G
YES	0.90	12	7.00	ISO FR VE FR	Y & G
YES	0.90	8	8.00	ISO FR VE FR	Y & G
YES	0.90	10	9.00	ISO FR VE FR	Y & R
YES	0.90	12	10.10	ISO FR VE FR	Y & G
YES	0.90	6	11.10	ISO FR VE FR	Y & G

CUSTOM SIZES AVAILABLE

Two page chart, continued from previous page

Fiberglass Grating - Molded

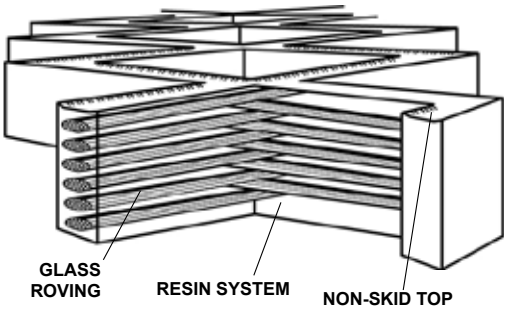
Duragrate® (standard)

Duragrate® molded fiberglass grating is a strong mesh grating panel that is the chemical resistant flooring choice for many industrial applications. Duragrate® panels are molded in one piece and feature a concave non-slip walking surface. The cost-effective panels allow for efficient on-site cutting to minimize grating waste and load bearing bars in both directions allow for use without continuous side support.

Duragrate® molded fiberglass grating is significantly lighter in weight than metallic gratings and the high resin content (65%) provides long, virtually maintenance-free performance. A higher safety is achieved by designing in a higher glass content at the bottom of the grating for greater tensile strength.

Typical Features:

- Bidirectional load bearing
- Uniform in appearance
- Low in conductivity
- Low maintenance
- Easy to fabricate and install
- Good impact resistance
- Corrosion resistant
- Cost effective
- Fire retardant
- Lightweight



Product Industries:

- Mining / Processing
- Chemical & Power plants
- Oil and Gas facilities
- Building construction
- Fire equipment
- Wastewater plants
- Agricultural
- Food and beverage
- Metal finishing
- Railroad / Transportation
- Pollution control
- Marine / Offshore
- Pulp and paper
- Electrical / Radar

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Fiberglass Grating - Molded

Duragrate® (standard)

Duragrate® molded fiberglass grating is composed of fiberglass rovings combined with a choice of five thermosetting resin systems. Standard Duragrate® grating has a concave profile on the upper surface for skid resistance. Grit tops are available upon request.

Standard Resin Systems Available* :

RESIN CODE	DESCRIPTION	RESIN BASE	CORROSION RESISTANCE	FLAME SPREAD RATING**
VE	Chemical Proof Fire Retardant	Vinyl Ester	Excellent	Class 1 25 or Less
XVE	Chemical Proof Fire Retardant	Vinyl Ester	Excellent	Class 1 10 or Less
PP	Industrial Grade Fire Retardant	Isophthalic	Very Good	Class 1 25 or Less
GP	Architectual Grade Fire Retardant	Orthophthalic	Good	Class 1 25 or Less
FF	Food Grade Fire Retardant	Isophthalic	Very Good	Class 2 30 or Less

** Strongwell's standard colors are Dark Gray, Green, Yellow, Orange and Light Gray. Please contact Customer Service for resin system and color requirements. Custom colors are available upon request.*
*** Flame Spread Rating per ASTM E-84 Tunnel Test*

How to Specify - The molded fiberglass grating shall be **Duragrate®** as supplied by Strongwell. Grating panels shall be (pick one from chart below for thickness, mesh pattern, resin code) molded grid pattern.

The grating shall be one-piece construction with the tops of the bearing bars and cross bars in the same plane.

Color shall be (green, orange, yellow, dark gray or light gray). The surface shall be (concave top, gritted).

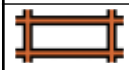
Shapes, Sizes and Availability :

THICKNESS	MESH PATTERN	PANEL SIZES
1"	1-1/2" Square	3' x 10', 4' x 8', 4' x 12'
1"	2" Square	4' x 12'
1"	3/4" x 4" Rectangular	4' x 12'
1"	1" x 4" Rectangular	3' x 10', 4' x 12'
1-1/2"	3/4" x 3/4" Micro Mesh	4' x 12'
1-1/2"	1-1/2" x 6" Rectangular	4' x 12'
1-1/2"	1-1/2" Square	3' x 10', 4' x 8', 4' x 12', 5' x 10'
2"	2" Square	4' x 12'

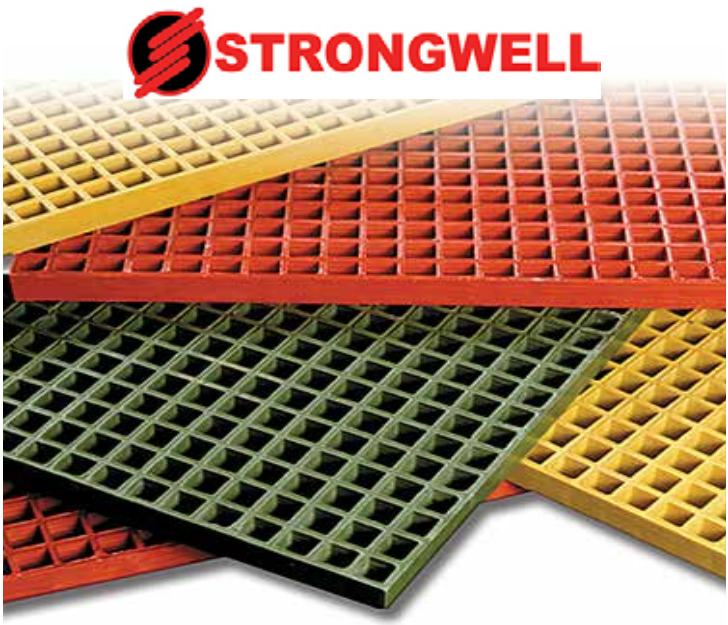
NOTE: All panel sizes available in VE, XVE, PP, GP or FF resin systems. Custom panel sizes and resins available upon request.

Fiberglass Grating - Molded

Duragrate® - Standard Grating Offerings

TOP VIEW	OPEN AREA	DEPTH	PATTERN	MESH SIZE	APPROX WGT. PER SQFT
	70%	1"	SQUARE MESH	1-1/2" x 1-1/2"	2.6 lbs
	70%	1-1/2"	SQUARE MESH	1-1/2" x 1-1/2"	3.8 lbs
	72%	2"	SQUARE MESH	2" x 2"	4.0 lbs
	44%	1-1/2"	RECT. MESH	3/4" x 1-1/2"	4.4 lbs
	69%	1"	RECT. MESH	1" x 4"	2.8 lbs
	67%	1-1/2"	RECT. MESH	1" x 6"	3.5 lbs

**Standard and Heavy Duty grades are available, please inquire with Sales Department*



A close up photo of the Duragrate molded grating. Alro Plastics can cut the grating to size for you, save yourself some time and whole lot of mess by letting Alro do the processing.

Fiberglass Structurals

Extren® - Standard Fiberglass Structural Shapes

A wide variety of standard shapes and custom composite shapes can be produced in a choice of standard resin systems. Fiberglass grating products are impervious to most industrial and environmental corrosives, non-conductive, electromagnetically transparent, provide thermal insulation and are less costly to maintain over the life of the product. Manufactured via the pultrusion process, these structural shapes are strong, flexible, dimensionally stable, and are inexpensive to install and remove with simple hand tools.

Extren® is a proprietary combination of fiberglass reinforcements and thermosetting polyester or vinyl ester resin systems. It is produced in more than 100 standard shapes. All Extren® shapes have a surface veil to protect against glass fibers penetrating the resin surface in service and to increase corrosion and UV resistance.

Extren® 500 - An all-purpose series utilizing an isophthalic polyester resin system with a UV inhibitor. Color: Olive Green

Extren® 525 - An all-purpose series utilizing a fire retardant isophthalic polyester resin system with a UV inhibitor. Color: Slate Gray (plus certain handrail and fixed-ladder components in yellow.)

Extren® 625 - A premium series, both fire retardant and highly corrosion resistant, utilizing a vinyl ester resin system with a UV inhibitor. Color: Beige

Typical Features:

- Corrosion resistant
- Dimensionally stable
- Low maintenance
- Custom colors
- Low thermal & electrical conductivity
- Nonmagnetic (electromagnetic transparency)
- High strength
- Lightweight

Extren® Product Logo - A product logo identification program has been implemented by Strongwell after designers and specifiers of Extren® learned that problems were occuring becuase of sellers or contractors were substituting look-alike shapes. Since July 1, 1993, Extren® fiberglass structural shapes and plate have been imprinted with the Extren® logo every 3 feet down the length of the part. Square and round tubes have the logo imprinted inside the shape. Small and unobtrusive, the logo assures customers that they are getting Extren® properties backed by corrosion, mechanical and structural testing as conducted by Strongwell.

Fiberglass Structurals

Extren® - Standard Fiberglass Structural Shapes

Product Industries:

- Chemical processing
- Cellular communication
- Building construction
- Food and Beverage
- Transportation
- Oil and Gas
- Air pollution control
- Electrical / Electrical Utility
- Water / Wasterwater
- Aeronautical defense
- Appliance / Equipment
- Consumer / Recreation
- Pulp and paper
- Agricultural

Product Shapes and Sizes:

ANGLES	CHANNELS	WIDE FLANGE BEAMS	ROUND TUBE	THERMAL CURED CLEAR ROD
1" x 1/8"	2" x 9/16" x 1/8"	3" x 1/4"	1"dia x 1/8"	1/4"dia.
1-1/4" x 3/16"	3" x 7/8" x 1/4"	4" x 1/4"	1-1/4"dia x 1/8"	3/8"dia.
1-1/2"x 1/8"	4" x 1-3/8" x 3/16"	6" x 1/4"	1-1/2"dia x 1/8"	1/2"dia.
1-1/2" x 3/16"	4" x 1-1/8" x 1/4"	6" x 3/8"	1-1/2"dia x 1/4"	5/8"dia.
1-1/2"x 1/4"	5" x 1-3/8" x 1/4"	8" x 3/8"	2"dia x 1/8"	3/4"dia.
2" x 3/16"	6" x 1-5/8" x 1/4"	10" x 3/8" (32'lg)	2"dia x 1/4"	13/16"dia
2" x 1/4"	*6" x 1-11/16" x 3/8"		2-1/2"dia x 1/4"	7/8"dia.
3" x 1/4"	*8" x 2-3/16" x 1/4"	THERMAL CURED CLEAR SQUARE BAR	3"dia x 1/4"	1"dia.
3" x 3/8"	8" x 2-3/16" x 3/8"	1/2" x 1/2"	SQUARE TUBE	1-1/8"dia
4" x 1/4"	10"x 2-3/4"x 1/2" (24'lg)	5/8" x 5/8"	1" x 1/8"	1-1/4"dia
4" x 3/8"	RECT. TUBE	3/4" x 3/4"	1-1/2" x 1/8"	1-1/2"dia
4" x 1/2"	4"x 1/8" x 2" x 1/4"	1" x 1"	2" x 1/8"	1-7/8"dia
6" x 1/2"		1-1/4" x 1-1/4"	2" x 1/4"	2"dia
SHEETS	I-BEAMS	1-1/2" x 1-1/2"	**2" x 1/4"	
1/8" thick	3" x 1-1/2" x 1/4"		3" x 1/4"	
3/16" thick	4" x 2" x 1/4"		4" x 1/4"	
1/4" thick	8" x 4" x 3/8"			
3/8" thick				
1/2" thick				
3/4" thick				

** Stock Series 525 only*
*** Stock, Yellow Series 525 only*

NOTE: Unless otherwise noted, all dimensions are in inches and stocked lengths are 10 foot and 20 foot long. The flat sheets of Extren are stocked in 48" x 96" sheets as a standard. All Extren® Series 500 products can be produced to meet NSF potable water standards in minimum mill run quantities. Only products bearing the NSF logo are certified.

These are just a sample of the products that Strongwell stocks and are readily available. Other products and sizes may be available, just not stocked at this time. Please contact your Alro Plastics representative about any custom run products or nonstocked shapes and sizes that you are interested in.

Fiberglass Structurals

Extren® - Standard Fiberglass Structural Shapes

PROPERTY TESTED	ASTM	UNITS	SERIES 500/ 525 SHAPES	SERIES 625 SHAPES
MECHANICAL PROPERTIES				
Tensile Stress, LW	D638	psi	30,000	30,000
Tensile Stess, CW	D638	psi	7,000	7,000
Tensile Modulus, LW	D638	10^6 psi	2.5	2.6
Tensile Modulus, CW	D638	10^6 psi	0.8	0.8
Compressive Stress, LW	D695	psi	30,000	30,000
Compressive Stress, CW	D695	psi	15,000	16,000
Compressive Modulus, LW	D695	10^6 psi	2.5	2.6
Compressive Modulus, CW	D695	10^6 psi	1.0	1.0
Flexural Stress, LW	D790	psi	30,000	30,000
Flexural Stress, CW	D790	psi	10,000	10,000
Flexural Modulus, LW	D790	10^6 psi	1.6	1.6
Flexural Modulus, CW	D790	10^6 psi	0.8	0.8
Modulus of Elasticity (1)	full	10^6 psi	2.6	2.8
Modulus of Elasticity	full	10^6 psi	2.5	2.5
W & I shapes > 4" W & I shapes > 102mm				
Parallel Compressive Shear Stress, LW (2)(9)	D3846	psi	3,000	3,000
Shear Modulus, LW (3)	---	10^6 psi	0.425	0.425
Short Beam Shear, LW (8)(9)	D2344	psi	4,500	4,500
Bearing Stress, LW	D953	psi	30,000	30,000
Poisson's Ratio, LW (9)	D3039	in/in	0.33	0.33
Notched Izod Impact, LW	D256	ft•lbs/in	25	25
Notched Izod Impact, CW	D256	ft•lbs/in	4	4
PHYSICAL PROPERTIES				
Barcol Hardness	D2583	---	45 (4)	45 (4)
24 hr Water Absorption (7)	D570	% Max	0.6	0.6
Density	D792	lbs/in^3	.062-.070	.062-.070

*(1) This value is determined from full section simple beam bending of **Extren** structural shapes.*
(2) The shear stress test results will change radically if notched orientation is altered. The value in this chart represents the test configuration where the notches are machined parallel to the reinforcing mat. For notches machined perpendicular to the reinforcing mat, this value would be two to three times larger.
*(3) The Shear Modulus value has been determined from tests with full sections of **Extren** structural shapes.*
(4) Value would be 50 if the surfacing veil were not there.
(5) Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.
(6) Values apply to series 525 and 625.
(7) Measured as a percentage maximum by weight.
(8) Span to depth ratio of 3:1; Extren angles will have a minimum value of 4000 psi and the I/W shapes are tested in the web.
(9) Typical values because these are shape and composite dependent tests.

LW = Lenghtwise, CW = Crosswise, PF = Perpendicular to laminate face, N.T. = Not Tested

Fiberglass Products

Additional Fiberglass Safety Products

Strongwell offers a broad range of fiberglass industrial products. Two other products often used with **Extren®** are **Safplate®** and **Fibrebolt®**. A brief description of each is given here. Full-color literature is available for each product upon request.

Safplate®

Safplate® fiberglass gritted plate is a tough, corrosion resistant floor plate. The unique combination of pultruded fiberglass plate and an anti-skid grit surface makes Safplate® a textured solid sheet flooring that is ideal for both wet and dry applications. Used in a variety of applications such as trench covers to contain vapors and fumes or predestrian bridge walkways for sure footing, Safplate® provides a long-lasting, maintenance-free alternative to steel plate for severe and corrosive environments.

Safplate® is available as solid plate or bonded to Duradek® or Duragrid® grating. The grit surface can be fine, medium or coarse. It is available in 4' x 8' panels in all standard Extren® plate thicknesses: 1/8", 3/16", 1/4", 3/8", 1/2" and 3/4". The standard Safplate® is fiberglass reinforced polyester with fire retardant in a gray color. Other resin systems and custom colors are available upon request, minimum quantities may apply.

Fibrebolt®

Fibrebolt® fiberglass studs and nuts are ideal for applications requiring mechanical fasteners that must be noncorrosive, low in conductivity and/or transparent to electromagnetic waves. Fibrebolt® studs are machined from pultruded fiberglass vinyl ester rods. The hex shaped nut is thermoplastic. They are easily assembled with a standard six point socket wrench.

Fibrebolt® studs and hex nuts are available in diameters of 3/8", 1/2", 5/8", 3/4" and 1" for immediate delivery. Four foot bolt lengths are standard, with custom lengths and partial length threading available upon request. Brown in the standard color. The studs and nuts have UV inhibitors to provide resistance to ultraviolet degradation and corrosion.

Composolite®

Composolite® is an advanced composite building panel system suitable for major load bearing structural applications. The modular construction system consists of a small number of interlocking fiber reinforced polymer (FRP) structural components produced by the pultrusion process. The main building panel is an open ribbed, 3" thick x 24"wide nominal size. Panels can be connected using the 3-way connectors, 45 degree connectors, toggles and/or hangers.

This uniquely designed system of interlocking components makes it possible to design fiberglass structures at significantly lower costs for a broad range of construction applications. Composolite® structures can be designed in "kit form" and shipped flat to the job site.

Fiberglass Products

Additional Fiberglass Safety Products

Safplank®

Safplank® is a high strength system of fiberglass planks designed to interlock to form a continuous solid surface. Safplank® is intended to replace wood, aluminum or steel planks in environments where corrosion or rotting creates costly maintenance problems or unsafe conditions.

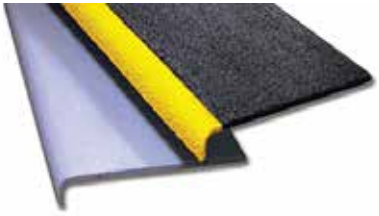
Safplank® is available in 2" deep panels in both 12" and 24" widths to offer flexibility in design. All stock panels are gritted and are available in 20' and 24' lengths. Other lengths are available upon request. Safplank® may be ordered with a smooth surface for non-pedestrian applications.

Safdeck®

Safdeck® is a system of 24" wide fiberglass panels designed to overlap for a continuous solid surface. Safdeck® is intended to replace wood, aluminum or steel decking in environments where corrosion or rotting creates costly maintenance problems or unsafe conditions. Low in conductivity and nonsparking, Safdeck® provides safe walkways in applications near electrical lines.

Duratread™

Duratread™ molded fiberglass stair tread covers provide an easy, cost effective way to increase the safety of stairways. The covers are intended for installation over concrete, metal or wood steps and for over fiberglass stair treads.



Duratread™ stair tread covers are ideal for use in any area where frequent use or exposure to slippery environments increases the risk of accidents. The ADA compliant covers feature a durable gritted surface and a highly visible nosing to ensure years of safe, maintenance-free service. Duratread™ covers also improve the appearance of warped, chipped and rotten steps and are perfect for use in commercial building applications where it is important to maintain an attractive appearance.

STRONGWELL

Fiberglass Products

Ballistic & Storm Panels

HS Armor Panels are designed for ballistics resistance, when struck by a bullet or projectile they delaminate and absorb the energy stopping the projectile. HS Amor panels can be installed and then covered with a variety of wall treatments and finished to imitate drywall making them ideal for classrooms, convenience stores and office buildings where protection is needed.

Typical Features:

- UL 94-VO flame rating
- Tested to UL 752
- Tested to NIJ Ballistic specifications
- Self-extinguishing

Product Industries:

- Judges benches
- Jury boxes
- Convenience stores
- Classrooms
- Bank Teller areas
- Panic rooms and safe rooms
- Storm shelters
- Office buildings

HS Armor Panels

Stock Thickness (inches) :	**1/4" up to 1-1/2"**
Stock Sheet Size (feet) :	**Widths: up to 4 foot** **Lengths: up to 20 foot**
Stock Panel Color :	**White**

STRONGWELL

Plastics Processing

Overview of Plastics Value-Added Services

CNC Panel Saw Cutting 12-2

Rounds & Structurals Cutting 12-3

Waterjet Cutting 12-4

CNC Production Routers 12-5

Milling & Machining 12-6

Drilling & Tapping 12-7

Plastic Welding 12-8

Bend, Glue & Polishing 12-9

Machining Guidelines .....12-10 to 12-14

Trouble Shooting Tips .....12-15 to 12-16

What is Saw Kerf 12-17

Standard Edge Finishes 12-18

Plastics Processing

CNC Panel Saw Cutting

Every Alro Plastics location has a CNC Saw for cutting plastics to the desired sizes. Our CNC production saws are capable of holding tight tolerances while cutting material up to 8" thick and 14 feet wide/long. With these heavy duty CNC saws we are able to cut thru a single block of 8" thick Nylon in one pass or we can stack multiple sheets of 1/4" thick Acrylic and cut them in one, efficient step. These high precision CNC saws are designed to fast and productive.

We pride ourselves on cutting and shipping the same day as ordered in most cases. With a few of our locations running two and even three shifts we are able to turnaround custom cut orders in a hurry. Along with our huge inventory of materials Alro Plastics can promise some of the fastest lead times in the industry. Give us a try on your next cut-to-size order and see what Alro can do for you!

Highlights

- Quantities: 1 pc - 50,000 pcs
- Thickness: 1/16" up to 8" thick
- Length/Width: 1/2" up to 168" wd/lg
- Standard Cut Tolerance: +1/16" / -0"
- Custom tolerances available by request
- Multiple shifts for shortest lead times

Plastics Processing

Rounds & Structural Cutting

Alro Plastics also offers same day cutting and shipping on our Rod and Tube stock. We stock up to 14" diameter in some materials and have the capabilities to cut up to 18" diameter in house. These saws can quickly cut a few pieces or be programmed to cut a production run. Our standard cut tolerance is always on the plus side so the pieces will never come in undersized. We also have the ability to cut U-channel, angle and various other profiles shapes on these saws.

Video available on YouTube

We also drop tag and bin locate all of our cut off pieces to offer our customers smaller minimun orders. This is helpful to customers looking for just a few pieces for a prototype run. Give your Alro representative the length you are looking for and they will check the drops to see if any will work for your job.

Highlights

- Quantities: 1 pc - 10,000 pcs
- Diameter: 1/8" up to 18" diameter
- Length/Width: 1" up to 20 feet long
- Standard Cut Tolerance: +1/4" / -0"
- Custom tolerances available by request
- Solid rounds and hollow rounds

Plastics Processing

Waterjet Cutting

With plastic sheets and slabs being offered in thicker sizes every year and the growing number of materials that are challenging to cut with traditional methods, Alro Plastics offers Waterjet cutting. The Waterjet is capable of cutting sheets up to 10" thick in a single pass to precise tolerances. This capability allows us to offer cut-to-size pieces beyond what our CNC saws can perform.

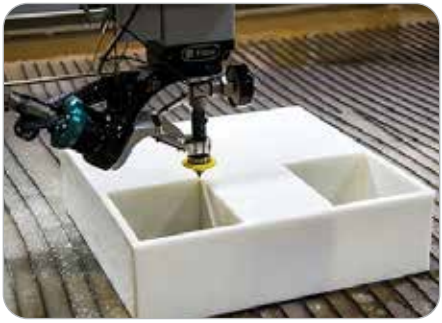
Video available on YouTube

Another advantage to Waterjet cutting is the ability to cut a wide range of challenging materials with ease. Materials like fiberglass, G10, glass-filled plastics, urethane, neoprene, rubber and even foam can be cut on the Waterjet. These materials were difficult to cut in the past but with the Waterjet Alro Plastics is able to offer cut-to-size pieces in all these materials.

This 5-axis machine can also do bevels and 3D cutting as well as "per print" cutting. We can upload drawings and prints to the Waterjet and cut out an assortment of shapes and contours as well as cut out holes and other shapes. This versatile machine allows us to offer even more unique services to our customers.

Highlights

- Quantities: 1 pc - 20,000 pcs
- Thickness: 1/32" up to 10" thick
- Width: 1/2" up to 78" wide
- Length: 1/2" up to 157" long
- Standard Cut Tolerance: +/- .015"
- Custom tolerances available by request
- Fiberglass, G10, glass-filled materials, rubber, urethane, foam and more



Plastics Processing

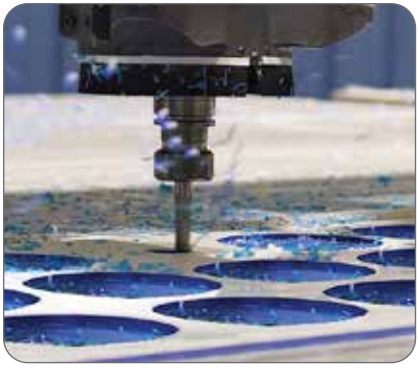
CNC Production Routers

Alro has multiple CNC Routers to machine custom plastic parts per print. These machines are capable of extremely close tolerances for milled, drilled and routed parts up to 120" wide x 144" long and up to 4" thick can be achieved. Arcs, curves, slotted tracks, machine guards and conveyor parts are just a handful of the many parts we are capable of producing. E-mail us your drawings at plastics@alro.com, we accept .dwg, .dxf, and .iges files.

We take pride in being ISO certified and do everything in our power to meet the most demanding lead times. Our goal is to keep our lead times on CNC routered parts to 2 weeks or less from stock material. Give us a shot on your next fabricated plastic part and see if we can exceed your expectations.

Highlights

- Quantities: 1 pc - 50,000 pcs
- Thickness: 1/16" up to 4" thick
- Width: 1/2" up to 120" wide
- Length: 1/2" up to 144" long
- Standard Cut Tolerance: +/- .015"
- Custom tolerances available by request
- Multi-Table Routers for production runs
- Automatic tool changers, up to 32 tools



Plastics Processing

Milling & Machining

Alro Plastics utilizes Haas VMC (Vertical Machining Centers) to give us the ability to machine small, intricate parts per print. The VMCs are able to machine parts from 1/16” up to 6” thick. It also has a 32” wide x 60” long table surface to hold a wide variety of parts. These machines are also great for secondary machining work and compliment our CNC Routers nicely.

Video available on YouTube

With its automatic tool change and ease of programming, we are able to machine complicated parts to print in a single operation. The rapid travel of the tool change process shaves time off the process enabling us to reduce run time and turn our more parts per cycle. The ease of programming allows us to quickly set up small run jobs and prototype runs with minimal cost and lead time.

Highlights

- Quantities: 1 pc - 10,000 pcs
- Thickness: 1/16" up to 6" thick
- Width: 1" up to 32" wide
- Length: 1" up to 60" long
- Ideal for prototypes and small, complex parts
- Custom tolerances available by request

Plastics Processing

Drilling & Tapping

Our FlexArm equipment allows Alro Plastics to offer in house capability of part tapping and Helicoil inserts. The FlexArm keeps the Helicoil insertion tool perpendicular to the work piece. The depth control ability offers consistency from part to part whether tapping or inserting helicoils. A FlexArm Tapping Machine will take care of prep work such as reaming, chamfering and deburring.

Highlights

- Quantities: 1 pc - 10,000 pcs
- Thickness: 1/4" up to 4" thick
- Length/Width: 1" up to 120" wide/long
- Helicoil Sizes:
- Standard: 8-32, 10-24, 10-32, 1/4-20, 3/8-20 and 1/2-13
- Metric: M3-0.5, M4-0.7, M5-0.8, M6 x 1.0, M8 x 1.25 and M10 x 1.50

Plastics Processing

Plastic Welding

When most people hear the word welding they immediately think of steel and metal welding. Well, did you know that some plastics can also be welded? Polypropylene, polyethylene, PVC, PVDF, ABS and certain thermoplastics can all be welded.

Alro Plastics has invested the time and resources to become very good at plastic welding and we offer this service to all of our customers. From the simple task of butt-welding two sheets together to make one longer sheet, to the complex process of creating custom fabricated tanks to print, we can do it all.

Highlights

- Hot gas and modified extrustion welding
- Done in house, better control of lead times
- Pieces machined on routers for best finish
- Experienced welders specializing in plastics
- Many plastics can be welded

Plastics Processing

Bend, Glue & Polish

Alro Plastics also offers our customers custom fabricated bent and glued parts to print. Some of our thinner gage plastics can be heat bent or cold formed on a press break, mostly our “See-through” materials like Acrylic, Plexiglas, Polycarbonate and PETG.

We can also CNC Saw Cut and Router these parts and assemble them together on custom fabricated jobs. ISO certified to ensure high quality finished parts in a timely manner. Please email us at plastics@alro.com for a quote!

Highlights

- CNC machined edges for the best bonds
- Ability to heat bend plastics per print
- Cold forming and bending also available
- Experienced fabricators specializing in plastics
- Complete assembly of finished parts

Machining Guidelines

For their mechanical, chemical, and lightweight properties, plastics are increasingly replacing metals in a wide range of engineering applications. Many of the same machining methods used to fabricate metal parts are also used for plastics; however, best practices for machining plastics differ considerably. Plastics exhibit a number of properties that influence machining procedures, including:

- Thermal expansion is up to 10 times greater with plastics than metals
- Plastics lose heat more slowly than metals, so avoid localized overheating
- Softening (and melting) temperatures of plastics are much lower than metals
- Plastics are much more elastic than metals

From material selection to proper tooling, from feed rates to stabilizing methods, part producers must weigh a range of factors in order to achieve good results when machining plastics. The following guidelines cover the most common plastic machining methods and provide useful tips and data for working with engineering polymers from Mitsubishi Chemical Group.

Plastic machining processs

This section covers the most common methods of machining plastic engineering components, providing guidelines and tips to achieve the best results with each. Proper machining is crucial to achieving part dimensions and performance. Improper machining can create stress within the finished part, negatively impacting its mechanical properties and risking premature part failure.

Threading and Tapping

What is threading? What is tapping?

Tapping and threading are two machining methods used to produce screw threads. Threading is the process of using a die tool to carve external threads, where tapping is the process of using a tap tool to create threads on the inside of a drilled hole.

Threading and tapping with plastic vs. metal

A primary consideration when threading and tapping plastic is that plastics are more notch-sensitive than metals. Some polymer materials may tear during threading, especially in fine pitch procedures.

Threading tips for plastic

Threading plastic should be done by single point using a carbide insert, taking four to five 0.001” passes at the end. Coolant usage is suggested.

Tapping tips for plastic

When tapping plastic, use the specified drill with a two-flute tap. Keep the tap clean of chip build-up. Use of a coolant during tapping is also suggested.

Machining Guidelines

Milling

What is milling?

Milling is a machining method that applies a high-speed cylindrical cutting tool to a stationary plastic shape, moving the cutter on an axis to subtract from the shape in different directions. Computerized numerical control (CNC) milling increases the accuracy and efficiency of plastic milling.

Milling plastic vs. metal

When milling plastic, it is crucial to properly stabilize the part on the worktable and minimize vibrations from the high-speed cutting tool – these may result in chatter marks and decreased accuracy due to the shape wandering.

Milling tips for plastic

- Climb milling, also known as down milling, is recommended over conventional milling.
- Sufficient fixturing on the mill bed allows fast table travel and high spindle speeds.
- The shape should not be fixed too tightly, however, as it may deform or spring.
- When face milling, use positive geometry cutter bodies.

Sawing

Sawing is a machining method that involves cutting a material into multiple pieces using a bandsaw, table saw, or other specialized equipment.

Sawing plastic vs metal. The primary difference between sawing plastic vs. metal is that the heat generated by the saw blade can negatively impact the plastic parts due to lower softening and melting temperatures. It is crucial to account for the speed of the blade, the thermal properties of the material, and the thickness of the shape when sawing plastic.

Tips for selecting a saw tool

- Band saws are versatile and perform well for straight, continuous curves, and irregular cuts.
- Table saws are convenient for straight cuts and can be used to cut multiple thicknesses and thicker cross sections – up to 4” with adequate horsepower.

Tips for selecting a saw blade

- Rip and combination blades with a 0° tooth rake and 3° to 10° tooth set are best for general sawing in order to reduce frictional heat.
- Hollow ground circular saw blades without set will yield smooth cuts up to 3/4” thickness.
- Tungsten carbide blades wear well and provide optimum surface finishes.

Machining Guidelines

Drilling and Boring

What is drilling? What is boring?

Drilling is a machining method that creates cylindrical holes and throughholes by means of a pointed helical tool. Boring is a secondary process for enlarging or finishing drilled holes.

Drilling and boring plastic vs. metal

The heat insulating characteristics of plastics require consideration during drilling operations, especially when the depth of the hole is greater than twice its diameter. Excessive heat build-up may result in chipping, rough surfaces, and inadequate tolerances.

Drilling tips for plastic

For small diameter holes (1/32" to 1" dia.)

- High-speed steel twist drills are generally sufficient.
- Frequent pullout (peck drilling) is suggested to improve swarf removal.
- A slow spiral (low helix) drill will allow for better swarf removal.

For large diameter holes (1" and greater)

- A slow spiral (low helix) drill or general-purpose drill bit ground to a 118° point angle with 9° to 15° lip clearance is recommended. The lip rake should be ground (dubbed off) and the web thinned.
- Avoid hand feeding - drill grabbing can result in microcracks.
- It is generally best to drill a pilot hole (maximum 1/2"dia.) using 600 to 1,000 rpm and positive feed of 0.005" to 0.015" per revolution.
- Secondary drilling at 400 to 500 rpm at 0.008" to 0.020" per revolution is required to expand the hole to larger diameters.

For especially notch-sensitive materials (such as Ertalyte® PET-P and glass reinforced materials)

- A two-step process involving both drilling and boring minimizes heat build-up and reduces the risk of cracking.
- First, drill a 1" diameter hole using an insert drill at 500 to 800 rpm with a feed rate of 0.005" to 0.015" per revolution.
- Next, bore the hole to final dimensions using a boring bar with carbide insert with 0.015" to 0.030" radii at 500 to 1,000 rpm and feed rate of 0.005" to 0.010" per revolution.

Machining Guidelines

Reaming

Most of the engineering plastics can be reamed with either hand or collar reamers to produce holes with good finish and accurate dimensions. Expansion type reamers and standard .001-.002" oversize stub machine reamers can also be used. Helical flute reamers are recommended if there is an interruption in the I.D.. Cuts made with a fixed reamer tend to be undersized unless at least .005" is removed by the final reaming. With a .01-.02" per revolution feed rate and a .005-.01" depth of cut, reamer speeds of 250-450 fpm are recommended.

Reaming PTFE / TFE is generally not recommended. The operation causes the material to compress, especially if the reamer is not exceptionally sharp. Also, PTFE's elasticity will cause holes to "fall in" creating undersize holes. If necessary, special reamers with a primary relief (clearance) angle can produce accurate holes. The use of an oversized reamer can correct undersized holes. Where hole diameter permits, a single point boring tool is recommended to finish the hole to close tolerances.

Turning

What is turning?

Turning is a machining process in which a plastic shape is rotated around a stationary lathe. Turning is especially useful for machining parts that are symmetrical along a common rotational axis.

Turning plastic vs. metal

As with other plastic machining processes, turning generates heat. In order to prevent damage to a plastic part, rotation speed, tool selection, and coolants should all be considered carefully along with the thermal properties of the material.

Turning tips for plastic

- Turning operations require inserts with positive geometries and ground peripheries.
- Ground peripheries and polished top surfaces generally reduce material build-up on the insert, improving the attainable surface finish.
- A fine-grained C-2 carbide is often recommended for plastic turning operations.

Machining Guidelines

Coolants

Coolants are generally not required for most machining operations (not including drilling and parting off). However, for optimum surface finishes and close tolerances, non-aromatic, water soluble coolants are suggested. Spray mists and pressurized air are very effective means of cooling and cutting interface. General purpose petroleum based cutting fluids, although suitable for many metals and plastics, may contribute to stress cracking of amorphous plastics such as PC 1000 Polycarbonate, PSU 1000 Polysulfone, Ultem® 1000 PEI, and Radel® R PPSU.

Coolant tips for plastics

- Coolants are strongly suggested during drilling operations, especially with notch sensitive materials such as Ertalyte® PET-P, Torlon® PAI, Celazole® PBI and glass or carbon reinforced products.
- In addition to minimizing localized heat-up, coolants prolong tool life. Two (flood) coolants suitable for most plastics are Trim 9106CS (Master Chemical Corp. - Perrysburg, OH) and Polycut (Tullco -Savannah, GA). A generally suitable mist coolant is Astro-Mist 2001A (Monroe Fluid Technology - Hilton, NY).

Post Annealing

If during the machining process significant material is removed, annealing is recommended to relieve machined-in-stress and minimize possibility of premature part failure.

Acrylic parts should be annealed at 175°F only after fabrication and polishing are completed. Anneal 10 hours for thicknesses up to .150", an additional 30 minutes for each 1/4" up to 1-1/2", and an additional hour for each 1/4" thereafter. Parts should be supported while annealing takes place in an air medium. Slow cooling is also highly recommended.

Delrin® should be air annealed at 320°F for 30 minutes plus 5 minutes per 0.04" of wall thickness. It is important that the parts be uniformly heated and the oven capable of controlling the circulating air temperature to ±5°F. Oil annealing in an oil circulating bath at 320°F will require 15-20 minutes to come up to temperature plus 5 minutes per 0.04" of wall thickness. Uniform heating is important, and the parts should be restrained from contact with each other and the walls of the bath.

Nylon should be annealed in the absence of air, preferably by immersion in a suitable liquid. A temperature of 300°F is often used for general annealing. Annealing time is 15 minutes per 1/8" of cross-section. When removed from the bath, the material should be allowed to cool in the absence of drafts. The choice liquid to be used as the heat transfer medium should be based on the following considerations:

- Heat range and stability should be adequate
- Should not attack Nylon
- Should not give off noxious fumes or vapors
- Should not present a fire hazard
- High boiling hydrocarbons, such as oils and waxes, may be used

Trouble Shooting - Drilling

DIFFICULTY	COMMON CAUSE
Tapered Hole	1. Incorrectly sharpened drill 2. Insufficient clearance 3. Feed to heavy
Burnt or Melted Surface	1. Wrong type drill 2. Incorrectly sharpened drill 3. Feed to light 4. Dull drill 5. Web too thick
Chipping of Surfaces	1. Feed to heavy 2. Clearance too great 3. Too much rake (thin web as descibed)
Chatter	1. Too much clearance 2. Feed light 3. Drill overhang too great 4. Too much rake (thin web as descibed)
Feed marks or Spiral lines on Inside Diameter	1. Feed too heavy 2. Drill not centered 3. Drill ground off-center
Oversize Holes	1. Drill ground off-center 2. Web too thick 3. Insufficient clearance 4. Feed rate to heavy 5. Point angle too great
Undersize Holes	1. Dull drill 2. Too much clearance 3. Point angle too small
Holes Not Concentric	1. Feed to heavy 2. Spindle speed to slow 3. Drill enters next piece too far 4. Cut-off tool leaves nib, which deflects drill 5. Web too thick 6. Drill speed to heavy at start 7. Drill not mounted on center 8. Drill not sharpened correctly
Burr at Cut-off	1. Dull cut-off tool 2. Drill does not pass completely through piece
Rapid Dulling of Drill	1. Feed too light of drill 2. Spindle speed to fast 3. Insufficient lubrication from coolant

Trouble Shooting - Turning & Boring

DIFFICULTY	COMMON CAUSE
Melted Surface	1. Tool dull or heel rubbing 2. Insufficient side clearance 3. Feed rate to slow 4. Spindle speed to fast
Rough Finish	1. Feed to heavy 2. Incorrect clearance angles 3. Sharp point on tool (slight nose radius required) 4. Tool not mounted on center
Burrs at Edge of Cut	1. No chamfer provided at sharp corners 2. Dull tool 3. Insufficient side clearance 4. Lead angle not provided on tool (tool should ease out of cut gradually, not suddenly)
Cracking or Chipping of Corners	1. Too much positive rake on tool 2. Tool not eased into cut (tool suddenly hits work) 3. Dull tool 4. Tool mounted below center 5. Sharp point on tool (slight nose radius required)
Chatter	1. Too much nose radius on tool 2. Tool not mounted solidly 3. Material not supported properly 4. Width of cut too wide (use 2 cuts)

Trouble Shooting - Cutting Off

DIFFICULTY	COMMON CAUSE
Melted Surface	1. Dull tool 2. Insufficient side clearance 3. Insufficient coolant supply
Rough Finish	1. Feed to heavy 2. Tool improperly sharpened 3. Cutting edge not honed
Spiral Marks	1. Tool rubs during its retreat 2. Burr on point of tool
Concave or Convex Surfaces	1. Point angle to great 2. Tool not perpendicular to spindle 3. Tool deflecting 4. Feed to heavy 5. Tool mounted above/below center
Nibs or Burrs at Cut-off Point	1. Point angle not great enough 2. Tool dull 3. Feed too heavy
Burrs on Outside Diameter	1. No chamber before cut-off diameter 2. Dull tool

Saw Cutting - Kerf Line

Whenever you cut up a full sheet of material into smaller pieces you lose some material due to the thickness of the blade. When the saw enters the material it chews up the material it is cutting through. This is referred to as the "Kerf Line" or wasted material. In order to properly yield out the correct amount of pieces one can expect from a full sheet you need to know how much Kerf to account for. The majority of our blades for our CNC Saws are .187"thick. You also need to factor in the cut tolerance as well, our standard cut tolerance is +1/16" / -0". With tolerances you want to shoot for the middle of the tolerance, so you have some flexibility either way.

Saw Blade (.187"thk) + Tolerance (.063") = .250" KERF Line.

We would then take the Kerf Line and add that number to each of our cut dimensions. For example, say our finished size is 7" x 11", and we will be cutting these out of 48" x 96" full sheets. So if you take the cut sizes and add the Kerf line you can then properly figure out the best possible yield from a full sheet of material.

7.00" + .250" = 7.250" and 11.00" + .250" = 11.250"

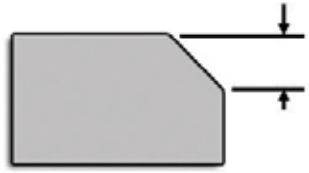
Now we take our full sheet sizes and divide them by the cut pieces with Kerf factored in to figure out the best possible yield.

48" / 7.250" = 6 pcs and 96" / 11.250" = 8 pcs. Full sheet yield = 48 pcs
48" / 11.250" = 4 pcs and 96" / 7.250" = 13 pcs. Full sheet yield = 52 pcs.

So the best yield is the second example, we could get 52 pcs from one full sheet of material if we cut it this way. If the total job was for 200 pcs, then we would need 4 sheets of material in order to get the 200+ pcs required. This is the same method we use when we are quoting our customers on any cut-to-size job.

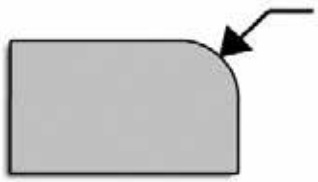
The "kerf" line can be seen in the above photo. Notice the faint line following the blade, that is the kerf line, where the blade cut through the sheet of plastic material.

Standard Edge Finishes



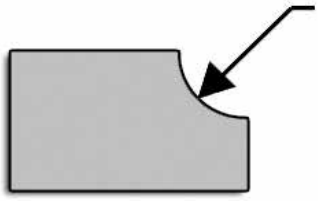
CHAMFERED EDGE CUT

Generally called out as 1/8" x 45 degrees or 1/8" x 1/8". The typical chamfer cut uses a 45 degree bit, but some prints do call out different degrees. The chamfer dimension is generally called out from the surface of the material down to the specific size.



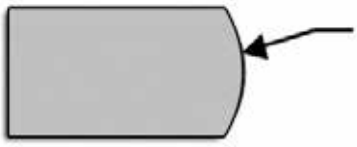
ROUND OVER EDGE

Usually used to break a sharp edge leftover from machining the part. By going back thru and rounding over the edges it reduces the chance of getting your hand cut or sliced. Ideal for work surfaces or some machine guards. Generally called out by the size of the Radius needed, ex. 1/8" Radius.



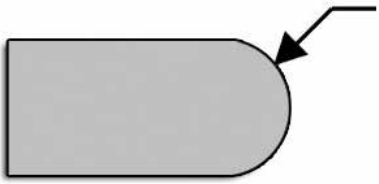
REVERSE RADIUS EDGE

Not as common as the others, more for decoration than anything else. Basically just come by with a ball-end cutter and drop it down to the desired depth. May have seen these on a picture frame or something similar.



FINGERNAIL EDGE CUT

Similar to the Full Radius (below), it is a little less round. The radius is always larger than half the thickness of the material. So the radius does not blend into the thickness smoothly, it ends abruptly. Still leaves a nice rounded edge to reduce any sharp corners. This cut is a lot easier to do than the Full Radius.



FULL RADIUSED EDGE

In the case of the Full Radius, the radius is exactly half the size of the thickness of the material or the diameter and thickness are the same size. This allows the radius to flow perfectly and smoothly into the thickness of the material. This is a very hard cut for most Plastics, since the thickness of the material can vary as much as +/-10% on some Plastics.

Reference

Trade Names, Chemical Resistance and More

Product Compliance ..... 13-2 to 13-3

Compliance Chart ..... 13-4 to 13-5

Key Suppliers 13-6

Chemical Resistance 1 ..... 13-7 to 13-17

Chemical Resistance 2 ..... 13-18 to 13-23

Plastic Weight Charts ..... 13-24 to 13-25

Terminology ..... 13-26 to 13-30

Product Compliance

Plastic materials are commonly used in processing equipment and products requiring various types of regulatory agency compliance. Our suppliers routinely work with these agencies to assure the widest variety of our products are recognized as being compliant - giving designers the broadest selection of canidate materials.

A brief overview of the six most common agencies is provided below. Additionaly, we have specific product listings with Underwriters Laboratories (UL), American Bureau of Shipping (ABS), ASTM and many global manufacturers.

Alro Plastics and our Suppliers can work with customers to develop unique product and quality specifications requiring testing, inspection and certifications. Such requests should be directed to Alro Plastics at (800) 877-2576.

FDA

FDA (Food & Drug Association) takes responsibility for determining whether and how manufactured materials may be used in contact with food products. Definitions for proper use are found in a series of regulations published annually under Government Regulations CFR 21. The FDA provides certain specifications regarding composition, additives, and properties. A material which meets these standards can then be stated as FDA COMPLIANT. End-users should note that it is their responsibility to use the product in a manner compatible with FDA guidelines.

USDA

USDA (U.S. Department of Agriculture) has jurisdiction over equipment used in federally inspected meat and poultry processing plants, and over packaging materials used for such products. Materials used in this equipment are approved on an individual basis. Determining suitabiliy for use of components and the materials from which they are made is the responsibility of the equipment manufacturer. On request, Alro will supply a "letter of guarantee" for a specific product listed as USDA compliant. This letter certifies that the material meets applicable FDA criteria. Supporting documentation as may be required by the Food Safety Inspection Service of USDA, is also available.

Canada AG

Agriculture Canada (Food Protection and Inspection Branch of the Candadian Government) is the Canadian government agency equivalent to the USDA. As with the USDA, plastic materials are approved per material for a group of related applications, such as Acetron® GP acetal (material) for meat and poultry processing (application).

3A-Dairy

3A-Dairy is a voluntary organization that provides standards of construction for milk, cheese, butter and ice cream processing equipment.

The organization covers the requirements of plastic materials for multiple use as product contact surfaces in equipment for production, processing, and handling of milk and milk products. The criteria for approval of plastic materials are specified in 3A standard 20-18, and include: cleanability, bacterial treatment, repeat use conditions, and FDA compliance. Materials are tested for compliance by the material supplier. Supporting documentation must be available as required by a food inspector.

Product Compliance

NSF

NSF (National Sanitation Foundation) sets standards for all direct and indirect drinking water additives. Manufacturers who provide equipment displaying the NSF symbol have applied to the NSF for device approval to a specific standard. The approval is issued for the finished product (device) in a specific use (application). To obtain device approval, all components within the device must comply with the Standard. Establishing compliance of the equipment's components can be accomplished in one of two ways:

1. The component has been tested to the Standard by the component supplier and is certified as such.
2. The equipment manufacturer must supply documentation that the component meets the Standard. If any testing is required, it must be completed by the equipment manufacturer.

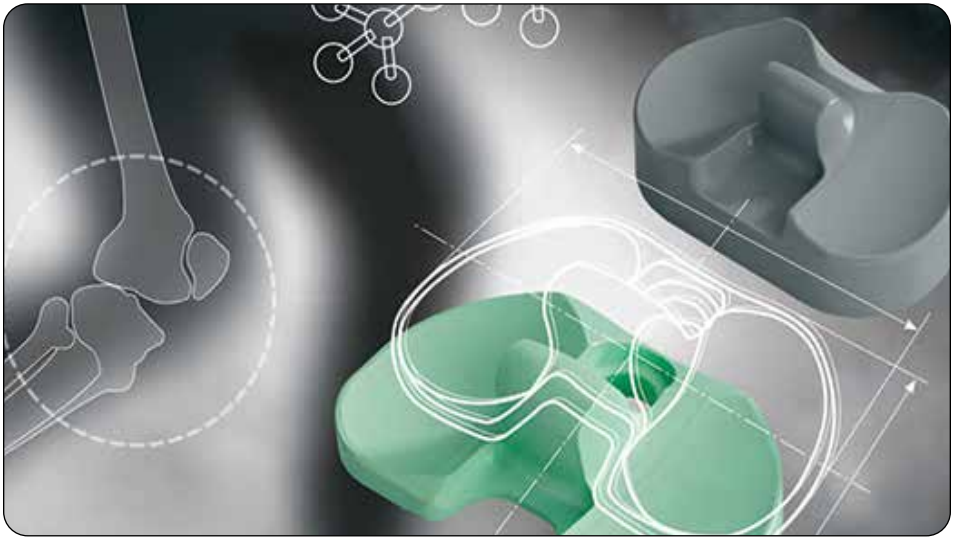
The NSF maintains numerous standards. Two standards which we frequently encounter and to which some of our products have been tested are:

51 Plastics in Food Equipment

61 Drinking Water System Components - Health Effects

USP Class VI

USP (U.S. Pharmacopoeia) Class VI judges the suitability of plastic material intended for use as containers or accessories for parenteral preperations. Suitability under USP Class VI is typically a base requirement for medical device manufacturers.



Product Compliance

MATERIAL NAME	PRODUCT FAMILY	COLOR	FDA	USDA
Acetron® GP	Acetal	Natural	YES	YES
Delrin®	Acetal	Natural	YES	YES
Delrin® AF Blend	Acetal	Brown	NO	NO
Ertalyte® PET-P	Polyester	Natural	YES	YES
Ertalyte® PET-P	Polyester	Black	YES	YES
Ertalyte® TX	Polyester	Gray	YES	YES
Fluorosint® 207	PTFE	Natural	YES	YES
Fluorosint® 500	PTFE	Natural	NO	NO
Ketron® PEEK	PEEK	Natural	YES	YES
MC® 901	Nylon 6	Blue	NO	NO
MC® 907	Nylon 6	Natural	YES	YES
Nylatron® GS	Nylon 6/6	Black-Grey	NO	NO
Nylatron® GSM	Nylon 6	Black-Grey	NO	NO
Nylatron® GSM Blue	Nylon 6	Dark Blue	NO	NO
Nylatron® NSM	Nylon 6	Grey	NO	NO
Nylon 101®	Nylon 6/6	Natural	YES	YES
Polycarbonate	PC	Natural	NO	NO
Polysulfone	PS	Natural	YES	YES
Radel® R	PPSU	Natural	NO	NO
Techtron®	PPS	Natural	NO	NO
Ultem® 1000	PEI	Natural	YES	YES
TIVAR® 1000	UHMW-PE	Natural	YES	YES
TIVAR® Oil Filled	UHMW-PE	Brown	YES	YES
TIVAR® Oil Filled	UHMW-PE	Gray	YES	YES
TIVAR® Clean Stat	UHMW-PE	Black	YES	YES
Proteus® Homopolyer	Polypropylene	Natural	YES	NO
Proteus® Homopolyer	Polypropylene	White	YES	NO
Proteus® Copolyer	Polypropylene	Natural	YES	NO
Proteus® White Flame Retardant 18G	Polypropylene	White	NO	NO
LDPE (Low Density)	Polyethylene	Natural	YES	NO
HDPE (High Density)	Polyethylene	Natural	YES	NO
HDPE (High Density)	Polyethylene	Black	NO	NO
Sanalite® Cutting Board (HDPE)	Polyethylene	Natural	YES	YES
Polytetrafluoroethylene (PTFE)	PTFE	White	YES	YES

Celazole® PBI, Torlon® PAI and all fiber-reinforced (i.e. glass, carbon) materials available from Mitsubishi Chemical Group are neither FDA, USDA, nor 3-A Dairy compliant. No Mitsubishi Chemical Group materials are suitable for implantable devices.

Product Compliance

NSF	3A-DAIRY	CANADA AG	USP CLASS VI	TYPICAL APPLICATIONS (STRUCTURAL & WEAR)
STD 51 & 61	YES	YES	NO	BOTH
STD 61	NO	YES	NO	BOTH
NO	NO	NO	NO	BEARING & WEAR
NO	YES	YES	NO	BOTH
NO	NO	NO	NO	BOTH
NO	YES	NO	NO	BOTH
NO	NO	NO	NO	BEARING & WEAR
NO	NO	NO	NO	BOTH
NO	YES	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	YES	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BEARING & WEAR
NO	NO	NO	NO	BEARING & WEAR
NO	NO	NO	NO	BEARING & WEAR
STD 61	YES	NO	NO	BOTH
NO	NO	NO	NO	STRUCTURAL
STD 61	YES	NO	YES	STRUCTURAL
NO	NO	NO	YES	STRUCTURAL
NO	NO	NO	NO	STRUCTURAL
STD 51	NO	NO	YES	STRUCTURAL
YES	YES	YES	---	WEAR
NO	NO	NO	NO	WEAR
NO	NO	NO	NO	WEAR
NO	NO	NO	NO	WEAR
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
NO	NO	NO	NO	BOTH
YES	NO	NO	NO	WEAR
YES	YES	NO	NO	WEAR

Celazole® PBI, Torlon® PAI and all fiber-reinforced (i.e. glass, carbon) materials available from Mitsubishi Chemical Group are neither FDA, USDA, nor 3-A Dairy compliant. No Mitsubishi Chemical Group materials are suitable for implantable devices.

Key Suppliers / Manufacturers

CAST NYLONS LIMITED

Ensinger

KING King Plastic Corporation
Our Innovation. Your Imagination.®

MITSUBISHI CHEMICAL GROUP

PLASKOLITE, INC.

POLYMER INDUSTRIES
GEARED TOWARDS EXCELLENCE

RÖCHLING
Engineered Plastics

SIMONA

STRONGWELL

Westlake plastics
LIFE IN POLYMERS

ZL ENGINEERING PLASTICS

member iapd
international association of plastics distribution

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Acetate Solvents Pure	1	1	NR	2	NR	NR	1	2	NR	NR	NR	NR	NR
Acetaldehyde	2	3	NR	2	3	*	*	*	NR	NR	NR	NR	NR
Acetamide	*	*	*	1	2	*	*	*	NR	NR	*	*	*
Acetic Solvents Crude	*	*	*	2	NR	NR	*	*	NR	NR	NR	NR	NR
Acetic Solvents Pure	1	1	NR	2	NR	NR	*	*	NR	NR	NR	NR	NR
Acetic Acid 10%	1	2	NR	1	1	1	1	1	1	1	1	2	NR
Acetic Acid 20%	1	2	NR	1	1	1	1	1	1	1	1	NR	NR
Acetic Acid 50%	1	2	NR	1	1	1	1	2	3	NR	NR	NR	NR
Acetic Acid 80%	1	2	NR	1	1	1	2	2	NR	NR	NR	NR	NR
Acetic Acid Glacial	1	2	NR	1	1	2	1	1	NR	NR	NR	NR	NR
Acetic Anhydride	1	1	NR	2	NR	NR	NR	NR	NR	NR	NR	NR	NR
Acetone	1	1	NR	1	1	2	NR	NR	NR	NR	NR	NR	NR
Acetophenone	3	3	*	2	2	NR	*	*	NR	NR	*	*	*
Acetyl Chloride	*	*	*	*	*	*	*	*	NR	NR	NR	NR	NR
Acetylene	*	*	*	1	*	*	*	*	1	1	1	1	*
Acrylonitrile	*	*	*	1	2	*	*	*	*	*	*	*	*
Adipic Acid	*	*	*	1	2	2	*	*	1	1	1	1	*
Alcohol Allyl	1	NR	NR	2	2	*	2	2	NR	NR	NR	NR	NR
Alcohol Amyl	1	NR	NR	1	2	*	1	2	NR	NR	2	NR	NR
Alcohol Butyl	1	1	1	1	1	2	1	1	NR	NR	2	NR	NR
Alcohol Ethyl	1	1	1	1	1	2	2	NR	1	1	1	1	1
Alcohol Methyl	*	*	*	1	1	1	1	1	1	1	1	1	1
Alcohol Propyl	*	*	*	1	*	*	2	NR	1	NR	1	*	*
Allyl Chloride	1	3	*	2	*	*	2	NR	NR	NR	NR	NR	NR
Alum	1	1	*	1	1	1	1	1	1	1	1	1	1
Alum Ammonium	*	*	*	1	1	1	1	1	NR	NR	NR	NR	NR
Alum Chrome	*	*	*	1	1	1	1	1	1	1	1	1	1
Alum Potassium	*	*	*	1	1	1	1	1	1	1	1	1	1
Aluminum Chloride	1	1	Boiling	1	1	1	1	1	1	1	1	1	1
Aluminum Fluoride	1	1	*	1	1	1	1	1	1	1	1	1	
Aluminum Hydroxide	1	1	*	1	1	1	1	*	1	1	1	1	1
Aluminum Nitrate	*	*	*	1	1	1	1	*	1	1	1	1	1
Aluminum Sulfate	1	1	Boiling	1	1	*	1	2	1	1	1	1	1
Ammonia Anhydrous	1	1	*	1	1	1	*	*	2	NR	*	*	*
Ammonia Aqueous	1	1	*	1	1	1	*	*	1	1	1	1	*
Ammonium Bifluoride	*	*	*	1	1	1	1	1	1	1	1	1	*
Ammonium Carbonate	1	*	*	1	1	1	1	1	1	1	1	1	*
Ammonium Chloride	1	1	Boiling	1	1	2	1	1	1	1	1	1	*
Ammonium Fluoride 10%	*	*	*	1	1	1	1	1	1	1	1	1	*
Ammonium Fluoride 25%	*	*	*	1	1	1	1	1	NR	NR	NR	NR	NR
Ammonium Hydroxide	1	1	*	1	1	1	1	1	1	1	1	1	*
Ammonium Metaphosphate	*	*	*	1	1	1	1	1	1	1	1	1	*
Ammonium Nitrate	1	1	1	1	1	1	1	1	1	1	1	1	*
Ammonium Persulfate	1	1	*	1	1	1	1	1	1	1	1	1	*
Ammonium Phosphate	1	*	*	1	1	1	1	1	1	1	1	1	*
Ammonium Sulfate	1	1	Boiling	1	1	1	1	1	1	1	1	1	*
Ammonium Sulfide	*	*	*	1	1	1	*	*	1	1	1	1	*
Amyl Acetate	1	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Amyl Chloride	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Aniline	1	2	3	1	3	3	NR	NR	NR	NR	NR	NR	NR
Aniline Hydrochloride	*	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Antimony Trichloride	1	*	*	1	1	1	1	1	1	NR	NR	NR	NR
Aqua Regia	2	3	NR	2	NR	NR	NR	NR	3	NR	NR	NR	NR
Arsenic Acid	1	*	*	1	1	1	1	1	1	1	1	1	*
Barium Carbonate	*	*	*	1	1	1	1	1	1	1	1	1	*
Barium Chloride	1	*	*	1	1	1	1	1	1	1	1	1	*
Barium Hydroxide	1	1	*	1	1	2	1	1	1	1	1	1	*
Barium Sulfate	1	*	*	2	NR	NR	1	1	1	2	1	1	1
Barium Sulfide	1	1	*	1	1	1	1	1	1	2	1	1	1
Beer	1	1	1	1	1	1	1	1	1	1	1	1	1
Beet Sugar Liquors	*	*	*	1	2	*	1	1	1	1	1	1	1
Benzaldehyde	1	*	*	1	NR	NR	NR	NR	NR	NR	NR	NR	NR
Benzene	3	NR	*	3	NR	NR	NR	NR	NR	NR	NR	NR	NR
Benzene Sulfonic Acid	1	1	*	2	NR	NR	NR	NR	1	1	1	1	*
Benzoic Acid	1	1	*	1	NR	NR	1	*	1	2	1	1	*
Benzyl Alcohol	1	1	1	1	3	NR	*	*	NR	NR	NR	NR	NR
Benzyl Chloride	*	*	*	1	1	2	*	*	2	NR	*	*	*
Bismuth Carbonate	*	*	*	1	1	1	1	1	1	1	1	1	1
Borax	1	1	*	1	1	2	1	1	1	1	1	1	*
Boric Acid	1	1	*	1	1	1	1	1	1	1	1	1	*
Bromine Liquid	*	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Bromine Water	3	*	1	NR	NR	NR	NR	NR	1	1	NR	NR	NR
Butadiene	3	NR	NR	NR	NR	NR	2	*	NR	NR	1	1	*
Butane	1	*	*	1	NR	NR	2	*	2	NR	1	NR	NR
Butyl Acetate	1	*	*	2	NR	NR	NR	NR	NR	NR	NR	NR	NR
Butyl Alcohol	1	1	1	1	1	1	2	2	NR	NR	1	NR	NR
Butylene	1	*	*	2	NR	NR	2	*	3	NR	2	NR	NR
Butyl Phenol	*	*	*	2	*	*	2	*	NR	NR	2	NR	NR
Butyne Diol	*	*	*	1	1	*	2	*	1	NR	1	NR	NR
Butyric Acid	1	2	*	1	1	1	2	*	NR	NR	1	NR	NR
Butyl Amine	*	*	*	2	*	*	*	*	NR	NR	*	*	*
Butyl Ether	*	*	*	NR	NR	NR	*	*	1	1	*	*	*
Butyl Chloride	*	*	*	NR	NR	NR	*	*	*	*	*	*	*
Butyl Phthalate	1	*	*	2	2	*	*	*	2	NR	*	*	*
Calcium Bisulfide	*	*	*	1	1	1	1	1	1	1	1	1	1
Calcium Bisulfite	1	*	*	1	1	1	1	1	1	1	1	1	1
Calcium Carbonate	*	*	*	1	1	1	1	1	1	1	1	1	1
Calcium Chlorate	*	*	*	1	1	1	1	1	1	1	1	1	*
Calcium Chloride	1	1	1	1	1	1	1	1	1	1	1	1	1
Calcium Hyrdroxide	1	1	Boiling	1	1	2	1	1	1	1	1	1	1
Calcium Hypochlorite	1	1	Boiling	1	2	2	1	1	1	1	1	1	*
Calcium Nitrate	*	*	*	1	1	1	1	1	1	1	1	1	*
Calcium Sulfate	1	1	*	1	1	1	1	1	1	1	1	1	1
Carbolic Acid	1	*	*	1	1	2	1	1	1	1	1	1	*
Carbolic Dioxide	1	1	*	1	1	1	1	1	1	1	1	1	1
Carbolic Disulfide	NR	*	*	NR	NR	NR	2	2	NR	NR	NR	NR	NR

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2 15-30% loss in propery values. Minor chemical attack.

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NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Carbon Monoxide	*	*	*	1	1	1	1	1	1	1	1	1	1
Carbon Tetrachloride	3	*	*	2	3	NR	NR	NR	NR	NR	NR	NR	NR
Castor Oil	*	*	*	1	3	NR	1	1	1	1	1	1	NR
Caustic Potash	1	1	*	1	1	1	1	1	1	1	1	1	1
Caustic Soda	1	1	1	1	2	2	1	*	1	1	1	1	*
Cellosolves	*	*	*	2	3	NR	2	*	1	2	1	2	*
Chloral Hydrate	*	*	*	1	*	*	2	*	1	1	1	1	*
Chloric Acid	*	*	*	NR	NR	NR	*	*	1	3	1	2	*
Chlorinated Water	1	1	*	2	3	*	*	*	1	3	*	*	*
Chlorine Dry	2	*	*	3	*	1*	NR	NR	NR	NR	NR	NR	NR
Chlorine Wet	2	2	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chloroacetic Acid	NR	*	*	1	1	*	2	*	2	3	1	2	NR
Chlorobenzene	2	NR	*	3	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chloroform	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chlorosulfonic Acid	NR	*	*	3	NR	NR	NR	NR	3	NR	2	NR	NR
Chrome Alum	*	*	*	1	1	NR	1	1	1	1	1	1	NR
Chromic Acid 10%	1	1	Boiling	1	1	2	1	NR	NR	NR	NR	NR	NR
Chromic Acid 30%	1	1	Boiling	1	NR	NR	1	NR	NR	NR	NR	NR	NR
Chromic Acid 40%	1	1	Boiling	1	NR	NR	*	*	NR	NR	NR	NR	NR
Chromic Acid 50%	1	1	Boiling	1	NR	NR	1	NR	NR	NR	NR	NR	NR
Citric Acid	1	1	3	1	1	1	1	1	1	2	1	1	1
Coconut Oil	*	*	*	1	1	*	1	1	1	1	1	1	1
Copper Carbonate	*	*	*	1	1	1	*	*	1	1	1	1	1
Copper Chloride	1	*	*	1	1	1	1	1	1	1	1	1	1
Copper Cyanide	1	*	*	1	1	1	1	1	1	1	*	*	*
Copper Fluoride	*	*	*	1	1	1	1	1	1	1	1	1	1
Copper Nitrate	1	*	*	1	1	1	1	1	1	2	1	1	1
Copper Sulfate	1	1	*	1	1	1	1	1	1	2	1	1	1
Cottonseed Oil	1	2	*	1	1	1	1	1	1	1	1	1	1
Cresol	*	*	*	NR	NR	NR	NR	NR	NR	NR	2	NR	NR
Cresylic Acid	1	*	*	NR	NR	NR	NR	NR	NR	NR	2	NR	NR
Croton Aldehyde	1	1	*	1	NR	NR	2	*	NR	NR	NR	NR	*
Crude Oil	1	2	*	1	2	*	NR	NR	1	1	1	1	*
Cyclohexane	1	1	*	3	NR	NR	*	*	2	NR	1	*	*
Cyclohexanol	1	1	1	2	*	*	*	*	NR	NR	NR	NR	NR
Cyclohexanone	1	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Detergent	1	1	1	1	1	1	1	1	1	1	1	1	*
Dextrin	*	*	*	1	1	*	1	1	1	1	1	1	*
Dextrose	1	*	*	1	1	*	1	1	1	1	1	1	*
Diacetone Alcohol	*	*	*	1	2	*	*	*	NR	NR	NR	NR	NR
Diazo Salts	1	1	*	1	1	*	1	1	1	1	1	1	*
Dibutyl Phthalate	1	1	*	1	2	NR	*	*	NR	NR	NR	NR	NR
Dichlorobenzene	*	*	*	3	NR	NR	*	*	3	NR	*	*	*
Dichlorordifluoro Methane	*	*	*	1	2	*	*	*	1	NR	*	*	*
Dichloroethylene	NR	*	*	1	NR	NR	*	*	NR	NR	NR	NR	NR
Dichlorothane	3	*	Boiling	1	*	*	*	*	NR	NR	*	*	*
Diesel Fuel	1	1	NR	1	2	NR	*	*	1	2	1	2	NR
Diethylamine	*	*	*	1	2	2	2	*	NR	NR	NR	NR	NR

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Diethylene Glycol	*	*	*	1	1	1	*	*	3	NR	*	*	*
Diethyl Cellosolve	*	*	*	*	*	*	*	*	*	*	*	*	*
Diethyl Ether	1	*	*	NR	NR	NR	*	*	NR	NR	NR	NR	NR
Diglycolic Acid	*	*	*	1	NR	NR	*	*	1	1	1	1	*
Dimethylamine	*	*	*	1	1	*	2	*	NR	NR	NR	NR	NR
Dimethyl Formamide	1	*	*	1	1	*	*	*	NR	NR	NR	NR	NR
Dimethyl Sulfoxide	*	*	*	1	2	*	*	*	NR	NR	*	*	*
Dioctyl Phthalate	*	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dioxane 1,4	*	*	*	1	NR	NR	NR	NR	NR	NR	NR	NR	NR
Diphenyl	*	*	*	NR	*	*	*	*	*	*	*	*	*
Diphenyl Ether	*	*	*	NR	*	*	*	*	NR	*	*	*	*
Diphenyl Oxide	*	*	*	*	*	*	*	*	NR	*	2	*	*
Dipropylene Glycol	*	*	*	1	2	*	*	*	2	3	*	*	*
Distilled Water	1	1	1	1	1	1	1	1	1	1	1	1	1
Dizynilbenzene	*	*	*	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Epichlorohydrin	*	*	*	1	1	*	*	*	NR	NR	NR	NR	NR
Ethane	1	*	*	3	*	*	*	*	NR	*	NR	NR	NR
Ethanolamine	*	*	*	1	1	2	*	*	3	*	*	*	*
Ethers	2	*	*	NR	*	*	*	*	NR	*	*	*	*
Ethyl Acetate	1	1	NR@140	1	1	2	2	*	NR	*	NR	NR	NR
Ethyl Acetoacetate	*	*	*	NR	*	*	*	*	NR	NR	NR	NR	NR
Ethyl Acrylate	*	*	*	NR	*	*	2	NR	NR	NR	NR	NR	NR
Ethyl Alcohol	*	*	*	1	1	2	2	NR	1	1	1	2	*
Ethyl Benzene	1	*	*	NR	*	*	*	*	NR	*	*	*	*
Ethyl Benzoate	*	*	*	2	3	*	*	*	NR	*	*	*	*
Ethyl Butyrate	*	*	*	2	NR	*	*	*	NR	*	*	*	*
Ethyl Chloride	*	*	*	NR	*	*	NR	*	NR	*	NR	NR	*
Ethyl Ether	NR	*	*	3	NR	*	NR	*	3	NR	NR	NR	NR
Ethyl Sulfate	*	*	*	*	*	*	*	*	*	*	*	*	*
Ethylene Bromide	*	*	*	NR	NR	NR	NR	NR	NR	*	NR	*	*
Ethylene Chloride	2	NR	*	3	NR	*	*	*	NR	*	NR	NR	*
Ethylene Chlorohydrine	*	*	*	NR	*	*	NR	NR	NR	*	NR	NR	*
Ethylene Diamine	1	*	*	1	*	*	NR	*	NR	*	NR	*	*
Ethylene Dibromide	*	*	*	2	*	*	*	*	NR	*		*	*
Ethylene Dichloride	3	*	*	2	3	NR	NR	*	NR	NR	NR	NR	*
Ethylene Glycol	1	1	1	1	1	1	1	1	1	1	1	1	1
Ethylene Oxide	1	3	*	2	3	*	NR	NR	NR	*	NR	*	*
Fatty Acids	1	1	*	1	1	1	1	1	1	1	1	1	1
Ferric Chloride (concent)	1	1	Boiling	1	1	1	1	1	1	1	1	1	1
Ferric Nitrate	1	*	*	1	1	1	1	1	1	1	1	1	1
Ferric Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	1
Ferrous Chloride	1	*	*	1	1	1	1	1	1	1	1	1	1
Ferrous Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	1
Fish Solubles	1	1	1	1	1	1	1	1	1	1	1	1	1
Fluoboric Acid	1	1	*	1	1	1	1	*	1	1	1	1	*
Fluorine Gas (dry)	NR	NR	NR	NR	*	*	1	*	NR	NR	1	*	*
Fluorine Gas (wet)	3	*	*	NR	*	*	1	*	NR	*	NR	*	*
Flousilic Acid	1	*	*	1	1	1	1	*	1	3	1	1	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Formaldehyde	1	1	*	1	1	2	1	*	2	2	1	NR	NR
Formic Acid	1	1	*	1	NR	NR	1	2	3	NR	1	NR	NR
Freon Dry	*	*	*	NR	*	*	*	*	*	*	*	*	*
Freon Wet	*	*	*	1	2	2	*	*	*	*	*	*	*
Fructose	1	1	1	1	1	1	1	1	1	1	1	1	1
Fruit Juice	1	1	1	1	1	1	1	1	1	1	1	1	1
Furfural	1	*	*	NR	*	*	NR	*	NR	*	NR	NR	*
Gallic Acid	1	1	*	1	1	1	NR	*	1	1	1	1	*
Gas Manufactured	*	*	*	NR	NR	NR	NR	NR	1	*	1	1	*
Gas Natural	NR	*	2	*	*	NR	NR	1	2	1	1	*	
Gasoline (leaded)	*	*	*	3	NR	NR	1	1	2	2	1	NR	*
Gasoline (unleaded)	1	2	*	3	NR	NR	1	1	2	2	1	NR	*
Gelatin	1	*	*	1	1	1	1	1	1	1	1	1	1
Glucose	1	*	*	1	1	1	1	1	1	1	1	1	1
Glue	1	*	*	1	*	*	*	*	1	1	1	1	*
Glycerine	1	1	1	1	1	1	1	1	1	2	1	1	*
Glycol	1	1	1	1	1	1	1	1	1	1	1	1	*
Glycolic Acid	*	*	*	1	1	1	2	*	1	1	1	1	*
Green Liquor	*	*	*	1	*	*	*	*	1	1	1	1	*
Helium	*	*	*	1	*	*	*	*	*	*	*	*	*
Heptane	1	1	*	2	NR	*	NR	NR	3	NR	1	1	*
Hexamine	*	*	*	*	*	*	*	*	*	*	*	*	*
Hexane	1	*	*	2	NR	NR	NR	NR	2	NR	1	*	*
Hexanol Tertiary	*	*	*	1	2	*	2	NR	2	2	1	1	NR
Hydrazine	*	*	*	3	*	*	NR	NR	NR	NR	*	*	*
Hydraulic Fluid (petroleum)	1	*	*	NR	*	*	NR	*	NR	*	*	*	*
Hydrobromic Acid (37%)	1	1	*	1	2	3	1	1	2	NR	*	*	*
Hydrochloric Acid (>20%)	1	1	Boiling	1	1	1	1	2	2	2	1	*	*
Hydrochloric Acid (50%)	1	1	Boiling	1	1	2	1	2	2	2	1	1	*
Hyrdrocyanic Acid	1	1	*	1	1	1	1	1	1	1	1	1	*
Hydrofluoric Acid (>40%)	1	2	*	1	1	2	1	1	2	3	NR	*	*
Hydrofluosilicic Acid	1	*	*	1	1	1	*	*	NR	NR	NR	NR	NR
Hydrofluorisilicic Acid	1	*	*	1	1	1	*	*	1	2	*	*	*
Hydrogen Chloride	1	1	*	1	1	*	1	1	1	*	*	*	*
Hydrogen Cyanide	1	1	*	1	1	1	1	1	1	1	1	1	1
Hydrogen Fluoride	1	1	*	1	*	*	*	*	2	*	NR	*	*
Hydrogen Gas	1	*	*	1	1	1	1	1	1	2	1	1	1
Hydrogen Peroxide	1	2	3	1	2	3	1	2	1	1	1	*	*
Hydrogen Sulfide (wet/dry)	1	*	*	1	1	1	1	1	1	1	1	1	*
Hydroquinone	1	1	*	1	1	1	1	1	1	1	1	1	*
Hydroxylamine Sulfate	*	*	*	1	1	*	*	*	1	1	1	1	1
Hypo Sodium Thiosulfate	*	*	*	1	1	1	*	*	1	1	1	1	1
Hypochlorous Acid	*	*	*	1	1	*	2	NR	1	1	1	1	*
Iodine	1	*	*	1	1	1	2	NR	NR	NR	1	NR	NR
Isobutyl Alcohol	*	*	*	1	2	2	*	*	2	3	*	*	*
Isooctane	1	*	*	1	NR	NR	*	*	1	*	*	*	*
Isopropyl Acetate	*	*	*	2	3	*	*	*	NR	NR	*	*	*
Isopropyl Alcohol	1	1	1	1	1	1	*	*	1	2	1	*	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Isopropyl Ether	1	*	*	2	NR	NR	*	*	3	*	NR	*	*
Jet Fuel (JP3,4,5)	*	*	*	1	NR	*	*	*	1	1	1	*	*
Kerosene	1	3	*	1	NR	*	NR	NR	1	1	1	1	*
Keytones	2	NR	*	2	NR	*	*	*	NR	*	NR	*	*
Lactic Acid	1	1	*	1	1	2	1	1	2	3	1	1	*
Lacquer Solvents	1	*	*	NR	*	*	*	*	NR	*	*	*	*
LPG (Propane)	*	*	*	1	2	*	*	*	NR	NR	*	*	*
Lard	1	1	*	2	NR	*	NR	NR	1	2	1	1	*
Lauric Acid	*	*	*	1	1	*	2	NR	1	1	1	1	*
Lauryl Chloride	*	*	*	1	1	*	NR	*	1	1	1	1	*
Lead Acetate	1	*	*	1	1	2	1	1	1	1	1	1	*
Lead Molten	NR	NR	NR	NR	*	*	NR	*	NR	*	NR	*	*
Lead Nitrate	1	1	*	1	1	*	*	*	2	2	*	*	*
Lead Sulfamate	*	*	*	1	1	*	*	*	1	*	*	*	*
Lime	*	*	*	1	1	1	*	*	1	2	*	*	*
Lime Sulfur	1	*	*	1	1	1	*	*	1	1	*	*	*
Lineoleic Acid	*	*	*	2	*	*	2	NR	1	1	1	1	*
Linseed Oil	1	1	NR	1	1	1	NR	NR	1	1	1	*	*
Lithium Chloride	1	*	*	1	*	*	*	*	1	*	*	*	*
Lithium Hydroxide	1	*	*	1	*	*	*	*	1	1	*	*	*
Lubricating Oil	1	*	*	1	NR	*	*	*	2	2	1	1	*
Lye	1	1	1	1	1	1	*	*	1	1	1	1	*
Machine Oil	*	*	*	1	1	NR	*	*	1	1	1	1	*
Magnesium Bisulfate	*	*	*	1	2	*	1	1	1	2	1	1	*
Magnesium Carbonate	*	*	*	1	1	1	1	1	1	1	1	1	*
Magnesium Chloride	1	1	*	1	1	1	1	1	1	1	1	1	*
Magnesium Hydroxide	1	1	*	1	1	1	1	1	1	1	1	1	*
Magnesium Nitrate	*	*	*	1	1	1	1	1	1	1	1	1	*
Magnesium Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	*
Maleic Acid	1	1	*	1	1	1	1	1	1	1	1	1	*
Malic Acid	*	*	*	1	NR	*	*	*	1	1	1	1	*
Manganese Chloride	1	*	*	1	*	*	*	*	1	*	1	*	*
Manganese Sulfate	*	*	*	2	*	*	*	*	2	2	*	*	*
Mercuric Chloride	1	*	*	1	1	1	1	1	1	1	1	*	*
Mercuric Cyanide	*	*	*	1	1	1	1	1	3	3	1	1	*
Mercurous Nitrate	*	*	*	1	1	1	1	1	3	3	1	1	*
Mercury	1	1	*	2	2	2	1	1	1	1	1	1	*
Methane	1	*	*	1	*	*	*	*	1	1	1	*	*
Methanol	*	*	*	1	1	1	1	1	1	3	1	1	1
Methyl Acetate	1	*	*	1	*	*	*	*	NR	*	*	*	*
Methyl Acetone	*	*	*	*	*	*	*	*	NR	*	*	*	*
Methyl Amine	*	*	*	1	*	*	*	*	NR	*	*	*	*
Methyl Bromide	*	*	*	2	NR	*	2	*	NR	*	NR	*	*
Methyl Cellosolve	*	*	*	2	*	*	*	*	NR	*	NR	*	*
Methyl Chloraform	2	NR	*	2	*	*	*	*	NR	*	NR	*	*
Methyl Chloride Wet	2	*	*	3	NR	*	NR	*	NR	*	NR	*	*
Methyl Chloride Dry	2	*	*	NR	*	*	*	*	NR	*	*	*	*
Methyl Ether Keytone	1	*	*	NR	*	*	NR	*	NR	*	NR	*	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Methyl Isobutyl Keytone	NR	*	*	NR	*	*	NR	*	NR	*	NR	NR	*
Methyl Salicylate	*	*	*	1	*	*	*	*	1	*	1	*	*
Methyl Sulfate	*	*	*	1	*	*	NR	*	1	NR	1	NR	*
Methyl Sulfuric Acid	*	*	*	1	1	1	1	1	1	1	1	1	*
Methylene Chloride	2	*	*	2	NR	*	NR	*	3	NR	NR	NR	*
Milk	1	1	1	1	1	2	1	1	1	1	1	1	*
Mineral Oil	1	3	NR	2	2	*	NR	NR	1	3	1	1	*
Mixed Acids	*	*	*	NR	*	*	*	*	3	NR	*	*	*
Molasses	1	*	*	1	1	1	1	1	1	1	*	*	*
Morpholine	*	*	*	2	2	*	*	*	*	*	*	*	*
Monochloroacetic Acid	NR	NR	NR	1	1	*	*	*	2	3	*	*	*
Monochlorobenzene	2	NR	*	NR	*	*	NR	*	NR	*	*	*	*
Monochlorodifluoromethane	*	*	*	1	*	*	*	*	NR	*	*	*	*
Monoethanolamine	*	*	*	1	2	2	*	*	NR	*	*	*	*
Motor Oil	1	*	*	3	3	*	*	*	1	1	1	1	1
Mustard	*	*	*	1	1	*	*	*	*	*	*	*	*
Naptha	1	1	NR	3	NR	*	1	1	NR	*	1	*	*
Napthalene	1	NR	*	2	2	*	1	1	NR	*	NR	*	*
Nickel Chloride	1	1	*	1	1	1	1	1	1	1	1	1	*
Nickel Nitrate	1	*	*	1	1	1	1	1	1	1	1	1	*
Nickel Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	*
Nitric Acid (100%)	NR	*	*	NR	*	*	NR	*	NR	*	NR	*	*
Nitric Acid (70%)	NR	*	*	NR	*	*	NR	*	NR	*	NR	*	*
Nitric Acid (50%)	1	*	*	2	NR	*	1	2	1	NR	1	*	*
Nitric Acid (30%)	1	1	*	1	1	*	1	1	1	NR	1	*	*
Nitric Acid (10%)	1	1	*	1	1	1	1	1	1	NR	1	*	*
Nitrobenzene	1	*	*	2	NR	*	NR	*	NR	*	NR	*	*
Nitrous Oxide	*	*	*	1	*	*	*	*	1	3	1	*	*
Ocenol	*	*	*	NR	*	*	2	NR	1	1	1	1	*
Oils and Fats	1	*	*	1	1	*	NR	NR	2	2	1	1	*
Oils, Vegetables	1	*	*	1	1	*	*	*	1	1	1	1	*
Oleic Acid	1	1	3	2	2	2	2	NR	1	1	1	1	*
Oxalic Acid	1	1	*	1	1	*	1	1	1	3	1	1	*
Oxygen	1	*	*	1	1	1	1	1	1	1	1	1	1
Ozone	2	3	*	3	*	*	*	*	3	NR	*	*	*
Palmitic Acid	*	*	*	2	2	*	1	1	2	NR	1	*	*
Paraffin	1	*	*	1	*	*	*	*	1	1	*	*	*
Pentane	*	*	*	*	*	*	*	*	3	*	*	*	*
Perchloroethylene	2	*	*	NR	*	*	*	*	NR	*	*	*	*
Perchloric Acid	1	1	*	NR	*	*	*	*	NR	*	NR	*	*
Petroleum	1	*	*	2	*	*	NR	NR	3	3	*	*	*
Petroleum Ether	1	NR	*	1	1	*	NR	*	*	*	*	*	*
Phenol	1	3	*	1	NR	*	*	*	NR	*	1	*	*
Phenol Sulfonic Acid	*	*	*	*	*	*	*	*	2	2	*	*	*
Phenylhydrazine	*	*	*	*	*	*	*	*	NR	*	NR	*	*
Phosphoric Acid (10%)	1	1	Boiling	1	1	1	1	1	1	1	1	1	*
Phosphoric Acid (25%)	1	1	Boiling	1	1	1	1	1	1	1	1	1	*
Phosphoric Acid (50-100%)	1	1	Boiling	1	1	1	1	2	1	1	1	1	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Phosphorus	1	1	*	2	*	*	*	*	2	3	*	*	*
Phosphorus Trichloride	1	1	*	NR	*	*	*	*	NR	NR	NR	*	*
Phosphorus Pentachloride	*	*	*	1	2	2	*	*	3	NR	*	*	*
Photographic Solutions	1	1	*	1	1	3	*	*	1	1	1	1	*
Phthalic Acid	1	1	*	2	2	2	*	*	1	1	*	*	*
Picric Acid	*	*	*	*	*	*	*	*	NR	NR	NR	NR	*
Plating Solutions Brass	*	*	*	1	1	1	1	1	1	1	1	1	1
Plating Solutions Cadmium	*	*	*	1	1	1	1	1	1	1	1	1	1
Plating Solutions Chrome	*	*	*	1	1	1	*	*	2	2	1	1	2
Plating Solutions Copper	*	*	*	1	1	1	1	1	1	*	1	1	1
Plating Solutions Gold	*	*	*	1	1	1	1	1	1	2	1	1	1
Plating Solutions Lead	*	*	*	1	1	1	1	1	1	1	1	1	1
Plating Solutions Nickel	*	*	*	1	1	1	1	1	1	1	1	1	1
Plating Solutions Silver	*	*	*	1	1	1	1	1	1	1	1	1	1
Plating Solutions Tin	*	*	*	1	1	1	1	1	1	1	1	1	2
Plating Solutions Zinc	*	*	*	1	1	1	1	1	1	1	1	1	1
Potassium Acetate (50%)	1	*	*	1	*	*	*	*	1	1	*	*	*
Potassium Aluminum Sulfate	1	1	*	1	1	1	1	1	2	2	1	1	*
Potassium Bicarbonate (60%)	1	*	*	1	1	1	*	*	1	1	1	1	*
Potassium Bichromate (5%)	1	*	*	1	1	1	1	1	1	1	1	1	1
Potassium Bromide (10%)	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Carbonate	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Chlorate	1	1	*	1	1	1	*	*	1	1	1	1	*
Potassium Chloride	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Chromate	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Cyanide	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Dichromate (5%)	1	*	*	1	1	1	1	1	1	1	1	1	1
Potassium Ferricyanide	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Ferrocyanide	1	*	*	1	1	1	*	*	1	1	1	1	*
Potassium Hydrate	1	*	*	*	*	*	*	*	1	2	*	*	*
Potassium Hydroxide	1	1	1	1	1	*	*	*	1	1	1	1	*
Potassium Hypochlorite	2	*	*	NR	*	*	*	*	3	3	1	1	NR
Potassium Iodide	2	*	*	1	1	1	*	*	1	*	1	*	*
Potassium Nitrate (10%)	1	*	*	1	1	1	*	*	1	1	1	1	*
Potassium Permanganate	1	1	*	1	2	3	1	1	1	1	1	1	*
Potassium Persulfate	1	*	*	1	1	*	1	1	1	1	1	1	*
Potassium Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	*
Potassium Sulfide	1	*	*	1	1	1	1	1	1	1	*	*	*
Potassium Sulfite	1	*	*	1	1	*	1	1	2	2	*	*	*
Propane	1	*	*	2	NR	*	*	*	1	2	1	*	*
Propyl Alcohol	1	1	1	1	1	1	2	NR	1	NR	1	NR	*
Porpylene Glycol	*	*	*	1	2	*	1	1	3	NR	*	*	*
Propylene Oxide	*	*	*	1	2	*	*	*	3	NR	*	*	*
Pyridine	1	*	*	1	1	*	*	*	NR	*	NR	*	*
Pyrogallic Acid	*	*	*	1	*	*	*	*	3	*	*	*	*
Pyroligneous Acid	1	2	NR@140	1	2	*	*	*	3	3	*	*	*
Resorcinol	*	*	*	1	1	1	*	*	1	1	*	*	*
Rosin	1	*	*	1	1	*	*	*	3	NR	*	*	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Salicylic Acid	*	*	*	1	2	*	1	1	NR	*	*	*	*
Salicylaldehyde	*	*	*	1	2	*	*	*	3	NR	*	*	*
Salt Brine	1	1	1	1	1	1	1	1	1	1	1	1	*
Sea Water	1	1	1	1	1	1	1	1	1	1	1	1	*
Sewage	*	*	*	1	1	1	*	*	1	1	*	*	*
Silicon Oil	1	*	*	1	1	*	*	*	1	NR	1	1	*
Silver Chloride	*	*	*	1	2	*	*	*	1	2	*	*	*
Silver Cyanide	1	1	*	1	1	1	*	*	1	1	1	1	*
Silver Nitrate	1	1	*	1	2	2	*	*	1	2	1	1	*
Soap Solutions	1	1	*	1	1	1	1	1	1	1	1	1	*
Sodium Acetate (60%)	1	1	*	1	1	1	*	*	2	3	1	1	*
Sodium Acid Sulfate	*	*	*	1	1	1	*	*	1	1	*	*	*
Sodium Benzoate (10%)	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Bicarbonate	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Bichromate	1	1	*	1	1	2	*	*	1	2	*	*	*
Sodium Bisulfate	1	*	*	1	1	1	1	1	1	1	1	1	1
Sodium Bisulfite	1	*	*	1	1	1	1	1	1	1	1	1	1
Sodium Borate	1	1	*	1	1	2	1	1	1	1	1	1	*
Sodium Bromide	*	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Carbonate	1	1	1	1	1	1	1	1	1	1	1	1	*
Sodium Chlorate	1	1	*	1	1	1	1	1	1	2	1	1	*
Sodium Chromate	*	*	*	1	1	*	*	*	*	*	*	*	*
Sodium Cyanide	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Dichromate	1	1	*	1	1	2	1	1	1	2	1	1	*
Sodium Ferricyanide	*	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Ferrocyanide	*	*	*	1	1	*	1	1	1	1	1	1	*
Sodium Fluoride	*	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Hydroxide	1	1	1	2	2	2	1	2	1	2	1	1	*
Sodium Hypochlorite	1	1	1	2	*	*	*	*	2	2	1	1	*
Sodium Hyposulfite	1	1	*	*	*	*	*	*	2	2	*	*	*
Sodium Metaphosphate	1	*	*	1	NR	*	*	*	2	2	1	1	*
Sodium Nitrate	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Nitrite	1	1	1	1	1	1	1	1	1	1	1	1	*
Sodium Perborate	1	*	*	1	1	1	*	*	1	1	1	1	*
Sodium Peroxide	1	1	*	2	2	*	*	*	2	*	*	*	*
Sodium Phosphates	1	1	1	1	1	1	*	*	1	2	1	1	*
Sodium Silicate	1	*	*	1	1	1	*	*	1	1	1	1	*
Sodium Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Sulfide	1	*	*	1	1	1	1	1	1	1	1	1	*
Sodium Sulfite (90%)	1	*	*	1	1	2	1	1	1	1	1	1	*
Sodium Thiosulfate	1	1	*	1	1	2	*	*	1	1	1	*	*
Sodium Tetraborate	1	1	1	1	1	2	*	*	1	1	*	*	*
Soy Bean Oil	*	*	*	1	*	*	*	*	1	*	*	*	*
Stannic Chloride	*	*	*	1	1	1	1	1	1	1	1	1	*
Stannous Chloride	*	*	*	1	1	1	1	1	1	2	1	1	*
Starch	*	*	*	1	1	*	*	*	1	1	*	*	*
Stearic Acid	1	*	*	1	2	3	1	1	1	3	*	*	*
Stoddard's Solution	1	3	*	1	NR	*	*	*	NR	*	NR	*	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Styrene	*	*	*	*	*	*	*	*	NR	*	*	*	*
Sugar Juice	*	*	*	1	*	*	*	*	2	*	*	*	*
Sulfate Liquor	1	*	*	1	*	*	*	*	1	2	1	1	*
Sulfinol	*	*	*	*	*	*	*	*	*	*	*	*	*
Sulfur	1	1	*	1	1	1	1	1	1	1	*	*	*
Sulfur (Molten)	NR	NR	NR	NR	*	*	NR	*	NR	*	NR	*	*
Sulfur Chloride	*	*	*	NR	*	*	*	*	3	NR	1	1	*
Sulfur Dioxide Gas (Wet)	1	1	*	1	3	NR	1	1	NR	*	NR	*	*
Sulfur Dioxide Gas (Dry)	1	1	*	1	3	*	1	1	1	1	1	*	*
Sulfur Trioxide	*	*	*	NR	*	*	1	1	1	1	1	1	*
Sulfuric Acid (10%)	1	1	*	1	1	1	1	1	1	1	1	1	1
Sulfuric Acid (30%)	1	1	*	1	1	1	1	2	1	1	1	1	*
Sulfuric Acid (60%)	1	1	*	1	1	1	1	2	1	1	1	1	2
Sulfuric Acid (80%)	1	*	*	1	1	1	2	2	1	1	1	1	2
Sulfuric Acid (100%)	1	NR	*	1	2	NR	NR	NR	NR	NR	NR	*	*
Sulfurous Acid (10%)	1	*	*	1	1	1	1	1	1	1	1	1	*
Tall Oil	*	*	*	1	1	1	*	*	1	1	1	1	1
Tannic Acid	1	1	*	1	1	1	*	*	1	1	1	1	1
Tanning Liquor	1	*	*	1	2	2	1	1	1	1	1	1	1
Taritar Oil	*	*	*	1	*	*	*	*	NR	*	*	*	*
Tartaric Acid (10%)	1	*	*	1	1	1	NR	*	1	2	1	1	*
Tetrachloroacetic Acid	*	*	*	*	*	*	*	*	NR	*	*	*	*
Terachloroethane	*	*	*	NR	*	*	*	*	NR	*	*	*	*
Tetrachloroethylene	2	*	*	NR	*	*	*	*	NR	*	*	*	*
Tetraethyl Lead	*	*	*	2	NR	*	*	*	2	NR	1	*	*
Tetrahydrofuran	2	*	*	3	NR	*	NR	*	NR	*	NR	*	*
Tetrahydronaphthalene	1	*	*	3	NR	*	*	*	*	*	*	*	*
Tetraphosphoric Acid	*	*	*	*	*	*	*	*	*	*	*	*	*
Thionyl Chloride	3	*	*	NR	*	*	NR	*	NR	*	NR	*	*
Tin Tetrachloride	1	*	*	1	1	1	*	*	2	2	*	*	*
Titanium Tetrachloride	*	*	*	NR	*	*	*	*	NR	*	NR	*	*
Toluene	1	3	NR	NR	*	*	NR	*	NR	*	NR	*	*
Tomato Juice	1	*	*	1	1	1	*	*	1	*	1	1	*
Tributyl Citrate	*	*	*	2	3	*	*	*	3	NR	*	*	*
Tributyl Phosphate	*	*	*	2	NR	*	*	*	NR	*	NR	*	*
Transformer Oil	1	1	*	1	NR	*	*	*	NR	*	1	1	*
Trichloroacetic Acid	*	*	*	2	2	NR	*	*	NR	*	1	*	*
Trichloroethane	3	NR	*	NR	*	*	*	*	NR	*	*	*	*
Trichloroethylene	NR	*	*	3	NR	*	NR	*	NR	*	NR	*	*
Trichlorotrifluoroethane	*	*	*	1	*	*	*	*	NR	*	*	*	*
Tricresyl Phosphate	1	*	*	1	2	NR	*	*	NR	*	*	*	*
Triethanolamine	1	*	*	NR	*	*	NR	*	NR	*	NR	*	*
Triethylamine	*	*	*	NR	*	*	*	*	1	3	1	*	*
Triethylene Glycol	*	*	*	1	*	*	*	*	2	3	*	*	*
Trisodium Phosphate	1	1	*	*	*	*	*	*	*	*	*	*	*
Tripopylene Glycol	*	*	*	1	*	*	*	*	2	*	*	*	*
Trisodium Phosphate	1	1	*	1	1	1	1	1	1	1	1	1	*
Tung Oil	*	*	*	1	*	*	*	*	2	2	*	*	*

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

Continued on the next page

Chemical Resistance

CHEMICAL	TIVAR UHMW			Proteus Polypropylene			Polyethylene		PVC		Corzan CPVC		
	70°	122°	170°	70°	140°	180°	70°	140°	70°	140°	70°	170°	210°
Turpentine	1	3	NR	2	NR	*	NR	*	2	3	1	*	*
Undecanol	*	*	*	2	NR	*	*	*	1	3	*	*	*
Urea	1	*	*	1	1	1	1	1	2	NR	1	1	*
Urine	1	1	*	1	1	1	1	1	1	1	1	1	*
Varnish	1	*	*	1	*	*	*	*	NR	*	*	*	*
Vinegar	1	1	*	1	1	1	1	1	1	1	1	1	*
Vinyl Acetate	*	*	*	2	NR	*	2	NR	NR	*	NR	*	*
Vinyl Chloride	1	NR	*	*	*	*	*	*	NR	*	*	*	*
Vinylidene Chloride	*	*	*	NR	*	*	*	*	NR	*	*	*	*
Water, Fresh	1	1	1	1	1	1	1	1	1	1	1	1	1
Water, Acid Mine	1	1	*	1	1	1	1	1	1	1	1	1	NR
Water, Distilled	1	1	*	1	1	1	1	1	1	1	1	1	*
Water, Deionized	*	*	*	1	1	1	1	1	1	1	1	1	*
Water, Demineralized	*	*	*	1	1	1	1	1	1	1	1	1	*
Water, Salt	1	1	*	1	1	1	1	1	1	1	1	1	*
Whiskey	1	*	*	1	1	1	1	*	1	1	1	1	*
White Liquor	NR	*	*	1	1	*	*	*	1	1	1	1	*
White Spirit	1	3	*	1	1	1	*	*	1	1	*	*	*
Wine	1	1	1 to 160	1	1	1	1	*	1	1	1	1	*
Xylene	3	NR	*	NR	*	*	NR	*	NR	*	NR	*	*
Zinc Chloride	1	1	*	1	1	1	1	1	1	1	1	1	*
Zinc Cyanide	*	*	*	1	1	1	*	*	1	1	*	*	*
Zinc Molten	NR	NR	NR	NR	*	*	NR	*	NR	*	NR	*	*
Zinc Nitrate	*	*	*	1	1	1	1	1	1	1	1	1	*
Zinc Stearate	*	*	*	1	*	*	*	*	1	2	*	*	*
Zinc Sulfate	1	*	*	1	1	1	1	1	1	1	1	1	1

1 <15% loss in property values. Little or no chemical attack.

2 15-30% loss in propery values. Minor chemical attack.

3 30-50% loss in propery values. Moderate chemical attack.

NR Not Recommended. >50% loss in propery values.

** No data available.*

The chemical resistance of plastics can be difficult to predict. It is dependent upon: temperature, time of exposure, chemical concentration, and stress on the material. Increases in any of these factors may result in reduced chemical inertness. This table is intended as a **guide only**, and not intended as an alternative to actual testing. Alro Plastics and our suppliers highly recommend actual testing which represents the only method of evaluating suitability for use in your specific application.

Chemical Resistance 2

CHEMICAL	Concentration Weight, %	Nylon 101, Nylatron® GS	MC 901, MC 907 Nylatron® GSM, GSM Blue, Nylatron® NSM	Acetron® GP Acetal, Delrin®	Ertalyte® PET-P, Ertalyte® TX	PC 1000, Polycarbonate	PSU 1000, Polysulfone	Ultem® 1000 PEI	Fluorosint® PTFE	Techtron® PPS	Ketron® PEEK	Torlon® PAI	Celazole® Polybenzimidazole
Acetaldehyde Aq.	40	B	B	A	A	D	*	D	A	A	A	A	*
Acetamide Aq.	50	A	A	A	*	*	*	*	A	*	A	*	*
Acetic Acid Aq.	10	C	C	C	B	B	A	A	A	A	A	A	B
Acetone		A	A	A	B	D	D	C	A	A	A	A	A
Acrylonitrile		A	A	*	B	D	D	*	A	A	A	A	A
Alcohols, Aliphatic		B	B	A	A	A	A	A	A	A	A	A	*
Allyl Chloride		C	*	*	*	*	*	*	A	*	A	*	*
Ally Alcohol		*	B	*	A	B	*	*	A	A	A	A	*
Aluminum Chloride Aq.	10	A	A	*	A	A	*	*	A	A	A	A	*
Aluminum Sulfate Aq.	10	A	A	A	*	A	A	*	A	A	A	A	*
Ammonia Aq.	10	A	A	A	A	*	*	*	A	A	A	B	C
Ammonia Gas		C	B	D	A	D	B	*	A	*	A	C	C
Ammonium Carbonate Aq.	10	A	A	*	A	B	*	*	A	A	A	A	*
Ammonium Chloride Aq.	10	D	B	A	A	A	A	*	A	A	A	A	*
Ammonium Chloride Aq.	37	D	B	A	A	A	*	*	A	A	A	A	*
Amyl Acetate		B	D	A	*	D	D	B	A	A	A	A	*
Amyl Alcohol		*	A	*	*	B	A	*	A	A	A	A	*
Aniline		C	C	B	A	C	*	*	A	A	A	A	*
Antimony Trichloride Aq.	10	D	D	*	*	A	D	*	A	*	A	*	*
Barium Chloride Aq.	10	D	B	A	*	A	A	*	A	A	A	A	*
Barium Sulfate Aq.	10	*	A	A	*	*	*	*	A	*	A	A	*
Barium Sulfide Aq.	10	A	*	*	*	*	*	*	A	*	A	A	*
Benzaldehyde		A	C	A	A	D	*	D	A	B	A	A	*
Benzene		A	A	A	A	D	D	D	A	A	A	A	*
Benzenesulfonic Acid		D	*	C	*	D	*	*	A	A	D	D	*
Benzyl Alcohol		C	D	A	A	D	*	*	A	A	A	A	*
Benzzoic Acid Aq.	SAT	C	D	*	A	D	*	*	A	A	A	*	*
Beverages Aq. Alcohol		B	B	A	A	A	A	A	A	A	A	A	A
Beverages Aq.Carbonated		B	B	A	A	A	A	A	A	A	A	A	A
Bitumen		B	B	A	*	*	*	*	A	*	A	*	*
Bleaching Lye	10	C	B	C	*	*	*	*	A	*	A	A	*
Bleaching Lye	100	C	B	C	*	*	*	*	A	*	A	*	*
Boric Acid Aq.	10	D	D	*	A	A	*	*	A	A	A	*	*
Boron Trifluoride		D	D	*	*	*	*	*	*	*	*	*	*
Bromine Aq.	30	D	D	D	*	D	A	*	*	A	B	A	*
Bromine Liq.		D	D	D	*	D	*	*	*	A	D	*	*
Butanol		B	B	A	B	A	B	A	A	A	A	A	A
Butyl Acetate		A	B	A	A	D	D	B	A	A	A	A	*
Butyl Phthalate		D	*	*	*	*	*	*	A	B	A	A	*
Butylene Glycol		A	B	*	B	B	*	A	A	A	A	*	A
Butylamine		A	*	D	*	D	*	D	A	B	A	A	*
Butyric Acid Aq.	20	D	B	A	*	D	*	*	A	A	A	*	*
Butyric Acid	Conc	D	B	*	*	D	*	*	A	A	A	*	*
Butyrolactone		*	A	A	B	C	*	*	A	*	A	A	*
Calcium Chloride Aq.	10	D	A	A	A	A	A	*	A	A	A	A	*

A No attack, possibly slight absorption. Negligible effect on mechanical properties

B Slight attack by absorption, some swelling and a small reduction in mechanical properties likely.

C Moderate attack or appreciable absorption; material will have limited life.

D Material will decompose or dissolve in a short period of time.

* No Data Available

Aq. = Aqueous Solution Sat = Saturated Aqueous Solution Conc = Concentrated Aqueous Solution

Continued on the next page

Chemical Resistance 2

CHEMICAL	Concentration Weight, %	Nylon 101, Nylatron® GS	MC 901, MC 907 Nylatron® GSM, GSM Blue, Nylatron® NSM	Acetron® GP Acetal, Delrin®	Ertalyte® PET-P, Ertalyte® TX	PC 1000, Polycarbonate	PSU 1000, Polysulfone	Ultem® 1000 PEI	Fluorosint® PTFE	Techtron® PPS	Ketron® PEEK	Torlon® PAI	Celazole® Polybenzimidazole
Calcium Chloride (in Alcohol)	20	D	D	A	*	*	*	*	A	A	A	*	*
Calcium Hypochlorite		D	D	D	A	A	B	*	A	A	A	A	*
Camphor		A	A	A	*	*	*	*	A	A	A	*	*
Carbon Disulphide		A	A	A	*	D	*	*	A	A	A	*	*
Carbon Tetrachloride		A	A	A	A	D	A	A	A	A	A	A	A
Carbonic Acid Aq.	10	A	*	A	A	*	*	*	A	A	A	*	*
Carnalite Aq.	10	*	A	*	*	*	*	*	A	*	A	*	*
Castor Oil		A	*	A	A	A	*	*	A	*	A	*	*
Catechol		*	C	*	*	*	*	*	*	*	A	*	*
Chloroacetic Acid Aq.	10	D	C	D	*	*	*	*	A	A	A	*	*
Chloral Hydrate		D	D	*	*	*	*	*	A	*	A	*	*
Chlorine Aq.	10	D	D	D	*	D	D	*	A	*	D	*	*
Chlorine Gas	100	*	D	D	*	B	*	*	A	*	A	*	A
Chlorobenzene		A	A	A	A	D	D	*	A	A	A	A	*
Chloroform		A	C	C	D	D	D	D	A	A	A	A	A
Chlorosulfonic Acid Aq	10	D	C	D	*	*	*	*	A	D	D	*	*
Chrome Alum Aq.	10	A	*	*	*	A	*	*	A	*	A	*	*
Chromic Acid Aq.	1	D	C	B	A	A	A	A	A	A	A	A	*
Citric Acid Aq.	10	B	B	A	A	A	A	A	A	A	A	*	A
Citric Acid Aq.	Sat	C	C	*	A	*	A	*	A	A	A	*	*
Coconut Oil		A	A	*	*	*	*	*	A	A	A	*	*
Creosote		A	*	*	*	D	*	*	A	*	A	*	*
Cresols		D	D	*	*	D	D	*	A	A	A	*	*
Cresylic Acid		D	*	*	*	*	*	*	A	*	A	*	*
Cupric Chloride Aq.	10	D	*	A	A	A	A	*	A	A	A	*	*
Cupric Sulfate Aq.	0.5	*	B	A	A	A	*	*	A	A	A	*	*
Cupric Sulfate Aq.	10	B	*	A	*	*	*	*	A	A	A	*	*
Cupric Sulfate Aq.	Sat	*	B	*	*	*	*	*	A	A	A	*	*
Cyclohexane		A	A	A	A	B	B	A	A	A	A	A	A
Cyclohexanol		B	B	A	A	C	A	A	A	A	A	A	A
Cyclohexanone		A	A	A	A	D	D	*	A	A	A	A	A
Decalin		A	A	A	*	A	A	A	A	A	A	*	A
Detergents, Organic		A	A	A	A	A	A	A	A	A	A	*	A
Dibutylphthalate		A	A	A	*	D	*	B	A	*	A	A	*
Dichlorordifluoro Methane		A	A	A	A	D	D	D	A	B	A	*	A
Dichloroethylene		A	A	D	B	D	D	D	A	*	A	A	A
Diethyleneglycol Aq.	90	A	B	A	A	A	B	*	A	*	A	A	*
Diesel Oil		A	A	A	A	A	A	A	A	A	A	A	A
Dimethyl Carbinol		A	B	A	*	*	*	*	A	*	A	*	*
Dimethyl Aniline		A	*	*	B	D	D	D	A	A	A	A	*
Dimethyl Formamide		A	A	A	A	D	D	D	A	A	A	*	*
Dioxane		A	A	A	A	D	D	*	A	A	A	A	*
Edible Oils		A	A	A	A	A	B	A	A	A	A	A	A
Ethanol, Denatured	96	B	B	A	A	A	A	A	A	A	A	A	A
Ether, Diethyl		A	A	A	A	A	A	A	A	A	A	A	A

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Continued on the next page

Chemical Resistance 2

CHEMICAL	Concentration Weight, %	Nylon 101, Nylatron® GS	MC 901, MC 907 Nylatron® GSM, GSM Blue, Nylatron® NSM	Acetron® GP Acetal, Delrin®	Ertalyte® PET-P, Ertalyte® TX	PC 1000, Polycarbonate	PSU 1000, Polysulfone	Ultem® 1000 PEI	Fluorosint® PTFE	Techtron® PPS	Ketron® PEEK	Torlon® PAI	Celazole® Polybenzimidazole
Ethyl Acetate		A	A	C	A	D	D	B	A	A	A	A	*
Ethyl Butyrate		A	*	*	*	D	D	B	A	*	A	A	*
Ethyl Chloride		*	A	A	*	*	*	*	A	A	A	A	*
Ethylene Chlorohydrine		D	*	*	*	D	*	*	A	*	A	*	*
Ethylene Chloride		B	B	A	C	C	C	C	A	A	A	A	A
Ethylene Diamine		B	A	A	*	C	B	C	A	D	A	D	*
Ethylene Dichloride		B	*	B	*	D	*	D	A	B	A	A	A
Ethylene Glycol Aq.	96	A	B	A	A	B	A	D	A	A	A	A	A
Ethylene Propionate		A	*	*	*	*	*	*	A	*	A	A	*
Ferric Chloride Aq.	5	B	B	A	A	A	A	*	A	A	A	A	*
Ferric Chloride Aq.	10	B	*	A	*	A	A	*	A	A	B	A	*
Ferric Chloride Aq.	Sat	C	C	*	*	*	*	*	A	A	B	A	*
Ferrous Chloride Aq.	10	B	C	A	*	*	*	*	A	A	A	A	*
Fluorine		D	D	D	*	*	*	*	C	*	D	*	*
Flousilicic Acid Aq.	10	D	C	*	*	A	*	*	B	A	*	*	*
Fluothane		A	A	*	*	*	*	*	A	*	A	*	*
Freon 12 (Arcton 12)		A	A	A	A	D	A	*	A	B	A	*	A
Formaldehyde Aq.	10	A	B	A	A	A	C	A	A	A	A	A	*
Formic Acid Aq.	3	D	D	D	B	A	*	A	A	A	B	C	D
Formic Acid Aq.	10	D	D	D	C	B	D	A	A	A	B	C	D
Fruit Juices	Conc	A	B	A	A	A	A	*	A	A	A	A	*
Furfural		A	B	A	*	*	D	*	A	A	A	B	*
Gasoline		A	A	A	A	D	B	B	A	A	A	A	A
Glycerine		A	B	A	A	A	B	*	A	A	A	A	*
Heptane		A	A	A	A	A	A	A	A	A	A	A	A
Hexane		A	A	A	A	A	B	A	A	A	A	A	A
Hydrobromic Acid Aq.	10	D	C	D	*	*	B	*	A	B	D	A	*
Hydrochloric Acid Aq.	0.4	B	B	C	A	A	A	A	A	A	A	A	B
Hydrochloric Acid Aq.	2	C	D	D	B	A	A	A	A	A	A	A	D
Hydrochloric Acid Aq.	10	D	D	D	C	A	A	A	A	B	A	A	D
Hydrofluoric Acid Aq.	4	D	C	D	B	A	A	*	C	B	D	*	*
Hydrogenated Vegetable Oils		A	A	A	A	*	*	*	A	A	A	A	*
Hydrogen Peroxide Aq.	0.5	D	*	A	A	A	A	A	A	A	A	*	A
Hydrogen Peroxide Aq.	1	D	C	B	A	A	A	A	A	A	A	*	A
Hydrogen Peroxide Aq.	3	D	C	B	A	A	A	A	A	A	A	*	A
Hydrogen Sulfide Aq.	Sat	C	C	C	C	A	*	*	A	A	A	*	*
Hydroquinone		B	B	*	*	*	*	*	A	*	A	*	*
Iodine (in Alcohol)		D	D	*	*	D	*	*	A	*	A	*	*
Iodine (in Pt. Iodine) Aq.	3	D	C	*	*	D	*	*	A	*	A	*	*
Iso Octane		A	A	A	A	A	B	B	A	A	A	A	A
Isopropyl Alcohol		B	B	A	A	A	B	A	A	A	A	A	A
Isopropyl Ether		A	A	A	A	A	C	A	A	A	A	A	A
Lactic Acid Aq.	10	A	A	A	A	A	A	*	A	A	A	A	*
Lactic Acid Aq.	90	C	D	*	*	*	*	*	A	A	A	A	*
Lead Acetate Aq.	10	B	B	A	*	*	*	*	A	A	A	A	*

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Chemical Resistance 2

CHEMICAL	Concentration Weight, %	Nylon 101, Nylatron® GS	MC 901, MC 907 Nylatron® GSM, GSM Blue, Nylatron® NSM	Acetron® GP Acetal, Delrin®	Ertalyte® PET-P, Ertalyte® TX	PC 1000, Polycarbonate	PSU 1000, Polysulfone	Ultem® 1000 PEI	Fluorosint® PTFE	Techtron® PPS	Ketron® PEEK	Torlon® PAI	Celazole® Polybenzimidazole
Lead Stearate		A	A	*	*	*	*	*	A	*	A	*	*
Linseed Oil		A	A	A	*	A	A	*	A	A	A	*	*
Lithium Bromide Aq.	50	D	D	A	*	*	*	*	A	*	A	*	*
Lubricating Oils (Petro)		A	A	A	A	A	A	A	A	A	A	A	A
Magnesium Chloride Aq.	10	A	A	A	A	A	A	*	A	A	A	A	*
Magnesium Hydroxide Aq.	10	A	A	A	B	*	*	*	A	A	A	D	*
Magnesium Sulfate Aq.	10	A	A	A	*	*	*	*	A	A	A	A	*
Maleic Acid Aq.	Conc	*	C	*	*	*	*	*	A	*	A	*	*
Malonic Acid Aq.	Conc	*	C	*	*	*	B	*	A	*	A	*	*
Manganese Sulfate Aq.	10	A	A	A	A	*	*	*	A	*	A	*	*
Mercuric Chloride Aq.	6	C	D	B	*	A	*	*	A	*	A	*	*
Mercury		A	A	A	A	A	*	*	A	A	A	*	*
Methanol		A	B	A	A	B	B	A	A	A	A	*	A
Methyl Acetate		A	A	A	A	D	*	B	A	A	A	A	*
Methyl Ethyl Ketone		A	A	B	A	D	B	D	B	B	A	A	A
Methylpyrrolidone		A	A	*	*	*	D	*	A	A	A	*	*
Methylene Chloride		B	B	C	D	D	D	C	A	A	A	A	C
Methyl Phenyl Ether		A	*	*	A	*	*	*	A	A	A	A	*
Milk		A	A	A	A	A	A	A	A	A	A	A	A
Mineral Oils		A	A	A	*	A	A	A	A	A	A	A	A
Naphthalene		A	A	A	A	D	D	D	A	A	A	*	
Nickel Sulfate Aq.	10	A	A	*	*	A	*	*	A	A	A	*	
Nicotine		D	D	*	*	*	*	*	*	*	A	*	
Nitric Acid Aq.	0.1	C	C	D	B	A	A	A	A	A	A	A	B
Nitric Acid Aq.	10	D	D	D	C	A	C	A	A	B	A	A	C
Nitrobenzene		C	B	B	D	D	D	D	A	A	A	A	*
Nitromethane		A	B	*	B	A	D	*	A	A	A	A	*
Oleic Acid		A	A	A	A	A	A	*	A	A	A	*	*
Oxalic Acid Aq.	10	C	B	C	*	A	A	*	A	A	A	*	*
Ozone		C	C	C	A	D	A	*	A	*	A	*	*
Paraffin		A	A	A	A	A	A	A	A	A	A	A	A
Perchloroethylene		B	B	B	A	C	*	C	A	A	A	A	A
Perchloric Acid Aq.	10	D	C	C	A	*	*	*	A	*	A	*	
Petroleum Ether		A	A	A	*	A	*	*	A	A	A	A	
Phenol Aq.	6	D	D	D	A	D	*	*	A	*	B	*	A
Phenol Aq.	75	D	D	D	C	D	D	D	A	*	D	*	A
Phenol (Molten)		D	D	D	C	D	D	D	A	*	B	*	
Phosphoric Acid Aq.	0.3	*	B	C	A	A	A	A	A	A	A	A	B
Phosphoric Acid Aq.	3	D	C	C	A	A	A	A	A	A	A	A	C
Phosphoric Acid Aq.	10	D	D	D	B	A	A	A	A	A	A	A	C
Phthalic Acid Aq.	Sat	B	B	A	*	*	*	*	A	*	A	*	*
Phthalic Dioctyl		A	A	*	*	*	*	*	A	A	A	*	*
Potassium Acetate Aq.	50	A	A	A	*	*	*	*	A	*	A	A	*
Potassium Bicarbonate Aq	60	A	A	A	A	*	*	*	A	A	A	A	*
Potassium Bromide Aq.	10	A	A	A	A	A	*	*	A	A	A	A	*

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CHEMICAL	Concentration Weight, %	Nylon 101, Nylatron® GS	MC 901, MC 907 Nylatron® GSM, GSM Blue, Nylatron® NSM	Acetron® GP Acetal, Delrin®	Ertalyte® PET-P, Ertalyte® TX	PC 1000, Polycarbonate	PSU 1000, Polysulfone	Ultem® 1000 PEI	Fluorosint® PTFE	Techtron® PPS	Ketron® PEEK	Torlon® PAI	Celazole® Polybenzimidazole
Potassium Carbonate Aq	60	A	A	A	A	*	*	A	A	A	A	A	*
Potassium Chloride Aq	90	A	A	A	A	A	*	*	A	A	A	A	*
Potassium Dichromate Aq	5	C	B	A	A	A	*	*	A	A	A	A	*
Potassium Ferricyanide Aq	30	A	B	*	A	*	*	*	A	*	A	*	*
Potassium Ferrocyanide Aq	30	A	B	*	*	*	*	*	A	*	A	*	*
Potassium Hydroxide Aq	10	C	A	A	C	C	A	A	B	A	A	D	*
Potassium Hydroxide Aq	50	C	A	D	C	D	B	*	C	A	A	D	*
Potassium Nitrate Aq	10	A	A	B	A	A	A	*	A	A	A	*	*
Potassium Permanganate Aq	1	D	C	A	A	A	A	*	A	A	A	A	*
Potassium Sulfite Aq.	Conc	A	A	*	*	*	*	*	A	A	A	A	*
Potassium Sulfite Aq.	90	A	*	*	*	*	*	*	A	*	A	A	*
Propane Gas		A	A	A	A	A	*	*	A	A	A	*	A
Pyridine		A	A	B	*	D	D	*	A	*	A	D	*
Resorcinol		D	D	*	*	*	*	*	A	*	A	*	*
Salicylic Acid		A	A	D	A	*	*	*	A	*	A	*	*
Silicone Fluids		A	A	A	A	A	*	*	A	A	A	A	A
Silver Nitrate		A	A	A	A	A	*	*	A	A	A	A	*
Soap Solutions		A	A	A	A	A	A	A	A	A	A	A	A
Sodium (Molten)		*	*	C	*	*	*	*	B	*	D	*	*
Sodium Acetate Aq.	60	A	B	A	A	*	*	*	A	A	A	A	*
Sodium Benzoate Aq.	10	A	*	A	A	*	*	*	A	*	A	A	*
Sodium Bicarbonate Aq.	50	A	A	A	A	A	*	*	A	A	A	A	*
Sodium Bisulphite Aq.	10	A	A	D	A	A	*	*	A	A	A	A	*
Sodium Bromide Aq.	10	A	B	A	A	*	*	*	A	A	A	A	*
Sodium Carbonate Aq.	20	A	B	A	A	*	*	*	A	A	A	A	A
Sodium Carbonate Aq.	50	A	*	A	*	*	*	*	A	A	A	A	*
Sodium Chlorate Aq.	10	A	B	A	*	A	*	*	A	A	A	A	*
Sodium Chloride Aq.	10	A	B	A	A	A	A	*	A	A	A	A	*
Sodium Chloride Aq.	90	A	B	A	A	A	*	*	A	A	A	A	*
Sodium Cyanide Aq.	10	A	*	A	*	A	*	*	A	A	A	*	*
Sodium Hydroxide Aq.	10	C	D	D	C	C	A	A	B	A	A	D	B
Sodium Hydroxide Aq.	50	D	D	D	C	D	C	D	C	B	A	D	C
Sodium Hypochlorite 15%		D	C	D	A	A	A	*	A	A	A	A	B
Cl (Chlorine Bleach)													
Sodium Nitrate Aq.	50	A	A	A	A	C	*	*	A	A	A	*	*
Sodium Perborate Aq.	10	B	*	A	*	*	*	*	A	*	A	*	*
Sodium Phosphate Aq.	90	A	*	*	*	*	*	*	A	*	A	*	*
Sodium Silicate		A	A	*	A	A	B	*	A	A	A	*	*
Sodium Sulfate Aq.	90	A	A	*	A	A	*	*	A	A	A	A	*
Sodium Sulfide Aq.	90	A	*	*	B	*	*	*	A	A	A	A	*
Sodium Thiosulfate Aq.	10	A	A	A	A	A	A	*	A	A	A	*	*
Stannic Chloride Aq.	10	D	*	D	*	A	A	A	A	A	A	*	A
Stannic Sulfate Aq.	10	D	C	*	*	*	*	*	A	A	A	*	*
Stearic Acid		A	A	A	*	*	*	*	A	*	A	*	*
Styrene (Monomer)		A	A	A	C	D	*	*	A	A	A	*	*

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Sulfur		A	A	A	A	A	*	*	A	*	A	*	*
Sulfur Dioxide (Dry Gas)	100	C	A	D	B	A	*	*	A	A	A	A	*
Sulfuric Acid Aq.	2	C	C	D	A	A	A	A	A	A	A	A	B
Sulfuric Acid Aq.	5	D	D	D	A	A	A	A	A	A	A	A	B
Sulfuric Acid Conc.		D	D	D	C	D	D	D	A	B	D	*	*
Sulfurous Acid Aq.	10	A	*	D	*	A	A	A	A	A	A	*	B
Tallow		A	A	A	*	A	A	A	A	A	A	A	A
Tar		B	B	A	*	*	*	*	A	A	A	A	*
Tartaric Acid Aq.	10	B	A	A	*	A	*	*	A	A	A	*	*
Tetrachlorethylene		A	C	A	B	D	D	A	B	*	A	*	*
Tetrahydrofuran		A	A	B	A	D	*	*	A	A	A	A	A
Tetralin		A	A	A	A	*	*	*	A	*	A	*	*
Thionyl Chloride		D	C	B	*	*	*	*	A	*	A	*	*
Thiophene		A	*	*	*	D	*	*	A	*	A	*	*
Toluene		A	A	B	A	D	D	D	A	A	A	A	A
Transformer Oil		A	A	A	*	A	A	*	A	A	A	A	*
Trichlorethylene		B	B	D	B	D	D	D	A	A	A	A	*
Triethanolamine		A	A	A	B	D	C	D	A	A	A	D	*
Turpentine		A	A	A	*	B	C	*	A	A	A	A	*
Trisodium Phosphate Aq.	95	*	B	A	A	A	*	*	A	A	A	*	*
Urea		A	A	A	A	A	*	*	A	A	A	*	*
Vaseline		A	A	A	A	A	A	A	A	A	A	A	A
Vegetable Oils		A	A	A	A	A	A	A	A	A	A	A	A
Vinegar		C	C	B	A	A	*	A	A	A	A	A	A
Vinyl Chloride		A	A	*	*	*	*	*	A	A	A	*	*
Water		A	A	A	A	A	A	A	A	A	A	A	A
Wax (Molten)		A	A	A	A	A	A	A	A	A	A	A	A
White Spirit		A	A	A	*	*	*	*	A	A	A	*	*
Wines & Spirits		B	B	A	A	A	*	A	A	A	A	A	A
Xylene		A	A	A	A	D	D	C	A	A	A	A	A
Xylenol		D	D	A	*	D	D	B	A	*	A	A	A
Zinc Chloride Aq.	10	C	B	D	A	A	A	A	A	A	A	*	*
Zinc Oxide		A	A	C	*	*	*	*	A	A	A	*	*
Zinc Sulfate	10	A	*	C	*	A	*	*	A	A	A	*	*

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Plastic Weight Chart

Plastic Sheet and Flat stock (LBS./SQFT)

THICK	UHMW-PE	HDPE	ACETAL	ACRYLIC	POLYCARBONATE	POLYPROPYLENE	NYLON	ABS	PTFE / TFE	PVC	PHENOLIC
1/16"	0.32	0.32	0.49	0.39	0.40	0.30	0.39	0.35	0.75	0.47	0.48
1/8"	0.63	0.63	0.99	0.78	0.79	0.60	0.78	0.70	1.50	0.94	0.96
3/16"	0.94	0.94	1.48	1.16	1.19	0.89	1.16	1.05	2.24	1.40	1.43
1/4"	1.26	1.26	1.98	1.55	1.59	1.19	1.55	1.40	2.99	1.87	1.91
3/8"	1.89	1.89	2.97	2.33	2.38	1.78	2.33	2.10	4.49	2.81	2.86
1/2"	2.52	2.52	3.96	3.10	3.17	2.38	3.10	2.80	5.98	3.75	3.82
5/8"	3.15	3.15	4.95	3.88	3.96	2.97	3.88	3.49	7.47	4.68	4.77
3/4"	3.78	3.78	5.94	4.65	4.75	3.56	4.65	4.20	8.97	5.62	5.73
7/8"	4.41	4.41	6.93	5.42	5.55	4.16	5.42	4.92	10.46	6.56	6.68
1"	5.04	5.04	7.92	6.20	6.34	4.75	6.20	5.60	11.96	7.49	7.64
1-1/8"	5.67	5.67	8.91	6.97	7.13	5.35	6.97	6.32	13.45	8.43	8.59
1-1/4"	6.30	6.30	9.90	7.75	7.92	5.94	7.75	6.99	14.94	9.36	9.54
1-3/8"	6.93	6.93	10.89	8.52	8.72	6.54	8.52	7.73	16.44	10.30	10.50
1-1/2"	7.56	7.56	11.88	9.29	9.51	7.13	9.29	8.40	17.93	11.23	11.45
1-5/8"	8.19	8.19	12.87	10.07	10.30	7.73	10.07	9.13	19.42	12.17	12.41
1-3/4"	8.82	8.82	13.86	10.84	11.09	8.32	10.84	9.78	20.92	13.11	13.36
2"	10.08	10.08	15.84	12.39	12.68	9.51	12.39	11.18	23.91	14.98	15.27
2-1/4"	11.34	11.34	17.83	13.94	14.26	10.70	13.94	12.64	26.89	16.85	17.18
2-1/2"	12.60	12.60	19.80	15.48	15.84	11.88	15.48	13.98	29.88	18.72	19.08
2-3/4"	13.86	13.86	21.78	17.03	17.43	13.06	17.03	15.45	32.87	20.60	20.99
3"	15.12	15.12	23.76	18.58	19.01	14.26	18.58	16.85	35.86	22.47	22.90
3-1/4"	16.38	16.38	25.74	20.13	20.60	15.45	20.13	18.26	38.85	24.34	24.81
3-1/2"	17.64	17.64	27.72	21.68	22.18	16.64	21.68	19.66	41.84	26.21	26.72
4"	20.16	20.16	31.68	24.77	25.35	19.01	24.77	22.36	47.81	29.96	30.53
4-1/2"	22.68	22.68	35.64	27.87	28.52	21.39	27.87	25.28	53.79	33.70	34.35
5"	25.20	25.20	39.60	30.97	31.68	23.76	30.97	28.10	59.76	37.44	38.16
5-1/2"	27.72	27.72	43.56	34.06	34.85	26.14	34.06	30.89	65.74	41.19	41.98
6"	30.24	30.24	47.52	37.16	38.02	28.52	37.16	33.70	71.72	44.93	45.80
7"	46.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8"	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

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The materials above represent the most common plastics. If you need a weight for a plastic that is not shown above feel free to contact Alro Plastics and we will provide that information for you. Weights will differ if the material in question has any fillers added, like glass filled or carbon filled. All above plastics represent the virgin or unfilled version of the material.

Some materials listed above may or may not be in stock and some may be custom runs. The chart is just for reference only and should be used to help calculate shipping rates and such.

Plastic Weight Chart

Plastic Rod and Round stock (LBS./FOOT)

DIA.	UHMW-PE	HDPE	ACETAL	ACRYLIC	POLYCARBONATE	POLYPROPYLENE	NYLON	ABS	PTFE / TFE	PVC	PHENOLIC
1/8"	0.006	0.005	0.008	0.006	0.006	0.005	0.006	0.006	0.012	0.007	0.007
3/16"	0.013	0.011	0.017	0.014	0.014	0.011	0.014	0.013	0.026	0.016	0.16
1/4"	0.023	0.020	0.030	0.025	0.025	0.019	0.025	0.022	0.047	0.029	0.029
3/8"	0.052	0.045	0.068	0.057	0.057	0.044	0.056	0.050	0.105	0.066	0.065
1/2"	0.093	0.080	0.120	0.101	0.101	0.078	0.099	0.090	0.186	0.118	0.116
5/8"	0.145	0.125	0.188	0.158	0.158	0.121	0.155	0.140	0.291	0.184	0.180
3/4"	0.208	0.180	0.270	0.228	0.228	0.174	0.223	0.201	0.419	0.264	0.260
7/8"	0.283	0.245	0.368	0.310	0.310	0.237	0.303	0.274	0.570	0.360	0.354
1"	0.370	0.320	0.480	0.405	0.405	0.310	0.396	0.358	0.744	0.470	0.462
1-1/8"	0.468	0.405	0.608	0.513	0.513	0.392	0.501	0.453	0.942	0.595	0.585
1-1/4"	0.578	0.500	0.750	0.633	0.633	0.484	0.619	0.559	1.163	0.734	0.722
1-3/8"	0.700	0.605	0.908	0.766	0.766	0.586	0.749	0.677	1.407	0.889	0.873
1-1/2"	0.833	0.720	1.080	0.911	0.911	0.698	0.891	0.806	1.674	1.058	1.040
1-5/8"	0.977	0.845	1.268	1.069	1.069	0.819	1.046	0.945	1.965	1.241	1.220
1-3/4"	1.133	0.980	1.470	1.240	1.240	0.949	1.213	1.096	2.279	1.439	1.415
2"	1.480	1.280	1.920	1.620	1.620	1.240	1.584	1.432	2.976	1.880	1.848
2-1/4"	1.873	1.620	2.430	2.050	2.050	1.569	2.005	1.812	3.767	2.379	2.339
2-1/2"	2.313	2.000	3.000	2.531	2.531	1.938	2.475	2.238	4.650	2.938	2.888
2-3/4"	2.798	2.420	3.630	3.063	3.063	2.344	2.995	2.707	5.627	3.554	3.494
3"	3.330	2.880	4.320	3.645	3.645	2.790	3.564	3.222	6.696	4.230	4.158
3-1/4"	3.908	3.380	5.070	4.278	4.278	3.274	4.183	3.781	7.859	4.964	4.880
3-1/2"	4.533	3.920	5.880	4.961	4.961	3.798	4.851	4.386	9.114	5.758	5.660
4"	5.920	5.120	7.680	6.480	6.480	4.960	6.336	5.728	11.904	7.520	7.392
4-1/2"	7.493	6.480	9.720	8.201	8.201	6.278	8.019	7.250	15.066	9.518	9.356
5"	9.250	8.000	12.000	10.125	10.125	7.750	9.900	8.950	18.600	11.750	11.550
5-1/2"	11.193	9.680	14.520	12.251	12.251	9.378	11.979	10.830	22.506	14.218	13.976
6"	13.320	11.520	17.280	14.580	14.580	11.160	14.256	12.888	26.784	16.920	16.632
6-1/2"	15.633	13.520	20.280	17.111	17.111	13.098	16.731	15.126	31.434	19.858	19.520
7"	18.130	15.680	23.520	19.845	19.845	15.190	19.404	17.542	36.456	23.030	22.638
7-1/2"	20.813	18.000	27.000	22.781	22.781	17.438	22.275	20.138	41.850	26.438	25.988
8"	23.680	20.480	30.720	25.920	25.920	19.840	25.344	22.912	47.616	30.080	29.568
8-1/2"	26.733	23.120	34.680	29.261	29.261	22.398	28.611	25.866	53.754	33.958	33.380
9"	29.970	25.920	38.880	32.805	32.805	25.110	32.076	28.998	60.264	38.070	37.422
9-1/2"	33.393	28.880	43.320	36.551	36.551	27.978	35.739	32.310	67.146	42.418	41.696
10"	37.000	32.000	48.000	40.500	40.500	31.000	39.600	35.800	74.400	47.000	46.200
12"	44.000	n/a	58.000	n/a	n/a	n/a	57.000	n/a	n/a	n/a	n/a

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Terminology

ABLATIVE
To wear away, burn away, or vaporize.

ABRASION RESISTANCE
Ability to withstand the effects of repeated wear, rubbing, scraping, etc...

ACETAL RESINS
The molecular structure of the polymer is that of a linear acetal consisting of unbranched polyoxymethylene chains.

ACIDS
One of a class of substances compounded of hydrogen and one or more other elements, capable of uniting with a base to form a salt, and in aqueous solution, turning blue litmus paper red.

ACRYLATE RESINS
A class of thermoplastic resins produced by polymerization of acrylic acid derivatives.

ADHESIVE
A substance capable of holding materials together by surface attachment.

AGING
The effect of time on plastic exposed indoors at ordinary conditions of temperature and relatively clean air.

ALKALIES
Compounds capable of neutralizing acids and usually characterized by an acrid taste. Can be mild like baking soda or highly caustic like lye.

ANNEALING
A process of holding a material at a temperature near, but below its melting point, the object to permit stress relaxation without distortion of shape.

ARC RESISTANCE
Time required for a given electrical current to render the surface of a material conductive because of carbonization by the arc flame.

BLISTER
Undesirable rounded elevation on the surface of a plastic whose boundaries may be either more or less sharply defined, somewhat resembling in shape a blister on the human skin. A blister may burst and become flattened.

BOND
To attach by means of an adhesive.

BURNED
Showing evidence of thermal decomposition through discoloration, distortion or destruction of the surface of the plastic.

BUTADIENE STYRENE-PLASTICS
A synthetic resin derived from the copolymerization of butadiene gas and styrene liquids.

CALENDERING
A process by which a heated rubber plastic product is squeezed between heavy rollers into a thin sheet or film. The film may be frictioned into the interstices of cloth, or it may be coated onto cloth or paper.

CAST RESIN
A resinous product prepared by pouring liquid resins intoa mold and heat-treating the mass to harden it.

CELLULOID
A thermoplastic material made by the intimate blending of cellulose nitrate with camphor. Alcohol is normally employed as a volatile solvent to assist plasticization, and is subsequently removed.

CELLULOSE
A natural high polymeric carbohydrate found in most plants; the main constituent of dried woods, jute, flax, hemp, ramie, etc... Cotton is almost pure cellulose.

CELLULOSE ACETATE
An acetic acid ester of cellulose. It is obtained by the action under rigidly controlled conditions, of acetic acid and acetic anhydride on purified cellulose usually obtained from cotton linters. All three available hydroxyl groups in each glucose unit of the cellulose can be acetylated but in the material normally used for plastics, it is usual to acetylate fully an then to lower the acetyl value (expressed as acetic acid) to 52-56% by partial hydrolysis. When compounded with suitable plasticizers it gives a tough thermoplastic material.

CEMENT
A dispersion of a "solution" of unvulcanized rubber or a plastic in a volatile solvent. This meaning is peculiar to the plastics and rubber industries and may or may not be an adhesive composition.

COEFFICIENT OF LINEAR THERMAL EXPANSION
The amount of growth which occurs in a material when it is heated from one ambient temperature to another ambient temperature and is normally expressed in terms of in/in/°F.

COEFFICIENT OF FRICTION
The relation between force of frictional and normal pressure. Many factors affect friction & the lower the coefficient of friction the lower the wear on the machine or the material.

COLD FLOW
Change in dimensions or shape of some materials when subjected to external weight or pressure or pressure at room temperature.

COMPOUND
A combination of ingredients before being processed or made into a finished product. Sometimes used as a synonym for material formulation.

COMPRESSIVE STRENGTH
The maximum load in pounds which a one inch square section of material will support without fracturing.

CONDENSATION
A chemical reaction in which two or more molecules combine, usually with the separation of water or some other simple substance.

COPOLYMER
The product of simultaneous polymerization of two or more polymerizeable chemicals, commonly known as monomers.

COMPRESSIBILITY (RECOVERY)
This is a useful short-time test done at room temperature. Both are expressed as % of initial thickness. Some compressibility is necessary to fill irregularities, minor flaws or nicks. Good recovery when the load is released shows torque retention in a gasketed material.

CRAZING
Fine cracks at or under the surface of a plastic.

CREEP
The dimensional change with time of a material under load, following the initial instantaneous elastic deformation. Creep at room temperature is sometimes called Cold Flow.

CREEP RELAXATION
Expressed as a % of initial stress loss, this is a measure of a material's ability to maintain an initial stress over a period of time. A greater loss of stress increases the loss of bolting torque and the chance of leakage.

CROSS LAMINATE
A laminate in which some of the layers of material are oriented approximately at right angles to the remaining layers with respect to the grain or strongest direction in tension.

Terminology

CROSS-LINKING
Applied to polymer molecules, the setting-up of chemical links between the molecular chains. When extensive, as in most thermosetting resins, cross-linking makes one infusible super-molecule of all the chains.

DEFORMATION UNDER LOAD
The percentage of deformation that will occur in a material under a given period of time.

DEGRADATION
A deleterious change in the chemical structure of a plastic.

DELAMINATION
The separation of the layers in a laminate caused by the failure of the adhesive.

DIELECTRIC STRENGTH
Expressed in volts per mil and represents the number of volts required to cause an electrical breakthrough.

DIFFUSION
The migration or wandering of the particles or molecules of a body of fluid matter away from the main body through a medium or into another medium.

DIMENSIONAL STABILITY
Ability of a plastic part to maintain its original proportions under conditions of use.

DUROMETER
Trade name of the Shore Instrument Company for an instrument that measures hardness. The rubber or plastics durometer determines the "hardness" of rubber or plastics by measuring the depth of penetration (without puncturing) of a blunt needle compressed on the surface for a short period of time.

ELASTIC LIMIT
The load at which a material will no longer return to its original form when the load is released.

ELASTOMER
A material which at room temperature stretches under low stress to at least twice its length and snaps back to the original length upon release of stress.

ELECTRICAL PROPERTIES
Primarily the resistance of a plastic to the passage of electricity.

ELONGATION
The ability of a material to increase in length expressed as a percentage.

ELONGATION MODULUS
This is the force required to stretch the material to twice its original length. It is noted as PSI.

EMULSION
The dispersion of one liquid in another - possible only when they are mutually insoluble.

ESTER
A compound formed by the elimination of waste during the reaction between an alcohol and an acid; many esters are liquids. They are frequently used as plasticizers in rubber and plastic compounds.

ETHYL CELLULOSE
A thermoplastic material prepared by the ethylation of cellulose by diethyl sulfate or ethyl halides and alkali.

EXTRUSION
The compacting of a plastic material and forcing of it through an orifice in more or less continuous fashion.

FABRICATE
To work a material into a finished form by machining, forming or other operation, or to make flexible film or sheeting into end-products by sewing, cutting, sealing or other operation.

FILLER
A material added to plastic composition to impact certain qualities in the finished article.

FLEXURAL STRENGTH
The ability of a material to deflect under load and return to its original condition expressed in pounds per square inch.

FLUOROCARBONS
The family of plastics including polytetrafluoroethylene (PTFE), polychlorotrifluoroethlylene (PCTFE), polyvinylidene and fluorinated ethylene propylene (FEP), q.v. They are characterized by properties including good thermal and chemical resistance and nonadhesiveness and possess a low dissipation factor and low dielectric constant. Depending upon which of the fluorocarbons is used, they are available as molding materials, extrusion materials, dispersions film or tape.

FORMULATION
A combination of ingredients before being processed or made into a finished product. Sometimes used as a synonym for material compound.

FUSE
To join two plastics parts by softening the material by heat or solvents.

GENERIC
Common names for types of plastic materials. They may be either chemical terms or coined names. They contrast with trade marks which are the property of one company.

HARDNESS
A measure of the degree of surface hardness as measured on the Rockwell scale.

HEAT DISTORTION
The temperature at which a material bends a given number of mils under a given load. Commonly used as a relative comparison of materials.

HEAT RESISTANCE
The ability to withstand the effects of exposure to high temperature. Care must be exercised in defining precisely what is meant when this term is used. Descriptions pertaining to heat resistance properties include: boilable, washable, cigarette-proof, sterilizable, etc...

HOOP STRESS
The stress imposed on a cylindrical wall by internal pressure loading which acts so as to split the wall normal to any radius-wall intercept.

IMPACT STRENGTH
(1) The ability of a material to withstand shock loading; (2) the work done in fracturing, under shock loading, a specified test specimen in a specified manner.

IMPERMEABILITY
Permitting no passage into or through a material.

INJECTION MOLDING
A molding procedure whereby a heat-softened plastic material is forced from a cylinder into a relatively cool cavity which gives the article the desired shape.

LIGHT STABILITY
Ability of a plastic to retain its original color and physical properties upon exposure to sun or artificial light.

LIGHT TRANSMISSION
The amount of light a plastic will pass.

LONGITUDINAL STRESS
The stress imposed on the long axis of any shape. It can be either a compressive or tensile stress.

LOW PRESSURE LAMINATES
In general, laminates molded and cured in the range of pressures from 400 p.s.i. down to and including pressures obtained by the mere contact of the plies.

LUBRICANT
A substance used to decrease the friction between tosolid faces and sometimes used to improve processing characteristics of plastic compositions.

Terminology

MELAMINE PLASTICS
Thermosetting plastics made from melamine and formaldehyde resins.

MELTING POINT
The temperature at which the liquid first forms in a small sample as its temperature is increased gradually.

MODULUS
A term that may be applied to either tensile, flexural, compressive, or torsional actions. It defines the number of pounds per square inch required to cause deformation, elongation, or flexure in a material.

MODULUS OF ELASTICITY
The ratio of stress to strain in a material that is elastically deformed.

MOISTURE RESISTANCE
Ability to resist absorption of water.

MONOMER
The simplest repeating structural unit of a polymer; for addition polymers this represents the original unpolymerized compound.

NON-FLAMMABLE
Will not support combustion.

NON-RIGID PLASTIC
A plastic which has a stiffness or apparent modulus of elasticity of not over 10,000 p.s.i. at 23°C when determined in accordance with the Standard Method of Test for Stiffness in Flexure of Plastics.

NON-TOXIC
Non-poisonous.

NOTCH SENSITIVITY
The extent which the sensitivity of a material to fracture is increased by the presence of a surface in homogeneity such as a notch, a sudden change in section, a crack or a scratch. Low notch sensitivity is usually associated with ductile materials, and high notch sensitivity with brittle materials.

NYLON
The generic name for all synthetic fiber-forming polyamides, they can be formed into monofilaments and yarns characterized by great toughness, strength and elasticity, high melting point and good resistance to water and chemicals. The material is widely used for bristles in industrial and domestic brushes and for many textile applications. It is also in injection molding gears, bearings, combs, etc...

OLEFINS
A group of unsaturated hydrocarbons of the general formula CnH_2n and named after the corresponding paraffins by the addition of "ene" or "ylene" to the stern. Example are ethylene and propylene.

ORANGE-PEEL
Uneven and/or textured surface somewhat resembling an orange peel.

ORGANIC CHEMICAL
Originally applied to chemicals derived from living organisms, as distinguished from "inorganic" chemicals found in minerals and inanimate substances; modern chemists define organic chemicals more exactly as those which contain the element carbon.

PHENOLIC RESIN
A synthetic resin produced by the condensation of an aromatic alcohol with an aldehyde, particularly of phenol with formaldehyde. Phenolic resins form the basis for thermosetting molding materials laminated sheet and stoving varnishes. They are also used as impregnating agents and as compounds of paints varnishes, lacquers and adhesives.

PLASTIC
(n.) One of many high-polymeric substances, including both natural and synthetic products, but excluding the rubbers. At some stage in its manufacture every plastic is capable of flowing, under heat and pressure if necessary, into the desired final shape (adj.) Made of plastic: capable of flow under pressure or tensile stress.

PLASTICITY
A property of plastics and resins which allows the materials to be deformed continuously and permanently without rupture upon the application of a force that exceeds the yield value of the material.

PLASTICIZER
A liquid or solid incorporated in natural and synthetic resins and in related substances to develop such properties as resiliency, elasticity and flexibility.

POLYBUTYLENE PLASTICS
Plastics based on polymers made with butene as essentially the sole monomer.

POLYCARBONATE RESINS
Polymers derived from the direct reaction between aromatic and aliphatic dihydroxy compounds with phosgene or by the ester exchange reaction with appropriate phosgene-derived precursors.

POLYESTER
A resin formed by the reaction between a dibasic acid and dihydroxy alcohol, both organic. Modification with multi-functional acids and/or bases and some unsaturated reactants permit cross-linking to thermosetting resins. Polyester modified with fatty acids are called Alkyds.

POLYETHYLENE
A thermoplastic material composed by polymers of ethylene. It is normally a translucent, tough, waxy solid which is unaffected by water and by a large range of chemicals.

POLYMER
A high-molecular-weight organic compound, natural or synthetic whose structure can be represented by a repeated small unit, the "mer" e.g. polyethylene, rubber, cellulose. Synthetic polymers and formed by addition or condensation polymerization of monomers. If two or more monomers are involved, a copolymer is obtained. Some polymers are elastomers, some plastics.

POLYMERIZATION
Chemical change resulting in the formation of a new compound whose molecular weight is usually a multiple of that of the original substance.

POLYOLEFIN
A polymer prepared by the polymerization of an olefin(s) as the sole monomer(s).

POLYPROPYLENE
A tough, lightweight, rigid plastic made by the polymerization of high-purity propylene gas in the presence of an organometallic catalyst at relatively low pressures and temperatures.

POLYSTYRENE
A water-while thermoplastic produced by the polymerization of styrene (vinylbenezene). The electrical insulating properties of polystyrene are outstandingly good and the material is relatively unaffected by moisture. In particular, the power loss factor is extremely low over the frequency range 10-10/c.p.s.

POLYURETHANE RESINS
A family of resins produced by reacting diisocyanate with organic compounds containing two or more active hydrogens to form polymers having free isocyanate groups. These groups under the influence of heat or certain catalysts will react with each other or with water, glycols, etc... to form a thermosetting material.

Terminology

POLYVINYL CHLORIDE (PVC)
A thermoplastic material composed of polymers of vinyl chloride a colorless solid with outstanding resistance to water, alcohols and concentrated acids and alkalies. It is obtainable in the form of granules, solutions, latices and pastes. Compounded with plasticizers, it yields a flexible material superior to rubber in aging properties. It is widely used for cable and wire coverings in chemicals plants and in the manufacturing of protective garments.

POROSITY
Presence of numerous visible voids.

POSTCURE
Those additional operations to which a cured thermosetting plastic or rubber composition is subjected to enhance the level of one or more properties.

PV LIMIT
The Pressure-Velocity limit test is run at different surface speeds under increasing load. A material with good bearing ability has a high value.

RAYON
The generic term for fibers, staple and continuous filament yarns composed of generated cellulose, but also frequently used to describe fibers obtained from cellulose acetate or cellulose triacetate. Rayon fibers are similar in chemical structure to natural cellulose fibers (e.g. cotton) except that the synthetic fiber contains shorter polymer units. Most rayon is made by the viscose process.

RECOVERY (COMPRESSIBILITY)
This is a useful short-time test done at room temperature. Both are expressed as % of initial thickness. Some compressability is necessary to fill irregularities, minor flaws or nicks. Good recovery when the load is released shows torque retention in a gasketed material.

REINFORCED PLASTICS
Plastics with high strength filler imbedded in the composition, resulting in some mechanical properties superior to those of the base resin.

RESILIENCE
Usually regarded as another name for elasticity. While both terms are fundamentally related, there is a distinction in meaning. Elasticity is a general term used to describe the property of recovering original shape after a deformation, Resilience refers to the energy of recovery; that is, a body may be elastic but not highly resilient.

RESIN
Any class of solid or semisolid organic products of natural or synthetic origin, generally of high molecular weight with no definite melting point. Most resins are polymers, q.v.

RIGID PLASTICS
For purposes of general classification, a plastic that has a modulus of elasticity either in flexure or in tension greater than 100,000 p.s.i. at 23°C and 50% relative humidity when tested in accordance with ASTM Methods D747 or D790 Test for Stiffness of Plastics.

ROCKWELL HARDNESS
A common method for testing a plastics material for resistance to indentation in which a diamond or steel ball, under pressure, is used to pierce the test specimen. The load is expressed in kilograms.

RUBBER
An elastomer capable of rapid elastic recovery after being stretched to at least twice its length at temperatures from 0° to 150°F at any humidity. Specifically, natural rubber is the standard of comparison for elastomers.

SEALABILITY
Expressed as milliliters of leakage per hour. This test is conducted at room temperature under a certain gasket load and contained fluid (internal) pressure. The smaller the amount, the better.

SELF-EXTINGUISHING
A somewhat loosely-used term describing the ability of a material to cease burning once the source of flame has been removed.

SEMIRIGID PLASTIC
For purposes of general classification, a plastic that has a modulus of elasticity either in flexure or in tension between 10,000 and 100,000 p.s.i. at 23°C and 50% relative humidity when tested in accordance with ASTM Method D747 or D790 Test for Stiffness of Plastics.

SHORE HARDNESS
A method of determining the hardness of a plastic material using a scelroscope. This device consists of a small conical hammer fitted with a diamond point and acting in a glass tube. The hammer is made to strike the material under test and the degree of rebound is noted on a graduated scale. Generally, the harder the material the greater will be the rebound.

SIMULATED WEATHERING
The exposure of plastics to cyclic laboratory conditions of high and low temperatures, high and low relative humidities in an attempt to produce changes in their properties similar to those observed on long-time continuous exposure outdoors. The laboratory exposure conditions are usually intensified beyond those encountered in actual outdoor exposure in an attempt to achieve an accelerated effect.

SIMULATED AGING
The exposure of plastics to cyclic laboratory conditions of high and low temperatures, high and low relative humidities in an attempt to produce changes in their properties similar to those observed on long-time continuous exposure to conditions of temperature and relative humidity commonly encountered indoors or to obtain an acceleration of the effects of ordinary indoor exposure. The laboratory exposure conditions
are usually intensified beyond those actually encountered in an attempt to achieve an accelerated effect.

SOLVENT
The medium within which a substance is dissolved, most commonly applied to liquids used to bring particular solids into solution, e.g. acetone is solvent for PVC.

SPECIFIC GRAVITY
The density (mass per unit volume) of any material divided by that of water at a standard temperature, usually 4°C. Since water's density is nearly 1.00g/cc, density in g/cc and specific gravity are numerically nearly equal.

SPECIFIC HEAT
Ratio of the thermal capacity of a substance to that of water at 15°C.

STRENGTH
The mechanical properties of a plastic, such as load or weight carrying ability to withstand sharp blows. Strength properties include tensile, flexural and tear strength, toughness, flexibility, etc...

STRESS-CRACK
External or internal cracks in a plastic caused by tensile stresses less than that of its short-time mechanical strength.

STRETCH FORMING
A plastic sheet forming technique in which the heated thermoplastic sheet is stretched over a mold and subsequently cooled.

TEAR STRENGTH
Resistance of a material to tearing (strength).

Terminology

TENSILE STRENGTH
The capacity of a material to resist a force tending to stretch it. Ordinarily the term is used to denote the force required to stretch a material to rupture and is known variously as "breaking load", "breaking stress", "breaking strain". In plastics testing it is the load in pounds per square inch or kilos per square centimeter of original cross-sectional area supported at the moment of rupture by a piece of test sample on being elongated.

THERMAL CONDUCTIVITY
This shows the thermal insulating ability of a material. The higher the value, the greater the ability to conduct heat. It is expressed as BTU - inches per hour - square foot - degree Fahrenheit.

THERMAL EXPANSION
The increase in length of a dimension under influence of a change in temperature.

THERMOFORMING
Any process of forming thermoplastic sheet which consists of heating the sheet and pulling it down onto a mold surface.

THERMOPLASTIC
(adj.) Capable of being softened by heat and hardened by cooling. (n.) A material that will repeatedly soften when heated and harden when cooled. Typical of the thermoplastics family are the styrene polymers and copolymers, acrylics, cellulosics, polyethylenes, vinyls, nylons and the various fluorocarbon materials.

THERMOSET
A material that will undergo or has undergone a chemical reaction by the action of heat catalysts, ultra-violet light, etc... leading to a relatively infusible state. Typical of the plastics in the thermo-setting family are the aminos (melamine and urea), most polyesters, alkyds epoxies and phenolics.

TOLERANCE
A specified allowance for deviations in weighing, measuring, etc... or for deviations from the standard dimensions or weight.

TRANSLUCENT
Descriptive of a material or substance capable of transmitting some light, but not clear enough to be seen through.

TRANSPARENT
Descriptive of a material or substance capable of a high degree of light transmission, e.g. glass. Some polypropylene films and acrylic moldings are outstanding in this respect.

TRIBOLOGY
The study of the friction, wear, and lubrication of interacting surfaces in relative motion. (ie: bearings)

ULTRAVIOLET
Zone of invisible radiations beyond the violet end of the spectrum of visible radiation. Since UV wavelengths are shorter than the visible, their photons have more energy, enough to initiate some chemical reactions and to degrade most plastics.

VACUUM FORMING
Method of sheet forming in which the plastic sheet is clamped in a stationary frame, heated and drawn down by a vacuum into a mold. In a loose sense, it is sometimes used to refer to all sheet forming techniques, including Drape Forming, q.v. involving the use of vacuum and stationary molds.

VINYL CHLORIDE PLASTICS
Plastics based on resins made by the polymerization of vinyl chloride or copolymerization of vinyl chloride with minor amounts (not over 50%) of other unsaturated compounds.

VINYL PLASTICS
Plastics based on resins made from vinyl monomers except those specifically covered by other classifications, such as acrylic and styrene plastics. Typical vinyl plastics are polyvinyl chloride, polyvinyl acetate, polyvinyl alcohol, polyvinyl butyral and copolymers of vinyl monomers with unsaturated compounds.

VIRGIN MATERIAL
A plastic material in the form of pellets, granules, powder,flock or liquid that has not been subject to use or processing other than that required for its initial manufacture.

VISCOSITY
Internal friction of a liquid because of its resistance to shear agitation or flow.

VOLUME RESISTIVITY
The ability of a material to impede the flow of electricity as expressed in ohms per centimeter.

WATER ABSORPTION
The percentages by weight of water absorbed by a sample immersed in water. Dependent upon area exposed.

WATER VAPOR TRANSMISSION
The penetration of a plastic by moisture in the air.

WEAR FACTOR
This test measures material loss when an unlubricated sample under load is rotated on a fixed steel washer. The smaller the value, the smaller the wear.

WEATHER RESISTANCE
Ability of a plastic to retain its original physical properties and appearance upon prolonged exposure to outdoor weather.

WELDING
Joining thermoplastic pieces by one of several heat-softening processes. In hot-gas welding, the material is heated by a jet of hot air or inert gas directed from a welding "torch" onto the area over conditions of time, temperature and pressure.

YIELD POINT
There are various types of yield points - compressive, tensile, flexural and torsional. The point at which a material under stress will no longer return to its original dimensions after removal of the stress.

YIELD STRESS
The force which must be applied to a plastic to initiate flow. techniques, including Drape Forming, q.v. involving the use of vacuum and stationary molds.

Alro Metals

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Metals Product Line ..... 14-2 thru 14-3

Metals Processing ..... 14-4 thru 14-5

Alro Metals Outlet ..... 14-6 thru 14-7

Alro Locations Map ..... 14-8 thru 14-9

Alro Online Store and B2B 14-10

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Alloys

- Bar
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- Plate
- Tube

Aluminum

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- Cold Finished Bar
- Pipe & Tube
- Sheet & Plate
- Structural
- Expanded Metal
- Grating
- Custom Shapes

Carbon Steel

- Chrome Plated Bar
- Cold Finished Bar
- Hot Rolled Bar
- Reinforcing Bar
- Pipe & Tube
- Sheet & Plate
- Structural
- Grating
- Expanded Metal
- Custom Shapes

Cast Iron

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- Dura-Bar® Ductile Bar
- Dura-Bar® Gray Tube

Red Metals (Brass, Bronze & Copper)

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- Rod
- Sheet
- Plate
- Hollow Bar
- Custom Shapes

Stainless Steel

- Bar
- Pipe & Tube
- Sheet & Plate
- Structural
- Grating
- Expanded Metal

Tool Steel

- Bar
- Drill Rod
- Plate
- Flat Ground
- Super Square

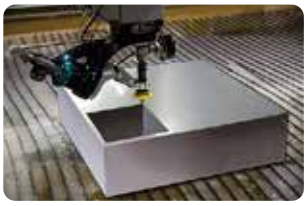
Other Metals

- Threaded Rod
- Perforated Sheet
- Bale Ties
- Flat Mesh
- Mesh Roll
- Strapping

Metals Processing

Sheet & Plate





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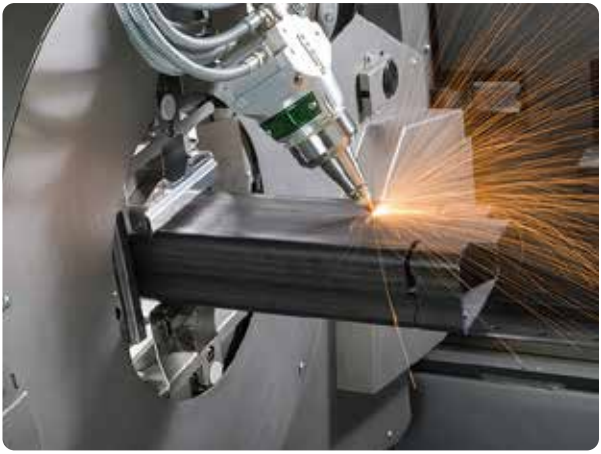
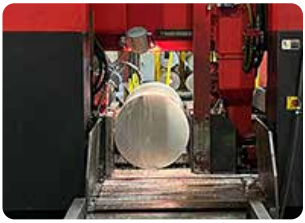
- Plasma Cutting
- Precision Saw Cutting
- Waterjet Cutting
- Oxy-Fuel Cutting
- Super Square Milling
- Thermal Processing
- Plate Grinding

Alro Steel

Metals Processing

Bar & Structurals



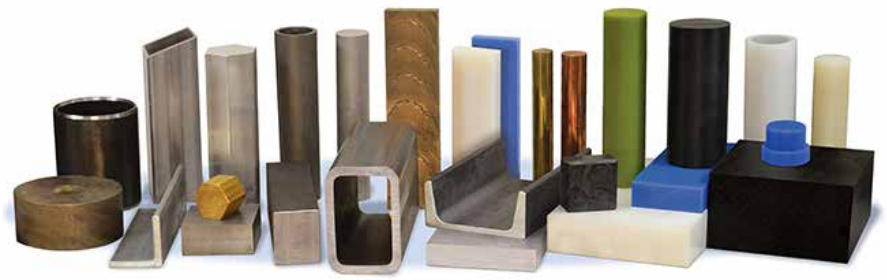


- Tube Laser Cutting
- Tube Cutting & Chamfering
- Structural Saw Cutting
- Production Saw Cutting
- Large Rounds Cutting

YouTube

Alro Metals Outlet

Public Welcome
Retail Setting
No Minimums
Fast Service



Your one-stop shop for all your Metal and Plastic needs!

- Carbon Steel
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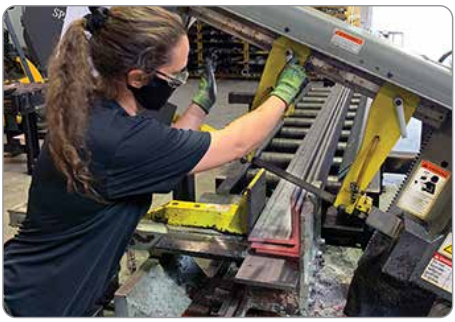
- Plastics
- Tool Steel
- CF Bar
- HR Bar
- Structurals
- Expanded Metals
- Re-rod & Mesh
- Pipe & Tubing
- **Full lengths**
- **Remnants**
- **Cut-offs & Drops**
- **Saw Cutting**
- **Shearing**

SCAN ME

Alro Metals Outlet locations act as an outlet store for metals, plastics and hardware supplies. We stock a broad range of products in a convenient retail setting. Alro Metals Outlet specializes in small and large orders, perfect for do-it-yourself (DIY), machine shops and maintenance departments. We sell drops as well as standard length material in bar, sheet and plate. Orders can be processed to size at the store while you wait. Stop by and browse our selection of metals and plastics to find just what you need.



Shearing and Saw Cutting available at all locations!

Alro Metals Outlet

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Fort Wayne, Indiana
Ann Arbor, Michigan
Grand Rapids, Michigan
Jackson, Michigan
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Lansing, Michigan
Livonia, Michigan
Troy, Michigan
Warren, Michigan
Cincinnati, Ohio
Cleveland, Ohio
Philadelphia, Pennsylvania
Baltimore, Maryland
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Syracuse, New York
Greensboro, N. Carolina
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Jacksonville, Florida
Miami, Florida
Orlando, Florida
Pompano Beach, Florida
Sarasota, Florida

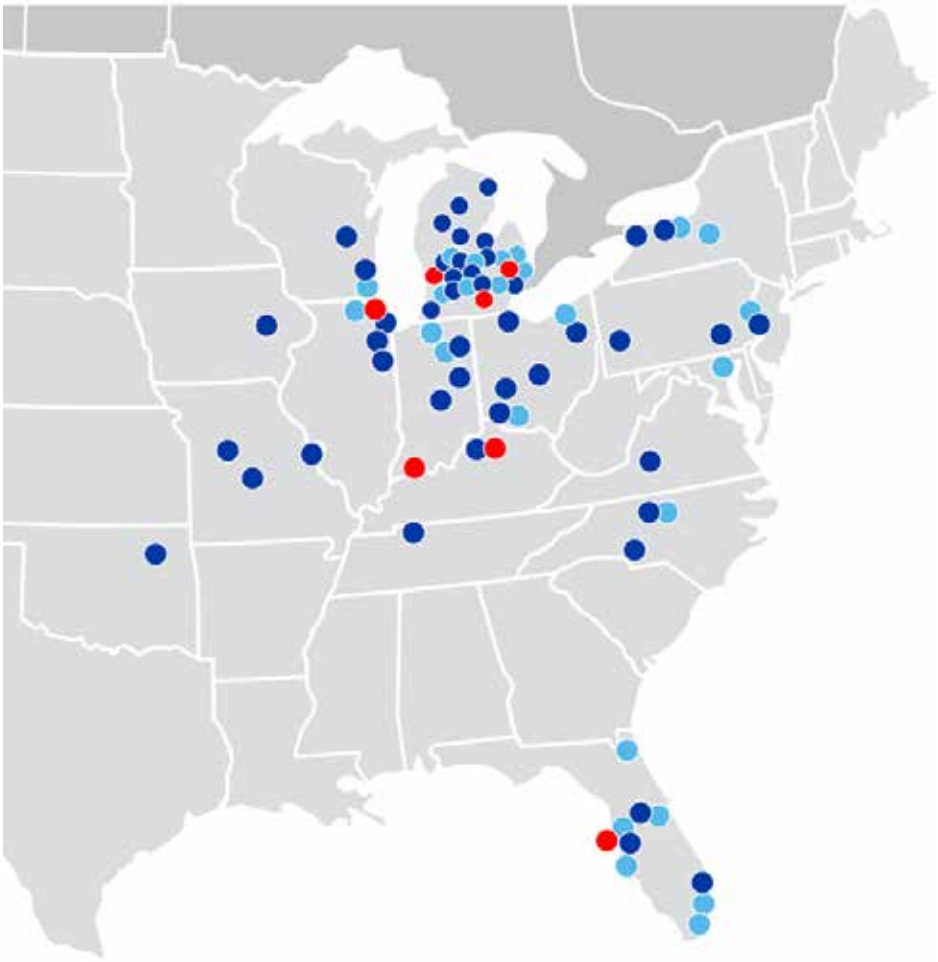
SQUARES & FLATS | ROUNDS | HEX | ROUND PIPE & TUBE | RECTANGULAR & SQUARE TUBE | SHEET & PLATE | ANGLES | BEAMS | CHANNELS

Alro Locations

Locations Map

View the Map below or scan QR Code

● Alro Steel ● Alro Plastics ● Alro Metals Outlet



Alro Locations

Metals Locations

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Alpena, MI
Battle Creek, MI
Bay City, MI
Boca Raton, FL
Bolingbrook, IL
Buffalo, NY
Cadillac, MI
Camdenton, MO
Cedar Rapids, IA
Charlotte, MI
Charlotte, NC
Chicago, IL
Cincinnati, OH
Clarksville, TN
Clare, MI
Columbus, OH
Dayton, OH
Detroit, MI
Flint, MI
Fort Wayne, IN
Grand Rapids, MI
Grayling, MI
Greensboro, NC
Indianapolis, IN
Jackson, MI
Lansing, MI
Livonia, MI
Louisville, KY
Milwaukee, WI
Muncie, IN
Niles, MI
Orlando, FL
Oshkosh, WI
Philadelphia, PA
Pittsburgh, PA
Potterville, MI
Roanoke, VA
Rochester, NY
Sedalia, MO
St. Louis, MO
Tampa, FL
Toledo, OH
Tulsa, OK
University Park, IL
York, PA

Plastics Locations

Clearwater, FL
Chicago, IL
Detroit, MI
Evansville, IN
Grand Rapids, MI
Jackson, MI
Louisville, KY

Outlet Locations

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Baltimore, MD
Cincinnati, OH
Clearwater, FL
Cleveland, OH
Elk Grove Village, IL
Elkhart, IN
Fort Wayne, IN
Grand Rapids,MI
Greensboro, NC
Jackson, MI
Jacksonville, FL
Kalamazoo, MI
Lansing, MI
Livonia, MI
Miami, FL
Orlando, FL
Philadelphia, PA
Pompano Beach, FL
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Syracuse, NY
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Alro Online Store

MyAlro.com

Aluminum • Alloys • Carbon Steel • Stainless Steel • Red Metals • Plastics

Did you know Alro also offers online shopping and e-business solutions for all of our customers? Visit the Alro Online Store from your computer or mobile device 24 hours a day. Set up your company account and purchase metals and plastics from our vast inventory.

Alro utilizes systems technology to achieve the benefits of e-Business in raw material procurement processes.

- **Business to Business (B2B) – Helps reduce purchasing transaction costs.**
- **Web Ordering (MyAlro.com) – Helps with material selection, quoting and estimating.**
- **Automated Inventory Replenishment (APOS) – helps reduce Kan Ban replenishment costs**
- **Summary Billing – helps reduce admin costs of processing raw material payables**
- **Advance Shipping Notices – helps reduce receiving time**

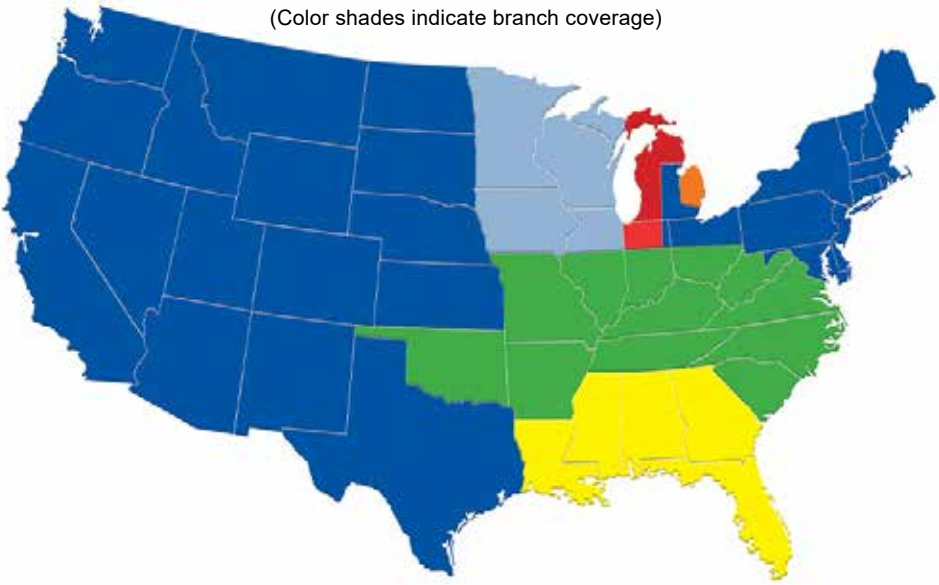
Alro computers retrieve business information from customers/vendors computers via the internet. During the process we pickup and deliver electronic business documents. This process typically does not require any programming on the part of our customers, as Alro systems are designed to accept virtually any customer document format. Some examples of these documents are as follows:

- **Purchase orders**
- **Invoices**
- **Quotes**
- **POD - Electronic Proof of Delivery**
- **ACH Payment notifications**
- **Mill Certifications**
- **CAD drawings**
- **Burn prints**
- **Material releases**

Plastics Locations and Coverage Map

Servicing Warehouse and Contact Information

(Color shades indicate branch coverage)



Jackson, MI

2218 Enterprise
Jackson, MI 49203
Ph: (517) 787-5500
Fx: (517) 787-6380

Detroit, MI

1750 E. Heights Drive
Madison Heights, MI 48071
Ph: (800) 877-2576
Fx: (517) 787-6380

Grand Rapids, MI

4670 60th S.E.
Grand Rapids, MI 49512
Ph: (616) 656-2820
Fx: (616) 656-2828

Chicago, IL

279 Madsen
Suite #102
Bloomingdale, IL 60108
Ph: (888) 877-2576
Fx: (616) 656-2828

Evansville, IN

1414 Baker Avenue
Evansville, IN 47710
Ph: (812) 424-5554
Fx: (812) 421-1265

Louisville, KY

5500 Shepherdsville Rd
Suite #300
Louisville, KY 40228
Ph: (502) 968-9980
Fx: (502) 968-5530

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Over 80 Locations in 16 States!

America's Premier Metals & Plastics Service Center

Clearwater, FL

12171 62nd Street
Suite #150
Largo, FL 33773
Ph: (727) 573-1480
Fx: (727) 573-1632

Decimal Equivalent Chart

Fraction	Decimal (inches)	Decimal (mm)	Fraction	Decimal (inches)	Decimal (mm)
1/64	.015625	.397	33/64	.515625	13.097
1/32	.031250	.794	17/32	.531250	13.494
3/64	.046875	1.191	35/64	.546875	13.891
1/16	.062500	1.588	**9/16**	.562500	14.288
5/64	.078125	1.984	37/64	.578125	14.684
3/32	.093750	2.381	19/32	.593750	15.081
7/64	.109375	2.778	39/64	.609375	15.487
1/8	.125000	3.175	**5/8**	.625000	15.875
9/64	.140625	3.572	41/64	.640625	16.272
5/32	.156250	3.969	21/32	.656250	16.669
11/64	.171875	4.366	43/64	.671875	17.066
3/16	.187500	4.763	**11/16**	.687500	17.463
13/64	.203125	5.159	45/64	.703125	17.859
7/32	.218750	5.556	23/32	.718750	18.256
15/64	.234375	5.953	47/64	.734375	18.653
1/4	.250000	6.350	**3/4**	.750000	19.050
17/64	.265625	6.747	49/64	.765625	19.447
9/32	.281250	7.144	25/32	.781250	19.844
19/64	.296875	7.541	51/64	.796875	20.241
5/16	.312500	7.938	**13/16**	.812500	20.638
21/64	.328125	8.334	53/64	.828125	21.034
11/32	.343750	8.731	27/32	.843750	21.431
23/64	.359375	9.128	55/64	.859375	21.828
3/8	.375000	9.525	**7/8**	.875000	22.225
25/64	.390625	9.922	57/64	.890625	22.622
13/32	.406250	10.319	29/32	.906250	23.019
27/64	.421875	10.716	59/64	.921875	23.416
7/16	.437500	11.113	**15/16**	.937500	23.813
29/64	.453125	11.509	61/64	.953125	24.209
15/32	.468750	11.906	31/32	.968750	24.606
31/64	.484375	12.303	63/64	.984375	25.003
1/2	.500000	12.700	**1**	1.00000	25.400