iapd
international association
of plastics distribution

IAPD THERMOPLASTICS RECTANGLE

Royal Hardware Mart
Solutions Plasticized.

High Strength
High Temperature
High Cost

IMIDIZED

Key Characteristics
Very high cost per pound
Excellent physical properties above 400 degrees F
Excellent electrical properties
Excellent dimensional stability
Low coefficient of friction (COF)

Materials
Polyimide (PI)
Polyamide Imide (PAI)
Polybenzimidazole (PBI)

AMORPHOUS HIGH PERFORMANCE THERMOPLASTICS

Key Characteristics
High cost
High temperature
High strength and good stiffness
Good chemical resistance
Transparent
Hot water and steam resistance

Materials
Polysulfone (PSU)
Polyetherimide (PEI)
Polyethersulfone (PES)
Polyarylsulfone (PAS)
Polyarylethersulfone (PAES)

SEMI-CRYSTALLINE HIGH PERFORMANCE THERMOPLASTICS

Key Characteristics
High cost
High temperature
High strength
Good chemical resistance
Good electrical properties
Low COF
Good toughness

Materials
Polyvinylidene Fluoride (PVDF)
Polytetrafluoroethylene (PTFE)
Ethylene-Chlorotrifluoroethylene (ECTFE)
Fluorinated Ethylene Propylene (FEP)
Polychlorotrifluoroethylene (PCTFE)
Perfluoroalkoxy (PFA)
Polyphenylene Sulfide (PPS)
Polyetheretherketone (PEEK)

AMORPHOUS ENGINEERING THERMOPLASTICS

Key Characteristics
Moderate cost
Moderate temperature resistance
Moderate strength
Good to excellent impact resistance
Good dimensional stability
Good optical qualities
Translucency

Materials
Polycarbonate (PC)
Polyphenylene Oxide (Mod PPO)
Polyphenylene Ether (Mod PPE)
Thermoplastic Polyurethane (TPU)

SEMI-CRYSTALLINE ENGINEERING THERMOPLASTICS

Key Characteristics
Moderate cost
Moderate temperature resistance
Moderate strength
Good chemical resistance
Good bearing and wear properties
Low COF
Difficult to bond

Materials
Nylon (PA)
Acetal (POM)
Polyethylene Terephthalate (PET)
Polybutylene Terephthalate (PBT)
Ultra High Molecular Weight
Polyethylene (UHMW-PE)

AMORPHOUS COMMODITY THERMOPLASTICS

Key Characteristics
Low cost
Low temperature resistance
Low strength
Good dimensional stability
Transparent (typically, but not always)

Materials
Acrylic (PMMA)
Polystyrene (PS)
Acrylonitrile Butadiene Styrene (ABS)
Polyvinyl Chloride (PVC)
Polyethylene Terepthalate Glycol (PETG)
Cellulose Acetate Butyrate (CAB)

SEMI-CRYSTALLINE COMMODITY THERMOPLASTICS

Key Characteristics
Low cost
Low temperature resistance, strength
Low COF
Near zero moisture absorption
Good electrical properties, toughness
Difficult to bond

Materials
High Density Polyethylene (HDPE)
Low Density Polyethylene (LDPE)
Polypropylene (PP)
Polymethylpentene (PMP)

AMORPHOUS KEY CHARACTERISTICS

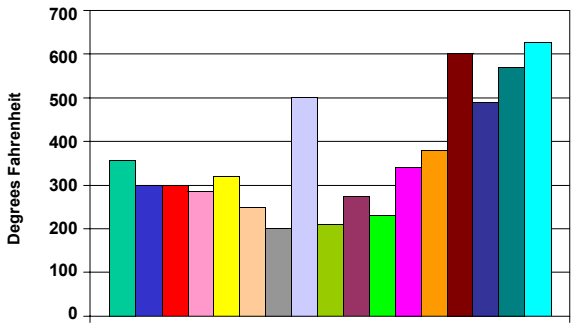
Soften over a broad range of temperatures
Easy to thermoform
Tend to be translucent
Bond well using adhesives and solvents
Prone to stress cracking
Poor fatigue resistance
Structural applications only (not bearing and wear)

SEMI-CRYSTALLINE KEY CHARACTERISTICS

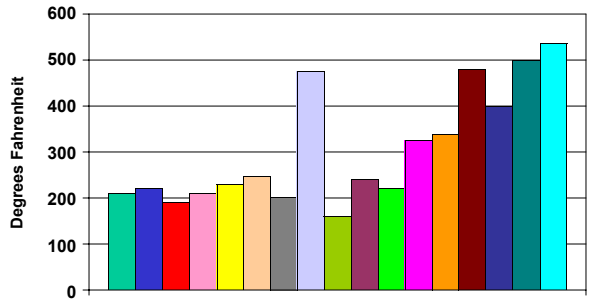
Sharp melting point
Difficult to thermoform
Tend to be opaque
Difficult to bond using adhesives and solvents
Good resistance to stress cracking
Good fatigue resistance
Good for bearing and wear and structural applications

PLASTIC PROPERTY COMPARISON GRAPH

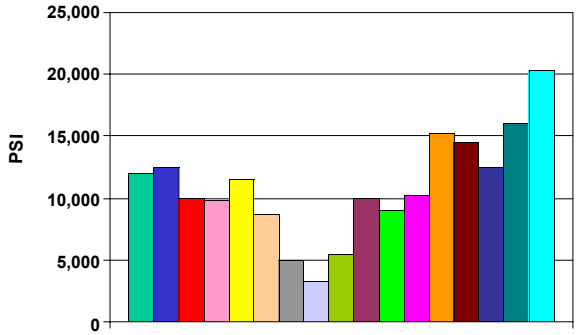
Operating Temperature
Short Term



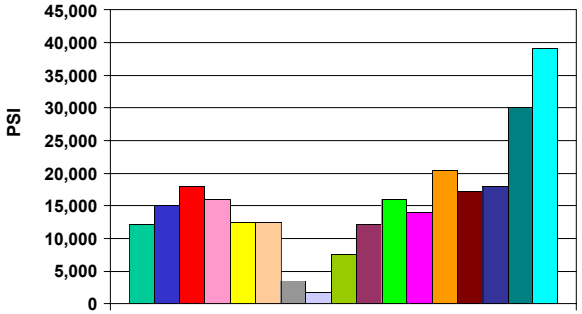
Operating Temperature
Long Term (Constant)



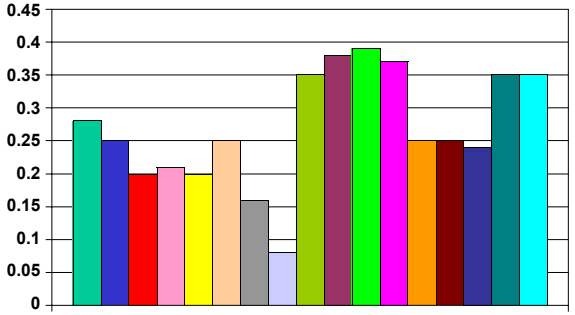
Tensile Strength



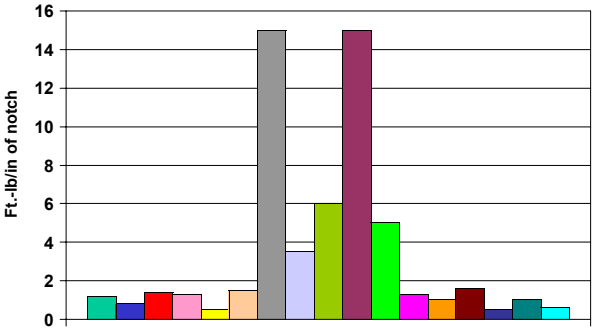
Compressive Strength



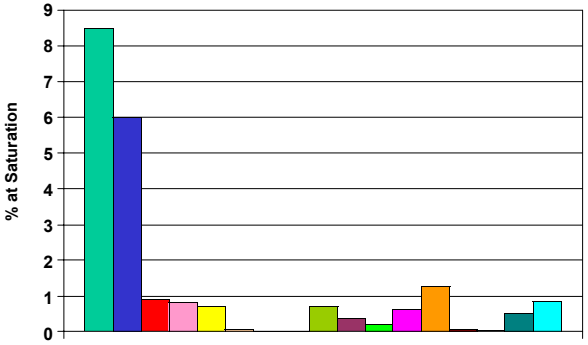
Coefficient of Friction
(Lower has less friction)



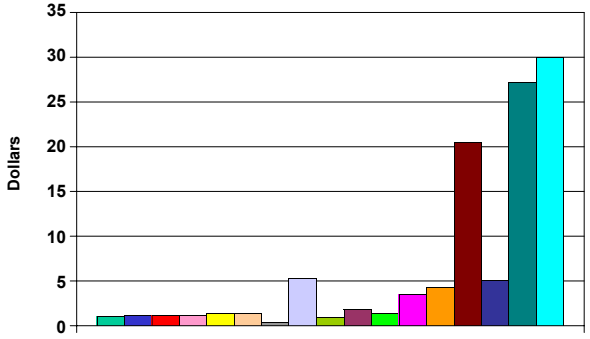
Impact Strength
(The higher the impact the better)



Moisture Absorption



Cost Comparison



- Nylon 6/6
- Cast Nylon
- POM
- POM Copolymer
- Polyester PET-P
- Polyester PBT
- UHMW-PE
- PTFE
- ABS
- PC
- PPO
- PSU
- PEI
- PEEK
- PPS
- PAI
- PI

For more educational products, or to order additional or customized Thermoplastics Rectangles, contact

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international association of plastics distribution

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MATERIAL SELECTION GUIDE

1. GET IN THE RIGHT GROUP
WHAT IS MOST IMPORTANT TO THE APPLICATION?

GENERAL GROUP CHARACTERISTICS

AMORPHOUS THERMOPLASTICS

- Soften over a wide temperature range
- Good formability
- Transparency
- Poor chemical resistance
- Bond well using adhesives or solvents
- Prone to stress cracking
- Poor fatigue resistance
- Structural applications only (not suitable for bearing and wear)

SEMICRYSTALLINE THERMOPLASTICS

- Sharp melting point
- Poor formability
- Opaque
- Good chemical resistance
- Difficult to bond using adhesives or solvents
- Resistant to stress cracking
- Good fatigue resistance
- Good for bearing and wear (as well as structural applications)

IMIDIZED MATERIALS

- Best physical properties above 400ºF
- Best temperature resistance
- Best bearing and wear capabilities
- Good chemical resistance

POTENTIAL MATERIAL CHOICES

- ABS
- Acrylic
- Kydex®
- Noryl®
- PETG
- Polycarbonate
- Polystyrene (HIPS)
- Polysulfone
- PVC
- Radel R®
- Ultem®

POTENTIAL MATERIAL CHOICES

- Acetal
- HDPE
- LDPE
- Nylon
- PBT
- PEEK
- PET
- Polypropylene
- PPS
- PTFE
- PVDF (Kynar®)
- UHMW-PE

POTENTIAL MATERIAL CHOICES

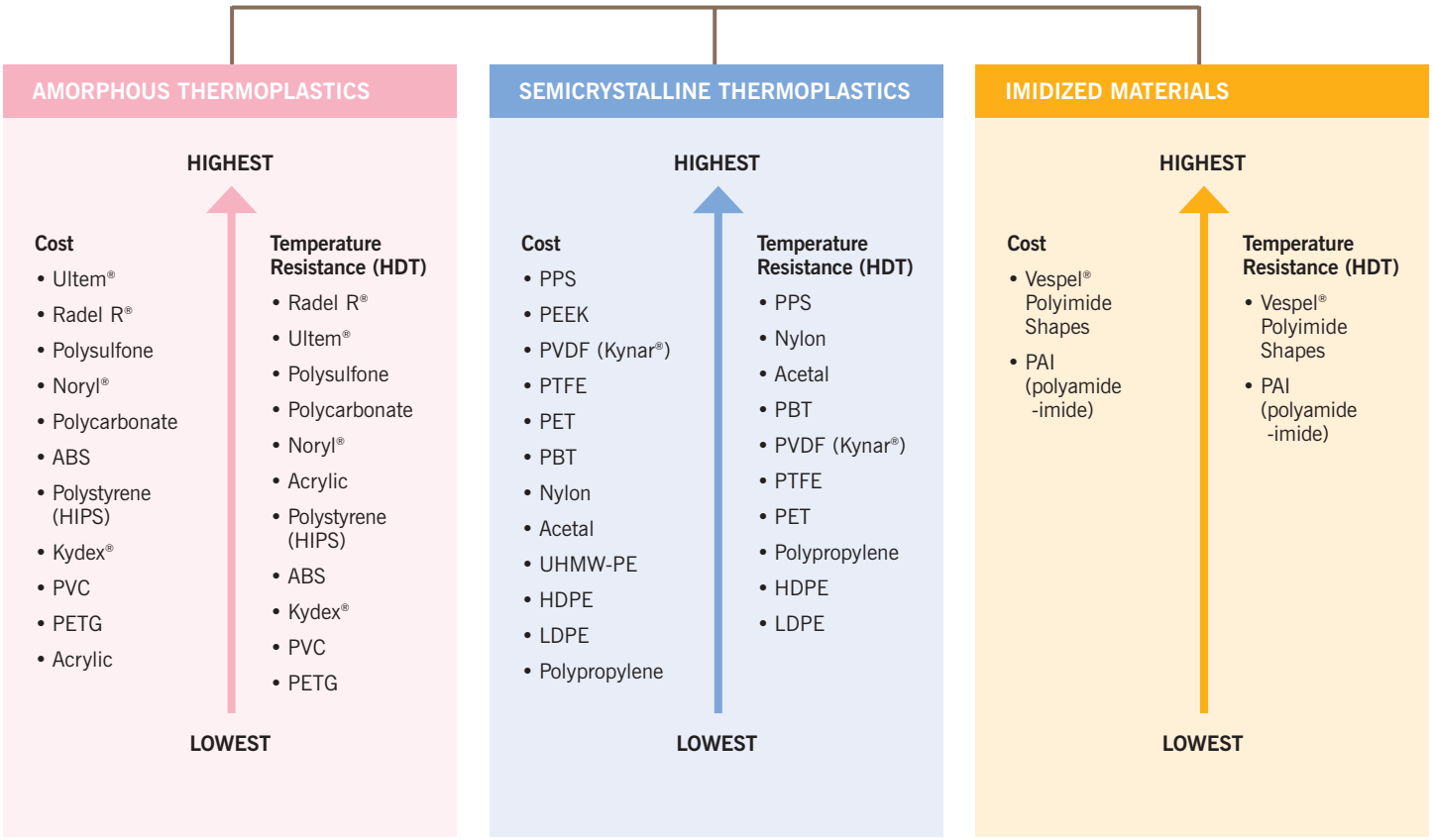
- PAI (polyamide-imide)
- Vespel® Polyimide Shapes

This selector guide is intended to help you review the needs of your particular application and determine a few material candidates that can then be tested.

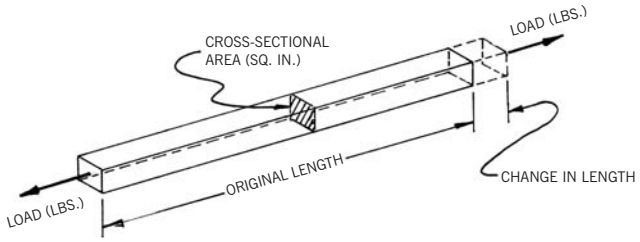
Although the information and statements herein are believed to be accurate, no guarantee of their accuracy is made. The statements and information are included for reference purposes only and are not intended and should not be construed as either a warranty of any type or representations applicable to the particular application, use or design of the buyer or user of the goods. In every case, we recommend that the purchaser or user before using or buying any product perform their own tests and make their own decision to determine to their own satisfaction whether the product is of acceptable quality, type and design and is suitable for the particular purposes under their own operating conditions.

MATERIAL SELECTION GUIDE

2. CHOOSE THE BEST FAMILY
IS TEMPERATURE A FACTOR? HOW CRITICAL IS COST?



MATERIAL SELECTION GUIDE



3. COMPARE THE MECHANICAL PROPERTIES
IS TENSILE STRENGTH (RESISTANCE TO BEING PULLED APART) IMPORTANT?

AMORPHOUS THERMOPLASTICS

Tensile strength - pull apart (psi)

• Ultem®	15,200
• Polysulfone	10,200
• Radel R®	10,100
• Acrylic	10,000
• Noryl®	9,600
• Polycarbonate	9,500
• PETG	7,700
• PVC	7,500
• Kydex®	6,100
• ABS	4,100
• Polystyrene (HIPS)	3,500

SEMICRYSTALLINE THERMOPLASTICS

Tensile strength - pull apart (psi)

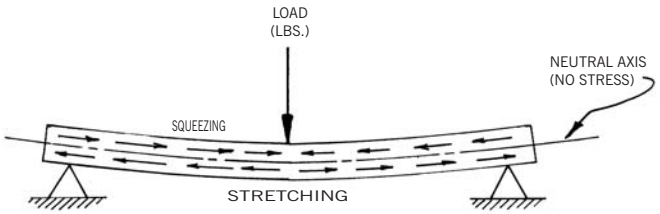
• PEEK	14,000
• Nylon (6 cast)	10,000-13,500
• PPS	12,500
• Nylon (6/6 extruded)	12,400
• PET	11,500
• Acetal (Homopolymer)	10,000
• Acetal (Copolymer)	9,800
• PBT	8,690
• PVDF (Kynar®)	7,800
• Polypropylene (Homopolymer)	5,400
• HDPE	4,000
• Polypropylene (Copolymer)	3,800
• UHMW-PE	3,100
• PTFE	1,500-3,000
• LDPE	1,400

IMIDIZED MATERIALS

Tensile strength - pull apart (psi)

• PAI (polyamide-imide)	21,000
• Vespel® Polyimide SP-1	12,500
• Vespel® Polyimide SP-21	9,500
• Vespel® Polyimide SP-3	8,200
• Vespel® Polyimide SP-22	7,500
• Vespel® Polyimide SP-211	6,500

MATERIAL SELECTION GUIDE



4. COMPARE THE MECHANICAL PROPERTIES IS FLEXURAL MODULUS (BENDING STIFFNESS) IMPORTANT?

AMORPHOUS THERMOPLASTICS

Flexural modulus - stiffness (psi)

• Ultem® (30% glass-filled)	1,300,000
• Polycarbonate (20% glass-filled)	800,000
• PVC	481,000
• Ultem®	480,000
• Acrylic	480,000
• Polysulfone	390,000
• Noryl®	370,000
• Radel R®	350,000
• Polycarbonate	345,000
• Kydex®	335,000
• Polystyrene (HIPS)	310,000
• PETG	310,000
• ABS	304,000

SEMICRYSTALLINE THERMOPLASTICS

Flexural modulus - stiffness (psi)

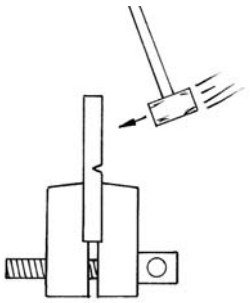
• PPS	600,000
• PEEK	590,000
• Nylon (6 cast)	420,000-500,000
• Acetal (Homopolymer)	420,000
• Nylon (6/6 extruded)	410,000
• PET	400,000
• Acetal (Copolymer)	370,000
• PBT	330,000
• PVDF (Kynar®)	310,000
• Polypropylene (Homopolymer)	225,000
• Polypropylene (Copolymer)	215,000
• HDPE	200,000
• UHMW-PE	110,000
• PTFE	72,000
• LDPE	30,000

IMIDIZED MATERIALS

Flexural modulus - stiffness (psi)

• PAI (polyamide-imide)	711,000
• Vespel® Polyimide SP-22	700,000
• Vespel® Polyimide SP-21	550,000
• Vespel® Polyimide SP-3	475,000
• Vespel® Polyimide SP-211	450,000
• Vespel® Polyimide SP-1	450,000

MATERIAL SELECTION GUIDE



5. COMPARE THE MECHANICAL PROPERTIES IS IZOD IMPACT (TOUGHNESS) IMPORTANT?

AMORPHOUS THERMOPLASTICS

Izod impact (notched) - toughness (ft-lbs/in)

• Kydex®	18
• Polycarbonate	12.0-16.0
• Radel R®	13
• ABS	7.7
• Noryl®	3.5
• Polystyrene (HIPS)	2.0
• PETG	1.7
• Polysulfone	1.3
• Ultem®	1.0
• PVC	1.0
• Acrylic	0.4

SEMICRYSTALLINE THERMOPLASTICS

Izod impact (notched) - toughness (ft-lbs/in)

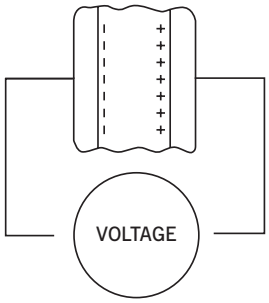
• LDPE	no break
• UHMW-PE	18.0
• Polypropylene (Copolymer)	12.5
• PTFE	3.5
• PVDF (Kynar®)	3.0
• PEEK	1.6
• PBT	1.5
• Acetal (Homopolymer)	1.5
• Polypropylene (Homopolymer)	1.2
• Nylon (6/6 extruded)	1.2
• Acetal (Copolymer)	1.0
• Nylon (6 cast)	0.7-0.9
• PET	0.7
• PPS	0.5

IMIDIZED MATERIALS

Izod impact (notched) - toughness (ft-lbs/in)

• PAI (polyamide-imide)	2.3
• Vespel® Polyimide SP-21	0.8
• Vespel® Polyimide SP-1	0.8
• Vespel® Polyimide SP-3	0.4

MATERIAL SELECTION GUIDE



6. COMPARE THE PROPERTIES
IS DIELECTRIC STRENGTH (ELECTRICAL INSULATION) IMPORTANT?

AMORPHOUS THERMOPLASTICS

Dielectric strength - insulation (v/mil)

• Ultem®	830
• PVC	544
• Kydex®	514
• Noryl®	500
• Acrylic	430
• Polysulfone	425
• PETG	410
• Polycarbonate	380
• Radel R®	360

SEMICRYSTALLINE THERMOPLASTICS

Dielectric strength - insulation (v/mil)

• Nylon (6 cast)	500-600
• Acetal (Homopolymer)	500
• Acetal (Copolymer)	500
• PTFE	400-500
• PEEK	480
• PPS	450
• PET	400
• PBT	400
• Nylon (6/6 extruded)	300-400
• PVDF (Kynar®)	280

IMIDIZED MATERIALS

Dielectric strength - insulation (v/mil)

• PAI (polyamide-imide)	600
• Vespel® Polyimide SP-1	560

MATERIAL SELECTION GUIDE

7. THINK ABOUT THE APPLICATION - IS FDA COMPLIANCE IMPORTANT?

AMORPHOUS THERMOPLASTICS

FDA compliant grades available:

- Acrylic
- PETG
- Polycarbonate
- Polystyrene (HIPS)
- Polysulfone
- PVC
- Radel R®
- Ultem®

SEMICRYSTALLINE THERMOPLASTICS

FDA compliant grades available:

- Acetal
- HDPE
- LDPE
- Nylon
- PBT
- PEEK
- PET
- Polypropylene
- PTFE
- PVDF (Kynar®)
- UHMW-PE

The virgin, natural, unfilled formulations of the sheet, rod, tube, and film products listed here are available from Curbell Plastics, Inc. in grades that comply with one or more of the FDA's guidelines for direct food contact at room temperature.

It is important to specify FDA compliant material at the time of the order to ensure that FDA compliant material is provided.

8. THINK ABOUT THE APPLICATION - IS CHEMICAL RESISTANCE IMPORTANT?

SEMICRYSTALLINE THERMOPLASTICS

Good chemical resistance:

- Acetal
- HDPE
- LDPE
- Nylon
- PBT
- PEEK
- PET
- Polypropylene
- PPS
- PTFE
- PVDF (Kynar®)
- UHMW-PE

See pages 76-77 for more specific information

IMIDIZED MATERIALS

Good chemical resistance:

- PAI (polyamide-imide)
- Vespel® Polyimide Shapes

See pages 76-77 for more specific information