

Welcome to:

**PRIMEX** 

A subsidiary of ICC Corporation Inc.

Materials Training



# Material Strengths & Weaknesses!

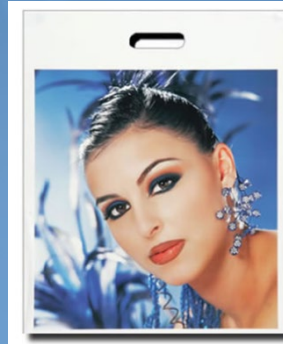
*Primex Plastics Corporation  
Committed to the Development of our  
Most Important Assets (You)*



Perfume packaging



Digital Printing



Food Packaging



Point of Purchase



Refrigerator liners



Window Trim



*Thermoforming/Fabrication grades*

# High Impact Polystyrene



# Polystyrene Strengths

- ❖ Relatively easy to process
- ❖ Matches most colors readily, and consistently, lot to lot
- ❖ Can be FDA, ROHS certified
- ❖ Economical compared to other thermoformable material
- ❖ Relatively easy to add modifiers, such as impact modifier, anti-stat
- ❖ Multiple layer capable (Co-ex or tri layer)
- ❖ Can be made UV resistant ; acrylic co-ex or film, hi or low gloss
- ❖ Die cuts and trims fairly easily
- ❖ Formed parts have sharp detail
- ❖ Not hygroscopic; will not absorb water
- ❖ Can be recycled/reprocessed
- ❖ Versatile tooling capable





# Polystyrene weaknesses

- ❖ Limited performance capability; heat, cold, impact, UV resistance, chemicals and solvents
- ❖ FDA capability limited to < 20% impact modifiers
- ❖ Polymer will begin to break down quickly if untreated sheet is exposed to UV
- ❖ Cannot be formed consistently with masking
- ❖ Polymer breaks down fairly fast if reprocessed multiple generations without adding virgin resin.
- ❖ Luminique clears can be difficult to print





Paddle Boat HMWPE



Playground Swirl HMWPE



Lawn & Garden HMWPE



HMWPE SR



Drum Liner LDPE



Calf Houses HMWPE

*HDPE; HMWPE; Co-Ex PE; LDPE*

# POLYETHYLENE




# PE Strengths

- ❖ Extremely versatile and tough
- ❖ Relatively straightforward thermoforming, moderate difficulty
- ❖ Chemically resistant to petrochemicals / many solvents
- ❖ With protection package, excellent UVI
- ❖ Embosses well, multiple surfaces available
- ❖ Reprocesses very well, multiple generation capability
- ❖ Co-ex capability, non skid
- ❖ Can modify orientation to enhance forming
- ❖ Easy to color consistently, lot to lot
- ❖ Can be twin sheet formed
- ❖ Can be talc, calcium, or rock filled to enhance performance, HDT





# PE Weaknesses

- ❖ Tool costs can be high; Formers must use Aluminum temp control tooling with and without plug assists
  - ❖ Non Forming applications can be tricky if flatness is important
  - ❖ Formed parts may not show sharp detail
  - ❖ Limited performance in high temp environment
  - ❖ Not good if you want to glue or paint it
  - ❖ CLTE can be an issue with wide temp use
  - ❖ Residual stress will cause warping
  - ❖ Parts may require post-form jig tooling
- 



# Identifying Polyethylene

- **Density**

- Type I 0.910 – 0.925 (LDPE)
- Type II 0.926 – 0.940 (MDPE)
- Type III 0.941 – 0.959 (HDPE)
- Type IV 0.960+ (Homopolymer HDPE)

**As Density increases, so does Tensile Strength @ Yield, Vicat Softening Temperature, Chemical Resistance, Stiffness, and Hardness. An increase in Density decreases Elongation, Low Temperature Impact, ESCR, and Permeability.**





# Identifying Polyethylene

- **Melt Index @ 190° C and 2.16kg (FMI)**

-Category 1	25+
-Category 2	10 - 25
-Category 3	1.0 - 10
-Category 4	0.4 – 1.0
-Category 5	< 0.4

As Melt Index increases, so does the flow of the material. A high flow material has low viscosity. Higher flow materials will sag more during forming. These materials are able to more evenly fill out intricate molds, but are also more prone to webbing. Higher flow materials will also have less Mold Shrinkage.



# Identifying Polyethylene

- **Molecular Weight**
  - As Molecular Weight increases the Melt Index decreases
  - As Molecular Weight increases so does Melt Viscosity, Tensile Strength, Creep Resistance, Impact, and Low Temperature Performance
- **Molecular Weight Distribution**
  - A narrow MWD will yield less warp
  - A broad MWD is easier to process

These are not results that are typically readily available for the resins. They are not listed on the TDS's and not reported on the COA's.



## HMWPE Property Comparison

Property	Method	Unit	HMWPE 1000	HMWPE 1500
<i>Specific Gravity</i>	D1505		0.949	0.945-0.965
<i>Melt Flow</i>	D1238	g/10 minutes	10	4.5-20
<i>TS@Y</i>	D638	psi	3,600	2,000-4,000
<i>Elongation</i>	D638	%	>600	>300
<i>Flexural Modulus</i>	D790	psi	170,000	100,000-200,000
<i>ESCR</i>	D1693	hrs	>600	>300
<i>Vicat</i>	D1525	°F	258	245-260
<i>Brittleness Temp</i>	D746	°F	<-131	<-100



Candy Trays



PO 500 Car Bumpers



Orthopedic & Prosthetics



Printed packaging



Food Storage Containers



Microwave Trays

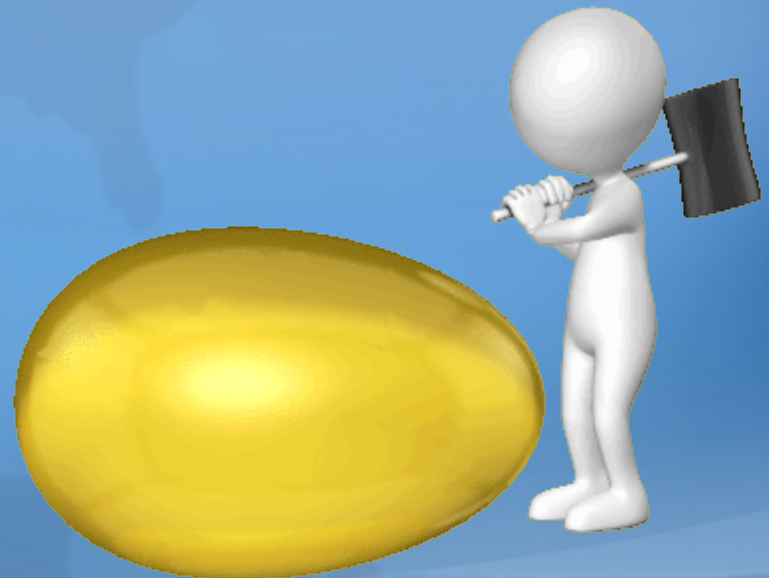
*Homopolymer & CoPolymer PP*

# POLYPROPELENE



# Polypropylene Strengths

- ❖ Excellent Chemical Resistance
- ❖ Low Taste and Odor (FDA) for Packaging
- ❖ Provides good moisture barrier
- ❖ Fabricates easily
- ❖ Cold Temp for frozen foods
- ❖ Microwave applications
- ❖ High heat deflection
- ❖ Impact
- ❖ Stiffness





# Polypropylene Weaknesses

- ❖ Longer Heating and cooling times (Longer Cycle times)
- ❖ High Shrinkage rate (Trimming issues)
- ❖ Narrow melting point, yield smaller processing window
- ❖ Homopolymer is not a cold temp material







# PRIMEX

A subsidiary of ICC Corporation Inc.



Prime ABS Weather-X 200



Prime ABS 752



Prime ABS Duralux



Prime ABS Weather-X ML 500



Prime ABS 200 GT

*Thermoforming/Fabrication grades*  
**ABS (Acrylonitrile Butadiene Styrene)**



# ABS strengths

- ❖ Ease of fabrication and coloring.
- ❖ High impact resistance with toughness and rigidity.
- ❖ Good electrical properties.
- ❖ Several weatherable options available in combination with acrylic films and resins and ASA resins.
- ❖ Ease of forming by conventional methods (wide forming window).
- ❖ Easily printed, painted, or bonded with adhesives.





# ABS weaknesses

- ❖ Poor solvent resistance.
- ❖ Easily yellows as a result of exposure to excessive or prolonged heat and UV radiation.
- ❖ May need to be dried prior to processing (hygroscopic).
- ❖ Poor elongation.







## Grades of PETG

*Polyethylene Terephthalate Glycol-Modified*

**14471:** Prime and Utility sheet or Roll stock

**6763:** Prime Medical grade (No longer available)



Blister Packs



Decorative Panels



Display Cases



Helmet shells



Food Trays

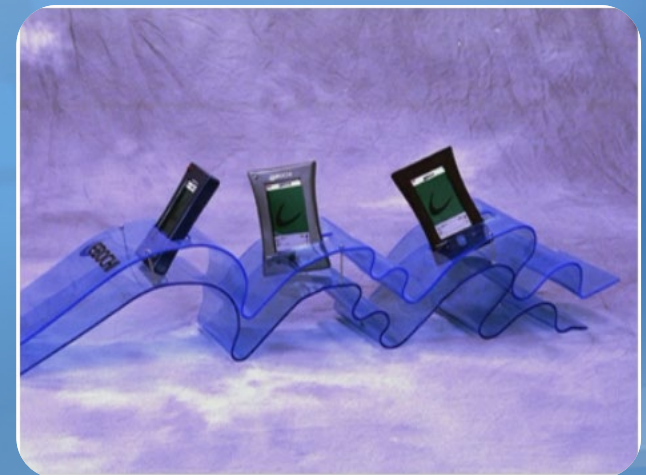


Distortion Print/Forming

*Thermoforming/Fabrication grades*  
**PETG (Polyethylene Terephthalate Glycol)**

# PETG Flexibility

- ❖ Spectar™ PETG 14471 gives outstanding design freedom
- ❖ Fabricators are able to achieve intricate designs
- ❖ PETG has superior thermoforming capabilities
- ❖ There is no need to dry PETG sheet before thermoforming
- ❖ PETG cold bends (brake bends) without stress-whitening
- ❖ Screen print, digital print, spray paint, and hot-stamp
- ❖ Easy to die cut



# PETG Durability

- ❖ Sheet made from Spectar™ PETG 14471 resin has outstanding impact strength
- ❖ PETG is 18 times tougher than acrylic
- ❖ PETG is 3 – 10 times tougher than impact-modified acrylic
- ❖ Reduced breakage in shipping
- ❖ Longer lasting displays
- ❖ Ease of fabrication: Routing, bending, sawing, drilling, thermoforming, punching, shearing, and bonding
- ❖ Excellent resistance to chemicals







# PETG Weaknesses

- ❖ PET and PETG are not inherently UV-stable, meaning they will yellow and become brittle when exposed to the sun for long periods of time
- ❖ PETG has a much lower water absorption than nylon and a low resistance to alkalis and hot water.
- ❖ PETG has a lower impact resistance than Polycarbonate and is more difficult to cut.
- ❖ PETG gluing and bondability issues also exist, but the "practice makes perfect" method can be put to use.





# PET ACRONYMS

**PETE** – Generic identification of polyester materials that is associated with Recycle Code <1>.

**PET** – Polyethylene Terephthalate – This is an all-inclusive code for polyester materials.

**APET** – Amorphous Polyethylene Terephthalate – The ‘A’ defines the solid state of the material. APET is a clear material.

**CPET** – Crystalline Polyethylene Terephthalate – The ‘C’ defines the solid state of the material.

CPET is Opaque white in color

**RPET** – Recycled Polyethylene Terephthalate – Virgin materials would most likely be classified as just PET. Recycled materials are identified as RPET.





# PET strengths

- ☐ Improved Tensile Strength
- ☐ High HDT (240)
- ☐ Overall Toughness
- ☐ Potential Down Gauging
- ☐ Clarity
- ☐ Low Cost

Compared to PMMA, PC, PP, PETG, and PVC







# PET Weaknesses

- ☐ Higher Density
- ☐ Elongation
- ☐ Notch Sensitivity
- ☐ Crystallizes

Compared to PMMA, PC, PP, PETG, and PVC





# PRIMEX Plastics Corporation

*Primex Plastics is committed to the development  
Of our Most important assets, which are our  
employees. We would like to take this opportunity to say,*

**Thank You!**

[PRIMEXPLASTICS.COM](http://PRIMEXPLASTICS.COM)