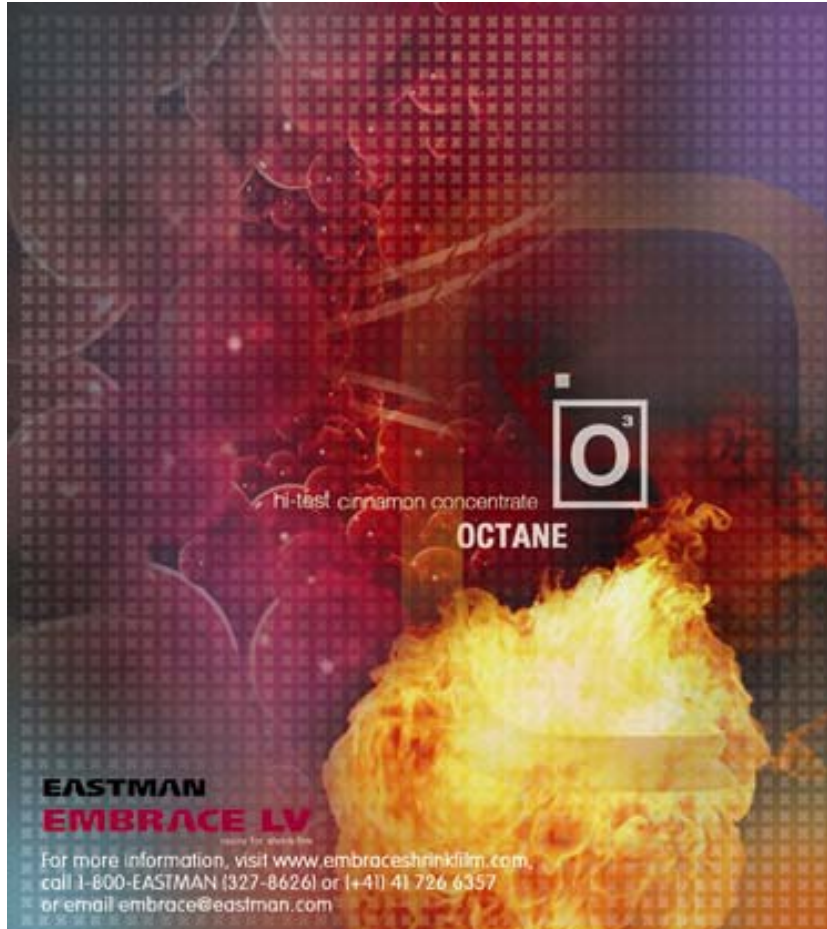


EMBRACE LV

resins for shrink film



Creating Value
for the
Extruder

EASTMAN

What does the "LV" mean in EMBRACE LV Resins?



L = Low Shrink Force

EMBRACE LV resin has a lower shrink force than current EMBRACE resin, up to 50% reduction

V = Versatile Shrink Curve

EMBRACE LV resin maintains high ultimate shrinkage offering the extruder the choice of making a shrink curve with a traditional EMBRACE resin shape, a PVC shape or a OPS shape.

EMBRACE LV Resin – Value Propositions



ALL

- High Ultimate Shrinkage
- No "Smiley Faces"
- Robust Processing Clear Shrink Film

Extruders

- Multiple Shaped Shrink Curve Offerings
- One 0.75 IV Reactor Grade Resin
- No Natural Shrinkage

Print Converters

- Current Printing and Seaming Systems
- Low Shrink Force
- No Machine Directional Shrinkage

Brand Owners

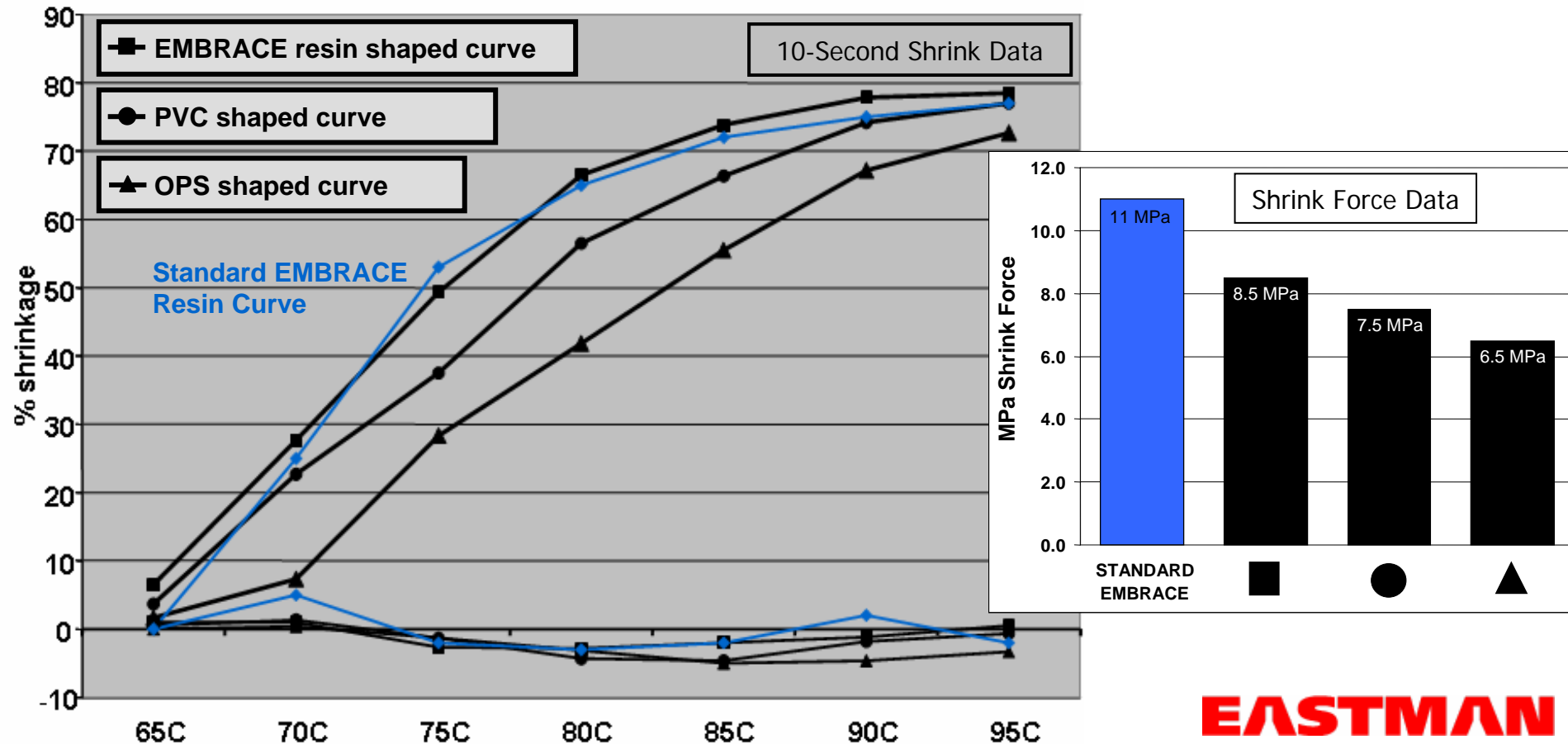
- Brand Specific Container Design Freedom
- Eye Catching Shelf Appeal
- Application in Steam and Hot Air Shrink Tunnels

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EMBRACE LV Resin Shrink Curves & Shrink Force

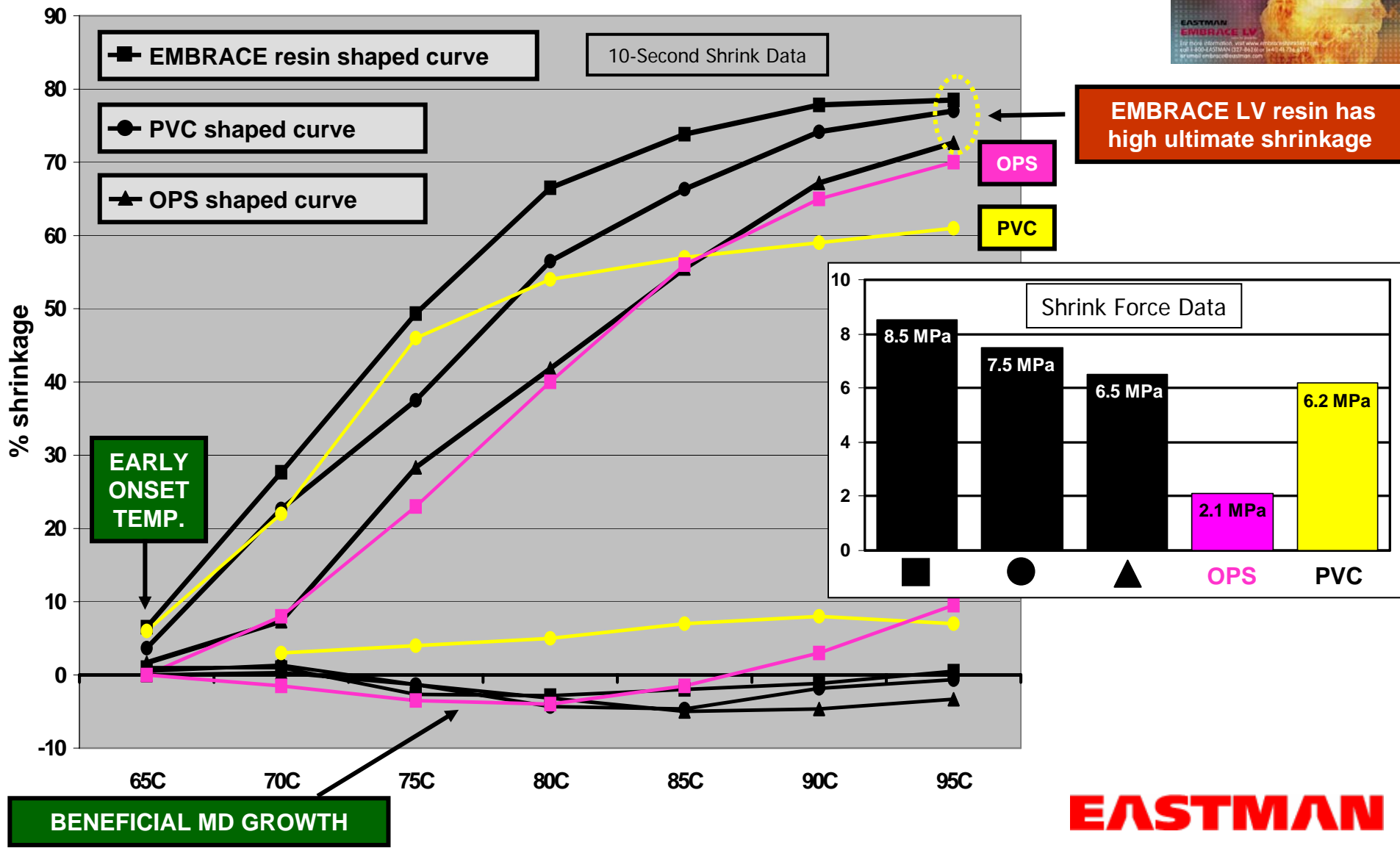


- Shrink curves and shrink force generated from films produced at Marshall & Williams and validated at commercial extrusion trials
- EMBRACE LV resin offers the extruder various shrink curve shapes, all with high ultimate shrinkage & low shrink force and from a single product



EMBRACE LV Resin vs. Competitive Resins

Comparative shrink curves and shrink force to competitive resins



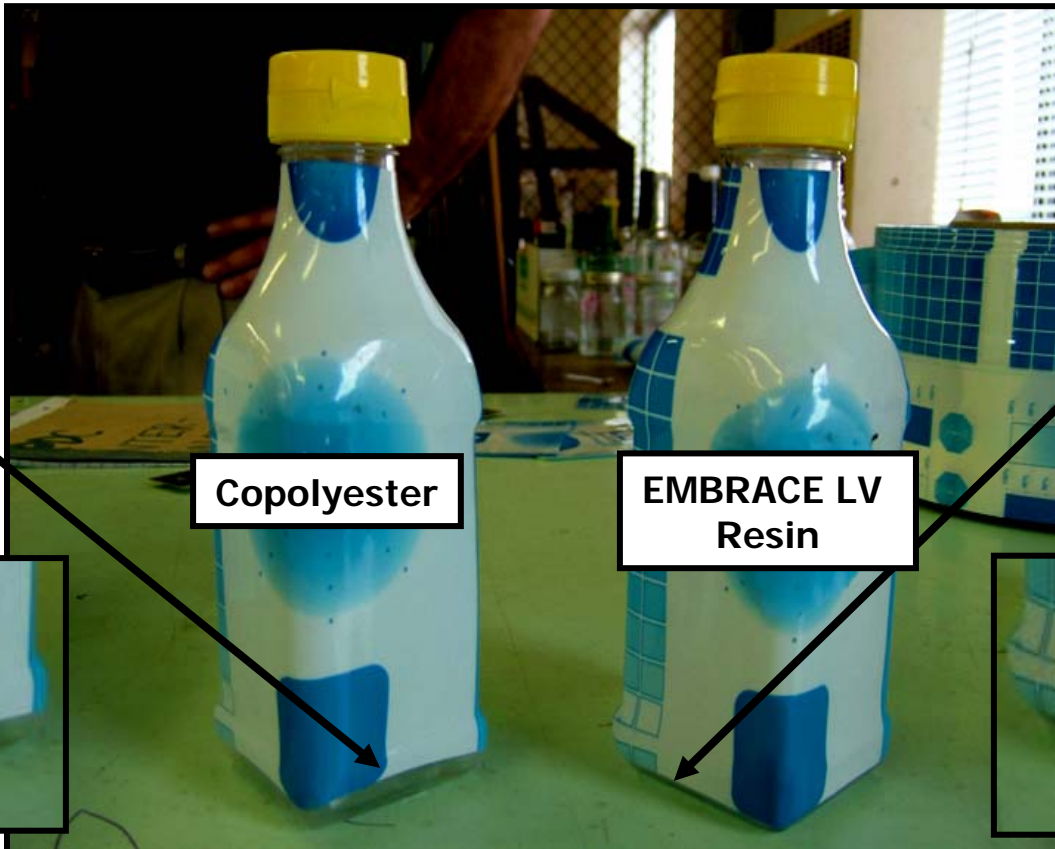
Low Shrink Force & MD Growth

- EMBRACE LV resin experiences MD growth of 5% to 8%, making shrinking easier in the shrink tunnel
- MD shrinkage at critical low temperatures, such as 70° C, can cause the label to creep up from the bottom or down from the top when sleeving a container.



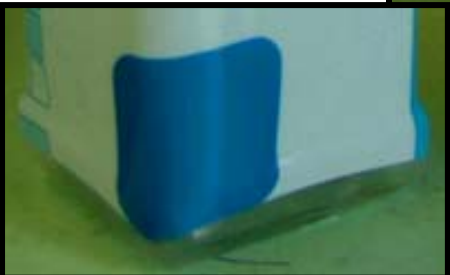
High Shrink Force
+
5% MD shrink

Low Shrink Force
+
5% MD growth



Copolyester

EMBRACE LV Resin



Shrink Force & MD Shrinkage

What does low shrink force and no MD shrinkage mean?

- Uniform Shrinkage
- Easy to Control Shrinkage
- No Smiley Faces



High Shrink
Force
+
5% MD **shrink**

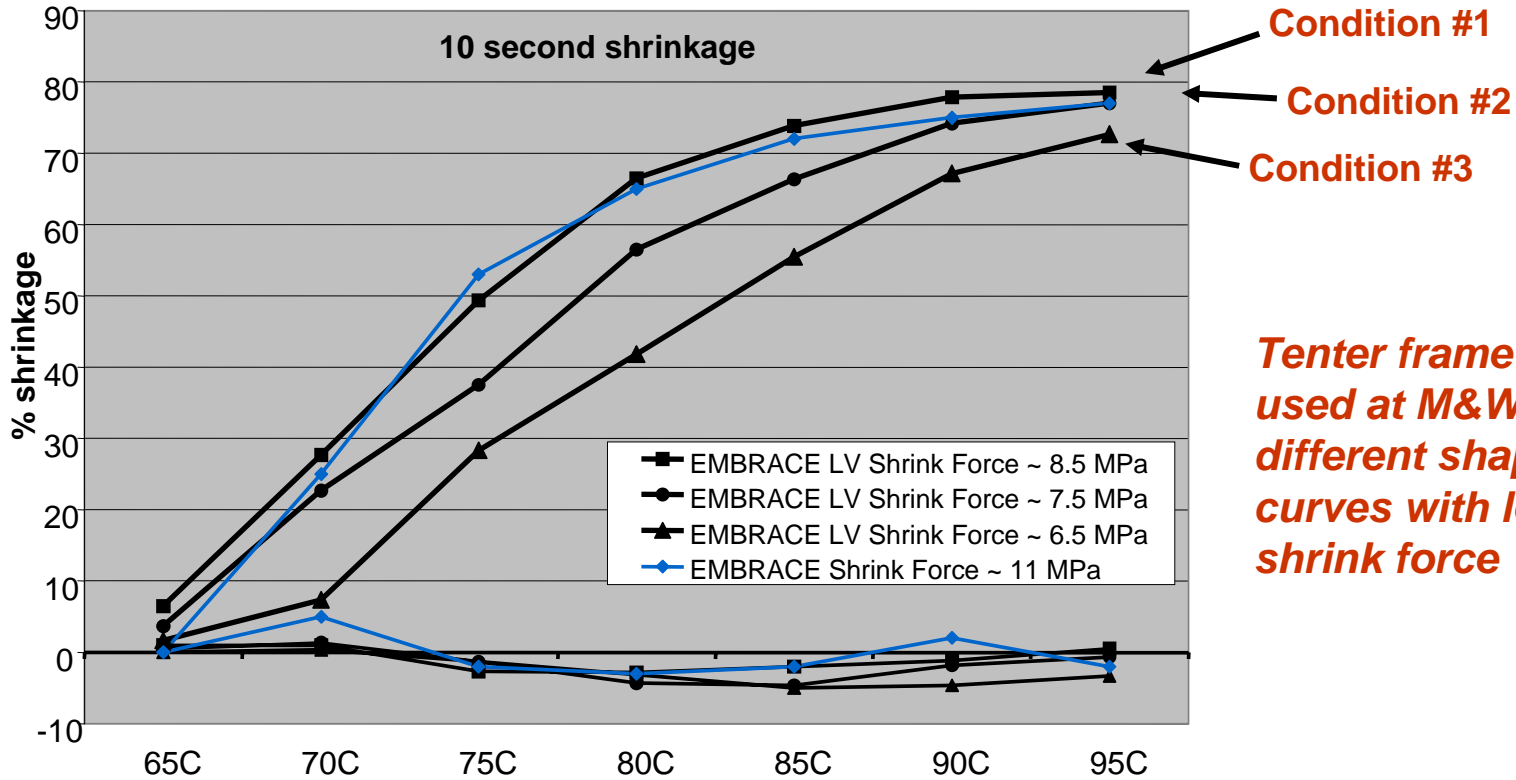
Copolyester

EMBRACE LV
Resin

Low Shrink
Force
+
5% MD **growth**



Marshall & Williams - Tenter Frame Conditions



Tenter frame conditions used at M&W to make different shaped shrink curves with lowered shrink force

Stretch Conditions	# 1	# 2	# 3
Linespeed FPM	50	50	50
Beginning Stretch Ratio	5.25	5.25	5.25
Clip Retraction (%)	5%	5%	5%
Finished Stretch Ratio	5	5	5
T _{preheat} °F	175	175	175
T _{stretch} °F	175	175	175
T _{anneal} °F	170	180	190

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EMBRACE LV Processing Guidelines: Drying & Extrusion

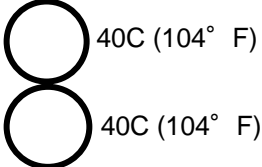


Drying

- Dry EMBRACE LV for **6 to 8 HOURS** at **55C (135° F)**
- Use a dehumidifying dryer with a dew point temperature of -30C to -40C (-22° F to -40° F)
- Airflow rate should be 1 CFM /lb /hr
- The recommended pellet moisture level is <0.05 wt% or <500 ppm
- Insufficient drying leads to excess MW loss during extrusion, resulting in decreased physical properties

Extrusion

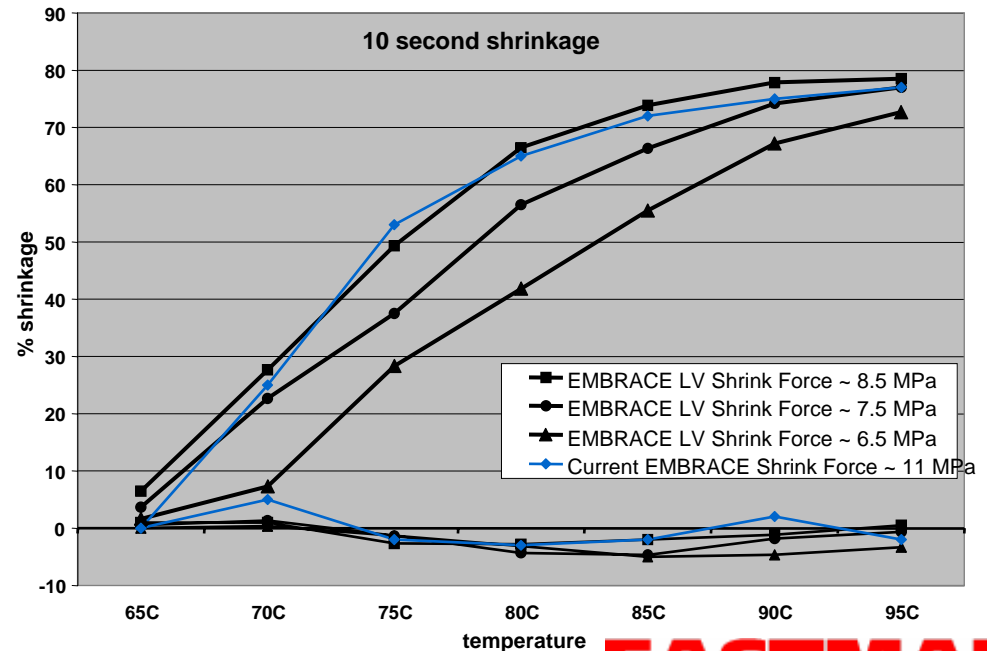
- Similar extrusion profile to EMBRACE
- Feed throat cooling and screw cooling is needed
- The following guidelines and temperature profile should be suitable for most equipment:

SCREW	BARREL TEMPERATURES	ADAPTER	DIE	SCREEN PACK	ROLL COOLING
65mm (2.5") Square pitch or barrier screw L:D = 24:1 to 32:1 3:1 compression ratio	Zone 1 = 250C (480° F) Zone 2 = 250C (480° F) Zone 3 = 250C (480° F) Zone 4 = 250C (480° F)	250C (480° F)	250C (480° F)	24 / 80 / 24 mesh	 40C (104° F) 40C (104° F)

***This slide consists of general processing guidelines only.
Processing conditions may differ depending on specific equipment.
Please contact your EMBRACE HY technical service representative for more detailed guidance.***

Benefits of EMBRACE LV Resin for the Print Converter

- Typical 5% MD growth offers material saving value when sizing shrink sleeve labels
- Larger shrink window in the shrink tunnel due to lower on set temperature
- No natural shrinkage means film dimensional stability during printing, storage and sleeving operations



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Benefits of EMBRACE LV Resin for the Brand Owner



- Eliminate "smiley faces" on oblong and square containers
- High quality shrinkage characteristics help insure eye catching shelf appeal
- Design freedom for use on highly contoured, brand specific containers
- Compatible with steam and hot air tunnels

Comparison of Film From EMBRACE LV Resin



2 mil SHRINK Film

Property	Test Method	Typical Value, Units		
		EMBRACE LV	EMBRACE (Control)	EMBRACE (Data Sheet)
Inherent Viscosity	EMN-A-AC-G-V-	0.69	0.69	0.7
Thickness of Film Tested		50 microns (2 mils)	50 microns (2 mils)	50 microns (2 mils)
Density	D1505	1.32 g/cm ³	1.35 g/cm ³	1.3 g/cm ³
Haze	D1003	4.9%	10%	4.9%
Gloss @ 60°	D2457	110	117	139
Transparency	D1746	98%	96%	85%
Regular Transmittance	D1003	87%	81%	86%
Total Transmittance	D1003	92%	91%	92%
Color	D2244	L*	95.8	95.9
		a*	0.02	0.02
		b*	0.38	0.37
Water Vapor Transmission Rate 38° C(100° F) ay 100% RH	F1249	1.6g/100in. ² *24h	1.2g/100in. ² *24h	1.3g/100in. ² *24h
Gas Permeability, O ₂ @ 30° C (86° F) at 68%RH	D3985	9.9 cm ³ *mil/100in ² *24h*atm	9.6 cm ³ *mil/100in ² *24h*atm	9.1 cm ³ *mil/100in ² *24h*atm
Elmendorf Tear Resistance M.D.	D1922	2.4N (242 gf)	1.2N (126 gf)	1.2N (120 gf)
		T.D.	NO DATA	NO DATA
Tear Propagation Resistance, Split Tear Method @ 254 mm/min (10 in./min)	D1938	28 N/mm (160 lbf/in.)	40 N/mm (230 lbf/in.)	NOT ON DATA SHEET
		T.D.	3 N/mm (16 lbf/in.)	3 N/mm (16 lbf/in.)

Comparison of Film From EMBRACE LV Resin



2 mil SHRINK Film

Property	Test Method	Typical Value, Units		
		EMBRACE LV	EMBRACE (Control)	EMBRACE (Data Sheet)
Tensile Strength @ Yield	D882			
M.D.		43 MPa (6200 psi)	45 MPa (6200 psi)	NOT ON DATA SHEET
T.D.		105 MPa (15200 psi)		NOT ON DATA SHEET
Elongation @ Yield	D882			
M.D.		3%	4%	NOT ON DATA SHEET
T.D.		4%		NOT ON DATA SHEET
Tensile Strength @ Break	D882			
M.D.		49 MPa (7100 psi)	49 MPa (7100 psi)	42 MPa (6100 psi)
T.D.		258 MPa (37400 psi)	284 MPa (41000 psi)	290 MPa (41000 psi)
Elongation @ Break	D882			
M.D.		480%	490%	265%
T.D.		42%	33%	34%
Tensile Modulus	D882			
M.D.		2000 MPa	1900 MPa	1800 MPa
T.D.		5300 MPa	6700 MPa	7250 MPa
Glass Transition Temperature (Tg)	D1525	71° C (159° F)	74° C (165° F)	76° C (169° F)
Surface Tension, Harmonic Mean				
Dispersive		44 dynes/cm	46 dynes/cm	38 dynes/cm
Polar		3 dynes/cm	2 dynes/cm	9 dynes/cm
Total		48 dynes/cm	48 dynes/cm	47 dynes/cm

EMBRACE LV

resins for shrink film

*The innovative, one resin solution
for the shrink body label market.*



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