10 Easy Ways to Analyze Your Plastic Parts for Ensuring Optimum Performance

presented by:

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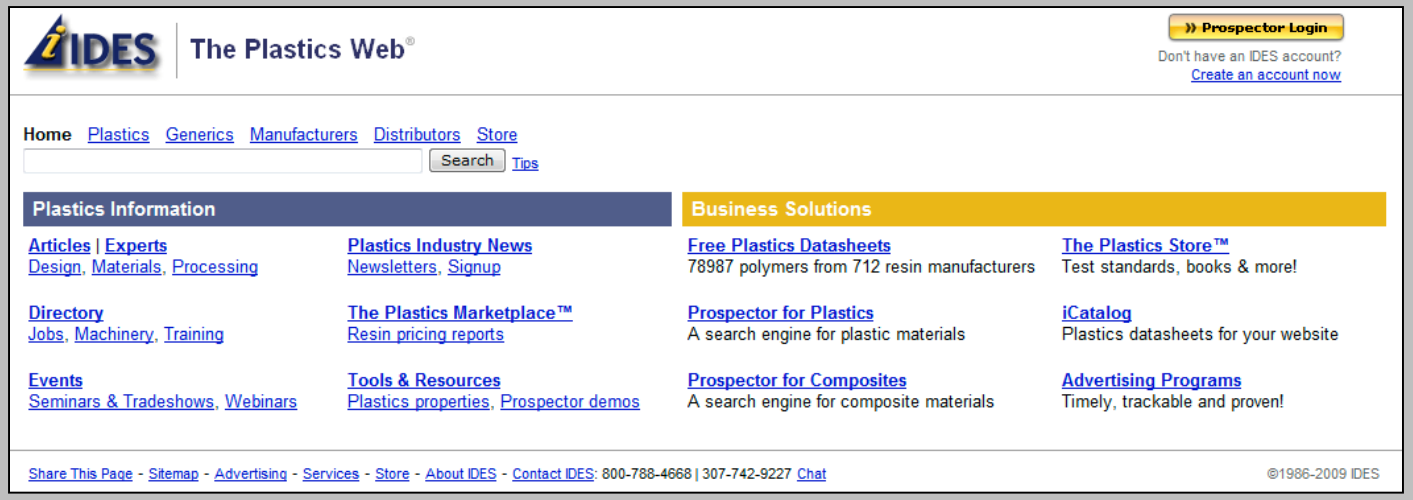

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Best Molding Practices

April 29, 2009

10 Easy Ways to Analyze Your Plastic Parts

- Visual Inspection
- Dimensional
- Polarized Light
- Burn Test
- Density
- Heat Distortion
- Viscosity
- Weight
- Solvent
- Regrind

- Special Offer
- Questions & Answers

Visual Inspection

Can Be Used To Locate:

- Stresses
- Cracking
- Crazing
- Degradation
- Burning
- Discoloration
- Contamination

Visual Inspection

Enhanced Vision:

- Adjustable Lighting
- High Power Lamps
- Increased Magnification

Visual Inspection

Different Lighting:

- Ultraviolet
- Fluorescent
- Incandescent
- Halogen
- Sodium Vapor
- LED light bulbs
- Black Light

Dimensional

After Molding, Polymers:

- Shrink
- Warp
- Distort

Dimensional

These Effects Are Exponential
Over Time, Often On A Log Scale.

Dimensional

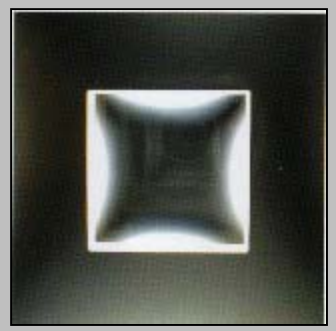
Take Dimensions After:

- 30-60 Minutes
- Annealing
- Simulating End Use

Polarized Light

Polarized Light Inspection:

- Determine Stress Concentrations
- Determine Degree Of Crystallinity
- Determine Amount Of Orientation



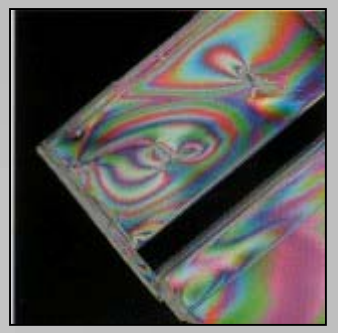
Polarized Light

When You Polarize Light, You Essentially Cause All Light Waves To Vibrate In One Direction.

Polarized Light

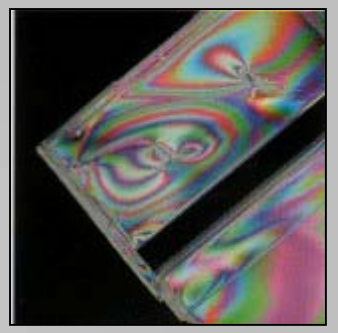
If You Oppose Two Polarized Plates At 90º, The Light Does Not Pass Through Second Plate.

Polarized Light



Light Waves Passing Through A Translucent Part Can Be Rotated When They Encounter Stresses.

Polarized Light



Only Rotated Light Waves Pass Through The Second Plate, Highlighting Stresses And Crystallinity.

Burn Test

When Exposed To Flame, Some Polymers:

- Burn Quickly or Slowly
- Char
- Cracks
- Melt
- Drip
- Give Off Odor Or Smoke
- Give A Colored Flame

	No Flame	Burns but Extinguishes on Removal of Flame Source			Continues to Burn after Removal of Flame Source				
Materials Thermoplastics	Odor	Odor	Color of Flame	Drips	Odor	Color of Flame	Drips	Speed of	Remarks
ABS	-	Acrid	Yellow, blue edges	No	Acrid	Yellow, blue edges	Yes	Slow	Black smoke with soot in air
Acetals	-	-	-	+	Formal dehyde	Blue, no smoke	Yes	Slow	
Acrylics	-	-	-	-	Fruity	Blue, yellow tip	No (cast) Yes (molded)	Slow	Flame may spurt if rubber modified
Cellulosics Acetate	-	Vinegar	Yellow with sparks	No	Vinegar	Yellow	Yes	Slow	Flame may spark
Fluorocarbons FEP	Faint odor of burnt hair	-	-	-	-	+	-	-	Deforms; no combustion, but drips
PTFE	Faint odor of burnt hair	-	-	-	-	-	-	-	Deforms; does not drip
CTFE	Faint odor of acetic acid	-	-	+	-	-	-	-	Deforms; no combustion, but drips
PVF	Acidic	-	-	-	-	-	-	-	Deforms
Nylons Type 6 & 6/6	-	Burnt Wool	Blue, yellow tip	Yes	-	-	-	-	6/6 More rigid
Polycarbonates	-	Faint, sweet aromatic ester	Orange	Yes	-	-	-	-	Black smoke with soot in air
Polyethylenes	-	-	-	-	Paraffin	Blue, yellow tip	Yes	Slow	Floats in water
Polyimides	b	-	-	-	-	-	-	-	Chars; marl rigid
Polypropylenes	-	Acrid	Yellow	No	Sweet	Blue, yellow tip	Yes	Slow	Floats in water; more difficult to scratch than polyethylene
Polystyrenes	-	-	-	-	Illuminating gas	Yellow	Yes	Rapid	Dense black smoke with soot in air
Polysulfones	-	b	Orange	Yes	-	-	-	-	Black Smoke
Polyurethanes	-	-	-	-	b	Yellow	No	Slow	Black smoke
Vinyls Flexible-Rigid	-	Hydrochloric Acid	Yellow with green spurts	No	-	-	-	-	Chars; melts
Polyblends ABS/Carbonate	-	-	-	-	b	Yellow, blue edges	No	-	Black smoke with soot in air
ABS-PVC	-	Acrid	Yellow, blue edges	No	-	-	-	-	Black smoke with soot in air
PVC/Acrylic	-	Fruity	Blue, yellow tip	No	-	-	-	-	-
Melamines	Formal dehyde and fish	-	-	-	-	-	-	-	-
Phenolics	Formal dehyde and phenol	Phenol and wood or paper	Yellow	No	-	-	-	-	May crack
Polyesters	-	Hydrochloric Acid	Yellow	No	b	Yellow, blue edges	No	Slow	Cracks and breaks
Silicones	b	-	-	-	-	-	-	-	Deforms
Ureas	Formaldehyde	-	-	-	-	-	-		

Burn Test

When Flame Is Removed, Some Polymers:

- Burn Quickly or Slowly
- Char
- Cracks
- Melt
- Drip
- Give Off Odor Or Smoke
- Self Extinguish

	No Flame	Burns but Extinguishes on Removal of Flame Source			
Materials Thermoplastics	Odor	Odor	Color of Flame	Drips	
ABS	-	Acrid	Yellow, blue edges	No	
Acetals	-	-	-	-	
Acrylics	-	-	-	-	
Cellulosics Acetate	-	Vinegar	Yellow with sparks	No	
Fluorocarbons FEP	Faint odor of burnt hair	-	-	-	
PTFE	Faint odor of burnt hair	-	-	-	
CTFE	Faint odor of acetic acid	-	-	-	
PVF	Acidic	-	-	-	
Nylons Type 6 & 6/6	-	Burnt Wool	Blue, yellow tip	Yes	
Polycarbonates	-	Faint, sweet aromatic ester	Orange	Yes	
Polyethylenes	-	-	-	-	
Polyimides	b	-	-	-	
Polypropylenes	-	Acrid	Yellow	No	

Burn Test

Acetals, For Example:

- Burn Slowly With A Blue Flame
- Do Not Smoke
- Continue To Burn After Flame Is Removed
- Drip When Burning
- Smells Of Formaldehyde

	No Flame	Burns but Extinguishes on Removal of Flame Source			Continues to Burn after Removal of Flame Source				
Materials Thermoplastics	Odor	Odor	Color of Flame	Drips	Odor	Color of Flame	Drips	Speed of	Remarks
ABS	-	Acrid	Yellow, blue edges	No	Acrid	Yellow, blue edges	Yes	Slow	Black smoke with soot in air
Acetals	-	-	-	-	Formal dehyde	Blue, no smoke	Yes	Slow	
Acrylics	-	-	-	-	Fruity	Blue, yellow	No (cast)	Slow	Flame may spurt if

Burn Test

Safety Issues:

- Perform Test Outside
  - Or Under Proper Ventilation
- Waft, Never Smell Directly
- Do Not Hold In Your Hand
- Have A Bucket Of Water Nearby
- Do Not Stand Over Sample
- Use Proper PPE

Density

Mass Divided By Volume:

g/cm3 = g/ml

Density

Water Is Most Common Comparison

H_2O Density = 1.000 g/cm^3

Density

Signifies:

- Polymer Type
- Degree Of Crystallinity
- Degree Of Packing
- May Help Find Voids

Density

To Determine:

1. Weigh Part (grams)
2. Determine Volume (ml or cm^3)
3. Density = Weight/Volume

Density

Amorphous Vs. Crystalline

Polymer	Da (g/cm^3)	Dc (g/cm^3)
Polyethylene	0.853	1.004
Poly(Vinyl Alcohol)	1.291	1.350
Poly(Vinyl Chloride)	1.412	1.477
Poly(Vinylidene Chloride)	1.775	1.957
Poly(Ethylene Terephthalate)	1.336	1.514

Heat Distortion

Heat Distortion Tests Measure The Deflection Of A Sample Of Specific Length, Width, And Thickness Tested Under Controlled Conditions In An Oil Bath.

Heat Distortion

We Recommend Conducting A Test Under Practical Conditions Related With Your Actual Part.

Heat Distortion

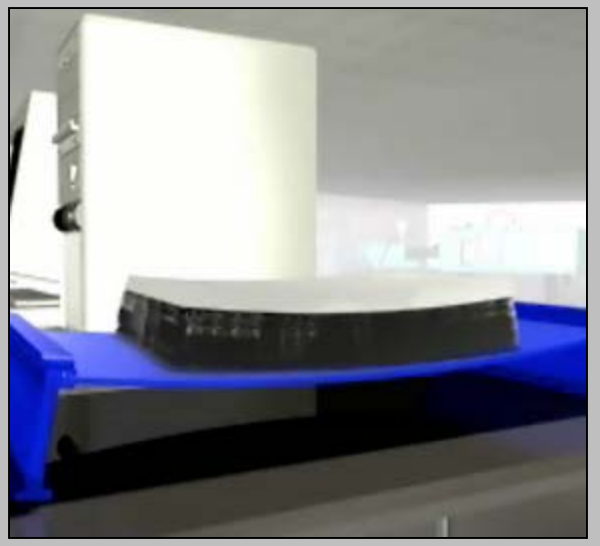
Sample Can Be Heated In:

- Oven
- Water Bath
- Oil Bath
- Drier

Heat Distortion

Sample Can Be Loaded:

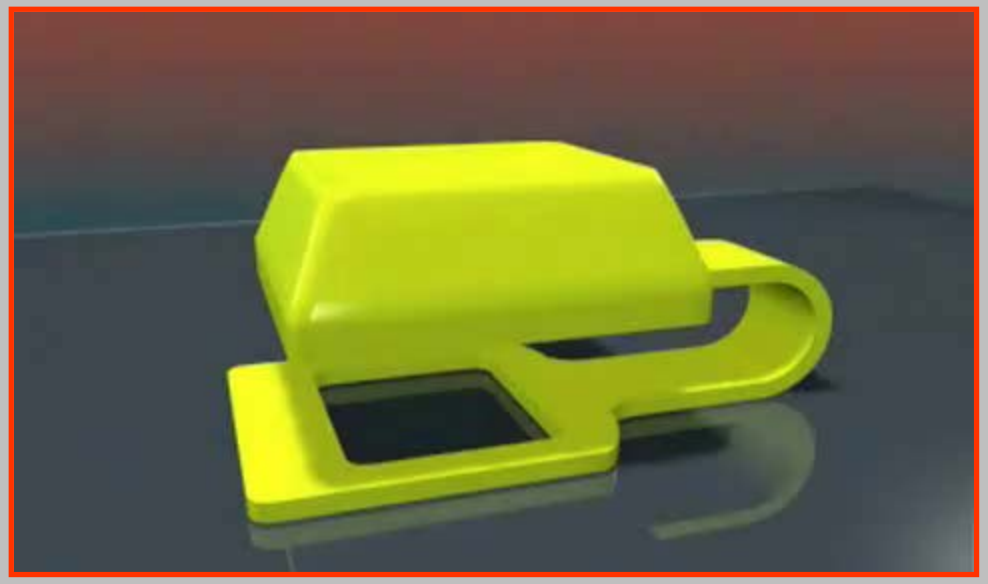
- Torsion
- Compression
- Flexural
- Weight
- Assembly



Heat Distortion

Test Can Be:

- Timed Deflection
- Measured Deflection
- Sensor
- Go / No-Go



Viscosity

Viscosity Is Measure Of A Polymer's Resistance To Flow.

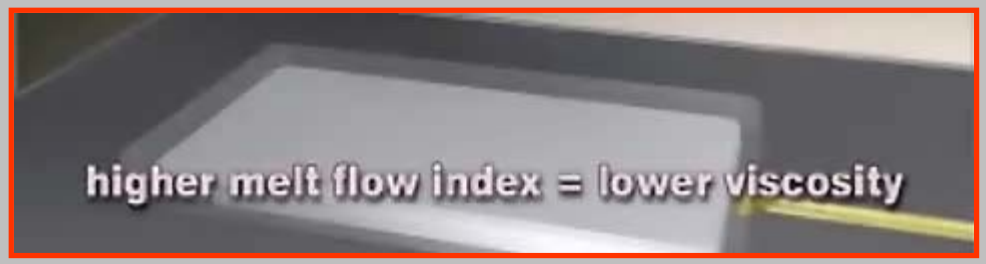
Viscosity

Actual Viscosity Measurements
Are Very Difficult To Obtain,
And Often Require Expensive
Lab Equipment.

Viscosity

In Most Cases, Relative Viscosity Can Be:

- Easy To Obtain
- Obtained With an Existing Machine
- Compare Viscosities
  - Using Different Times
  - Using Different Conditions



Viscosity

For A Given Mold...

Relative Viscosity Equals

Peak Plastic Pressure At Transfer

Multiplied By Fill Time.

$$vis_{(R)} = psi_{(Peak)} * t_{(Fill)}$$

Weight

Document The Weight:

- After Fill
- After Packing
- After Hold

123.90
Fill & Pack Part Weight (g)
125.40
Final Part Weight (g)

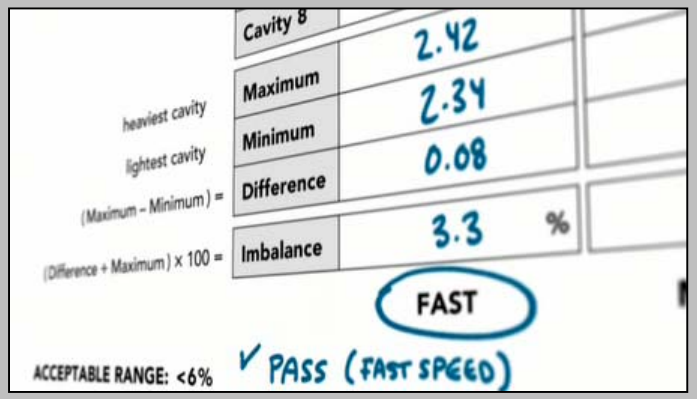
110.72
Fill Only Part(s) Weight (g)
3220
Air Shot (ppsi)

Weight

Multi-Cavity Mold Imbalance:

1. Mold Short Shot
2. Weigh Each Cavity
3. Determine Cavity Imbalance =

$$\frac{\text{(Heaviest-Lightest)}}{\text{Heaviest}} \times 100\%$$



Solvents

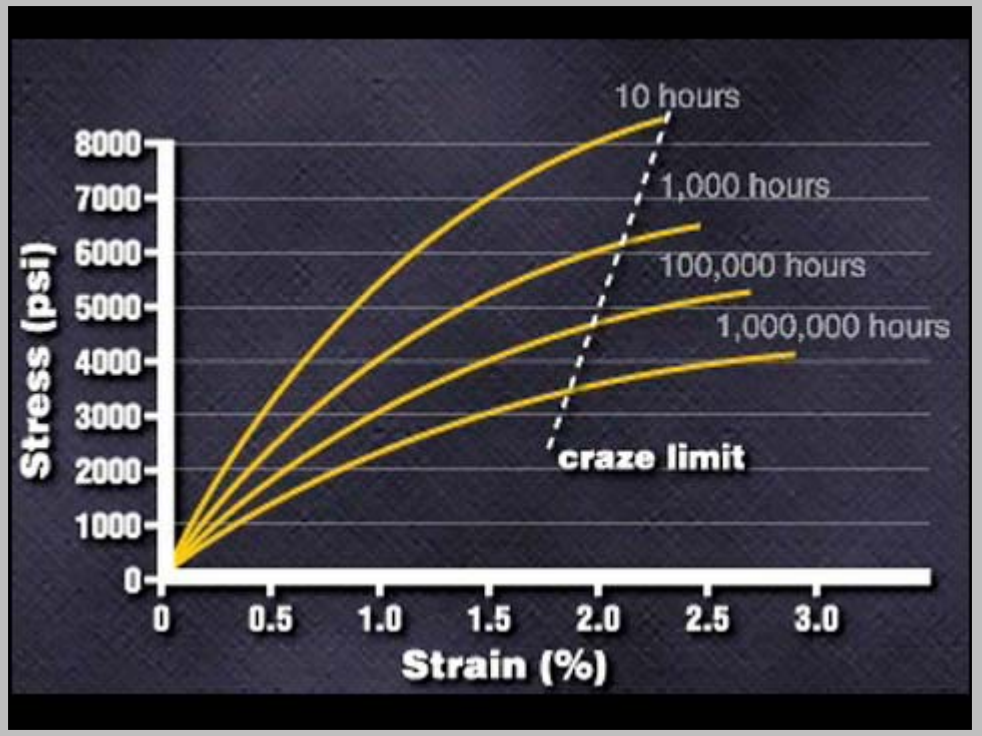
Solvents Can Identify:

- Molded In Stresses
- Variable Orientation
- Reduced Crystallinity
- Delamination
- Degradation

Solvents

Solvents Can Cause:

- Cracking
- Crazing
- Discoloration
- Distortion
- Warpage
- Brittleness



Solvents

Application:

- Soak For 15 Minutes
- Aerosol Spray
- Cloth Wipe

Solvents

Solvent Attacks Can Be Accelerated When a Sample Is Stressed.

Regrind

You Should Test The Integrity
Of Your Regrind.

Regrind

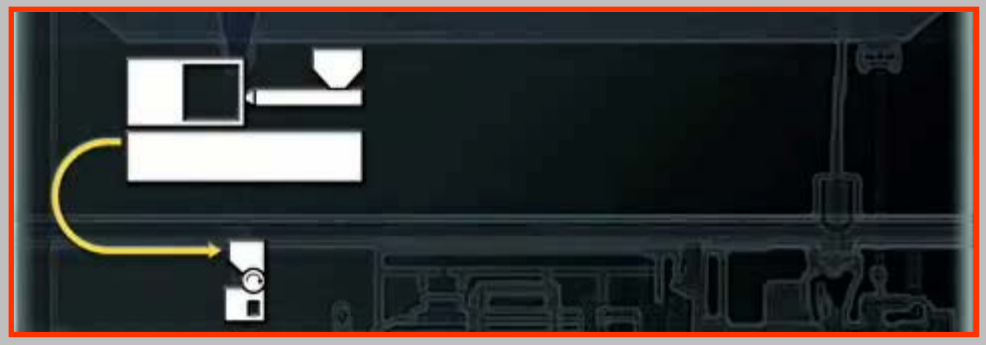
When Testing Regrind... First:

1. Mold Part Using 100% Virgin
2. Document Processing Parameters
   - Peak Pressure
   - Fill Time
3. Perform Any Important Or Relevant Tests

Regrind

Then:

4. Mold Part Using 100% Regrind
5. Document Processing Parameters
   - Peak Pressure
   - Fill Time
5. Perform Any Important Or Relevant Tests



Regrind

Lastly:

6. Determine Change In Properties

$$\frac{\text{(Change)}}{\text{(Original)}} \times 100\% = \%\ \text{Change}$$

Regrind

When Performance is Critical…

- Test Properties of Virgin Material
- Test Properties 1st Generation Regrind
- Determine Property Losses
  - Lower losses indicate better process

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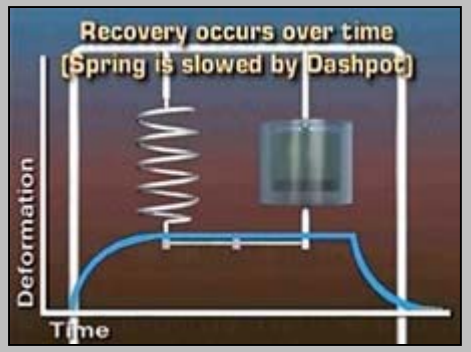

Practical Scientific Molding Techniques

Q & A Session

Please Ask Via Chat Feature

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