



Material Characterization



Eric Bowersox
Beaumont Advanced Processing
Lab Manager



Jennifer Schmidt
AIM Institute
Autodesk® Moldflow® Instructor

Introductions



- Eric Bowersox
 - Lab Manager, Beaumont Advanced Processing
 - B.S. Degree – Plastics Engineering Technology - Penn State Behrend
 - 14 Years in the Plastics Industry
 - 3 Years Mold Designer
 - 11 Years Process Engineer/Trainer
- Jennifer Schmidt
 - Moldflow® Instructor, American Injection Molding (AIM) Institute
 - Design Engineer, Beaumont Technologies
 - B.S. Degree – Plastics Engineering Technology - Penn State Behrend
 - 19 Years in the Plastics Industry
 - 11 Years performing Moldflow Analyses
 - Autodesk Moldflow Expert Certified

Learning Objectives



- Why Beaumont?
 - The history behind the acquisition
- How is material characterized?
 - What tests are performed
- Where is it used in the software?
 - How the quality of material data affects accuracy

Quick Questions



- What makes Autodesk Moldflow valuable?
 - The accuracy of the simulation
- What makes Autodesk Moldflow accurate?
 - The user
 - The software
 - Material characterization
- What makes material characterization accurate?

Beaumont History



1999



2014

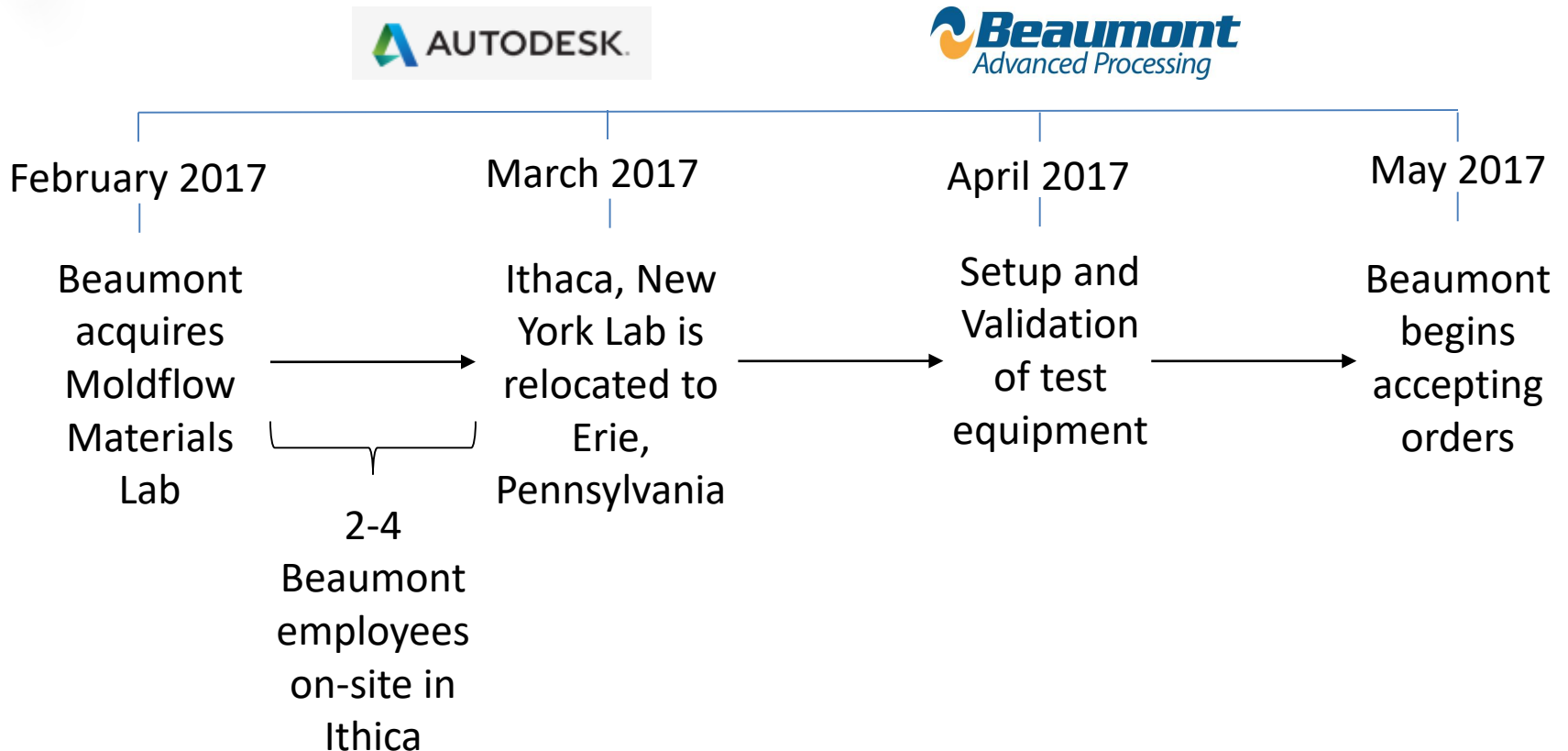


2005



2012

Acquisition Timeline



- What makes material characterization accurate?
 - Testing equipment
 - Testing procedures
 - Trained technicians
- 80% of all testing utilizes molded specimens
 - Moisture content when molding
 - Residence time
 - Actual melt temperature
 - Combined effects on material degradation
- Without properly manufactured test specimens



- Current testing offered:
 - Thermal Expansion (CTE): Longitudinal and Transverse
 - Specific Heat (Cp): Transition and Ejection temperatures
 - Shrinkage Correlation (Corrected residual in mold stress - CRIMS)
 - Mold Verification
 - PVT
 - Melt and Solid Density
 - Viscosity: IMR and Capillary
 - Pressure Dependent Viscosity
 - Mechanicals: Tensile Modulus and Poisson's Ratio

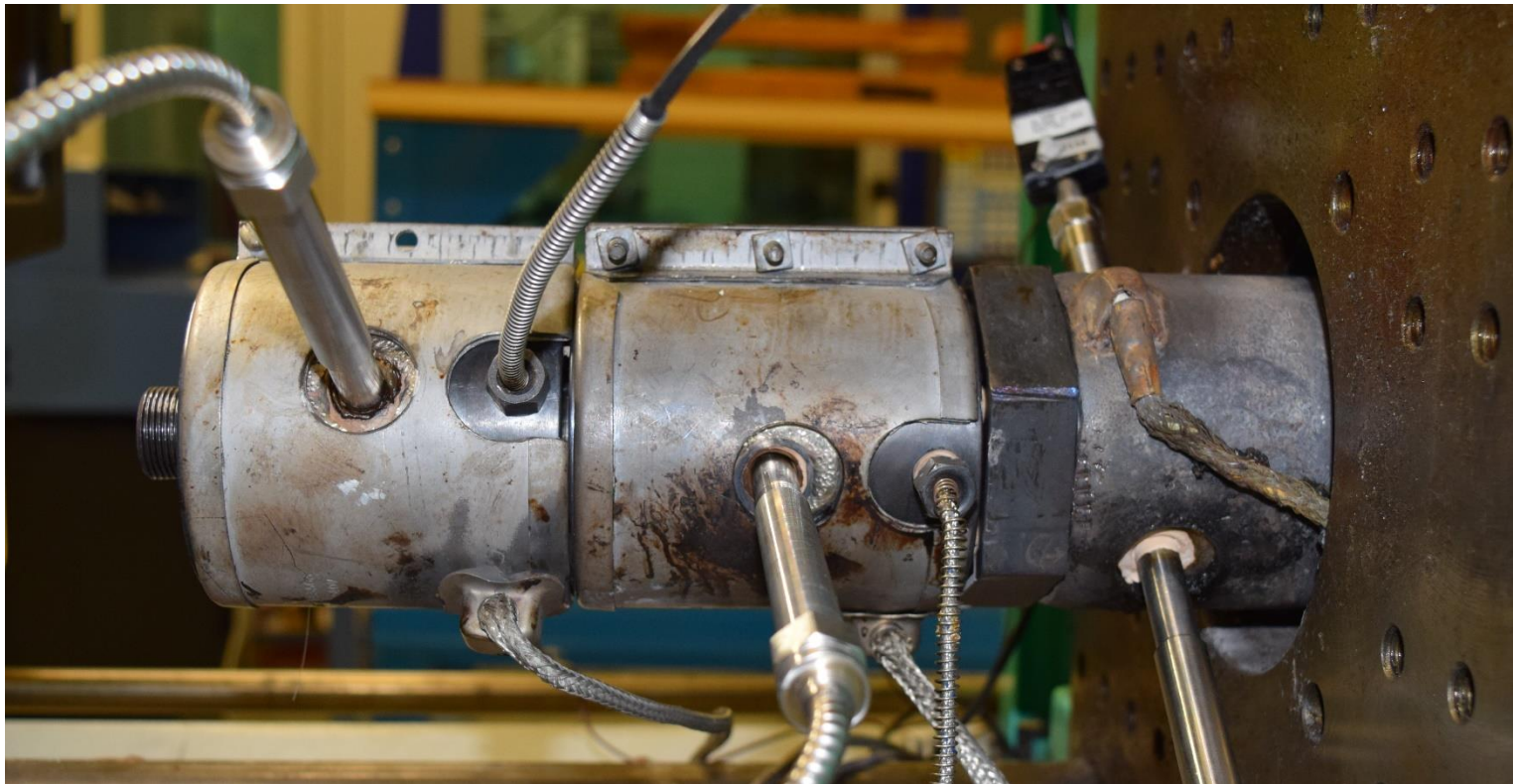
Viscosity- IMR

Equipment- Arburg Allrounder 270s



Viscosity- IMR

- Additional values captured during IMR testing
 - Juncture Loss
 - Extensional Viscosity



Viscosity- Capillary Rheometer



Equipment- CEAST Smart RHEO

Test Standard- ASTM D3835 Standard Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer



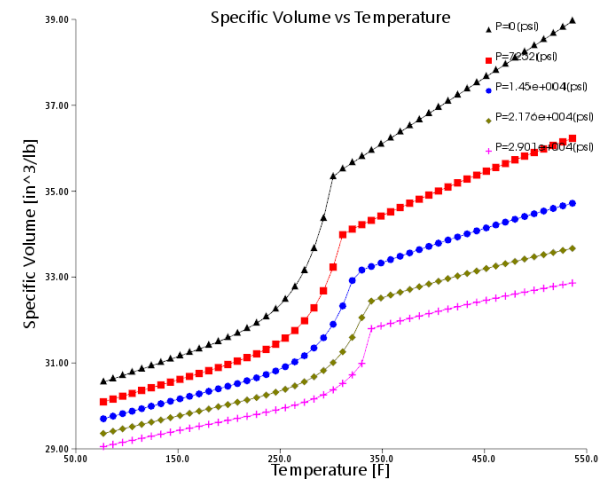
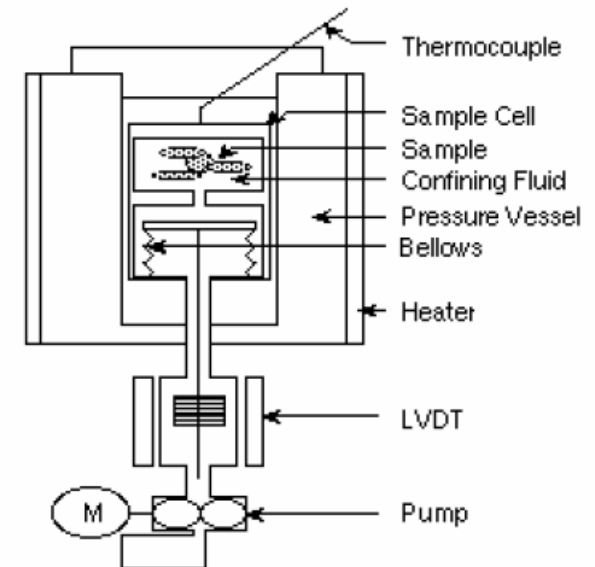
Capillary Vs. IMR Viscosity Testing



- Capillary rheology
- Pros:
 - Most widely available
 - Good reproducibility on most polymers
 - Standardized (ASTM D-3835)
- Cons:
 - No shear or pressure during plastication
 - Long dwell times (5-6 minutes) prior to testing
 - Long test times (1 - 4 minutes)
 - May not represent in-mold polymer behavior
 - Does not test long fibers accurately
- IM rheology
- Pros:
 - Plastication similar or identical to injection molding process
 - Plastication quickly through shear and pressure, also better mixing
 - Higher shear rates 60,000 reciprocal sec
 - Short dwell (residence) times (0.5 - 2 min.)
 - Short test times (\ll 1 minute)
- Cons:
 - Temperature transient prior to test start
 - Requires more material
 - Long fiber breakage due to screw

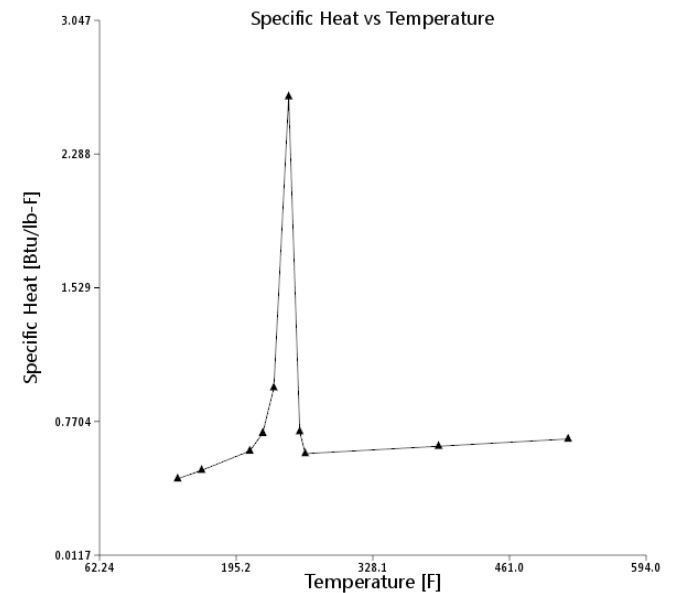
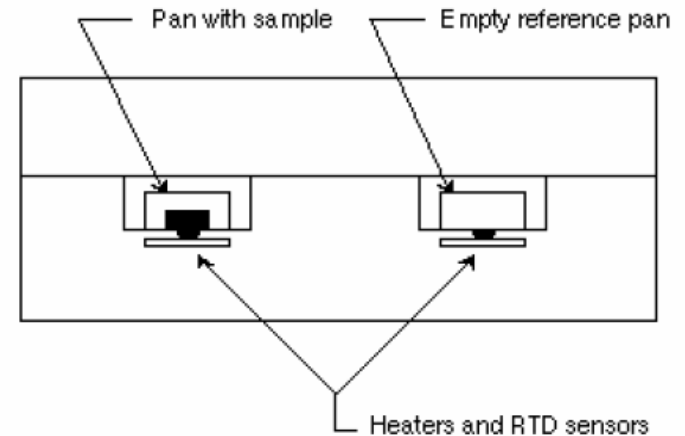
Melt & Solid Density

- Equipment- Gnomix PVT Apparatus**



Specific Heat

- **Equipment-** Diamond DSC
- **Test Standards-**
 - ASTM E1269 Determination of Specific Heat Capacity by DSC



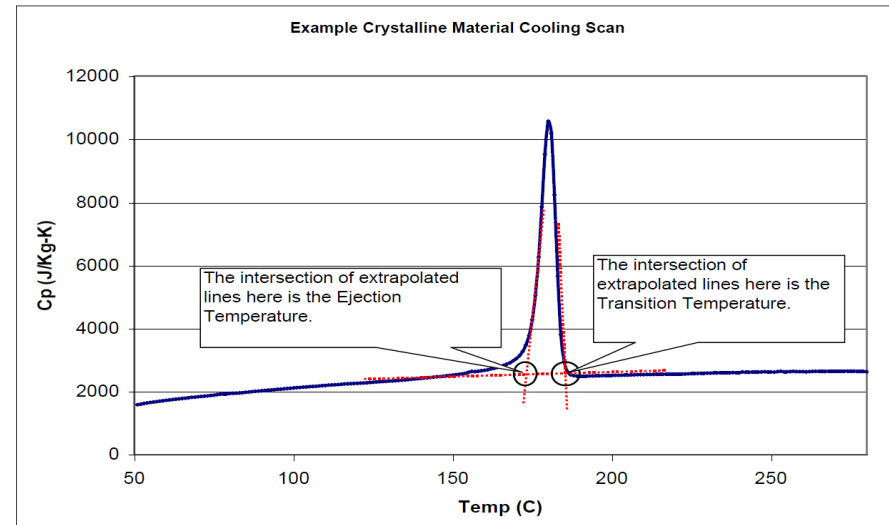
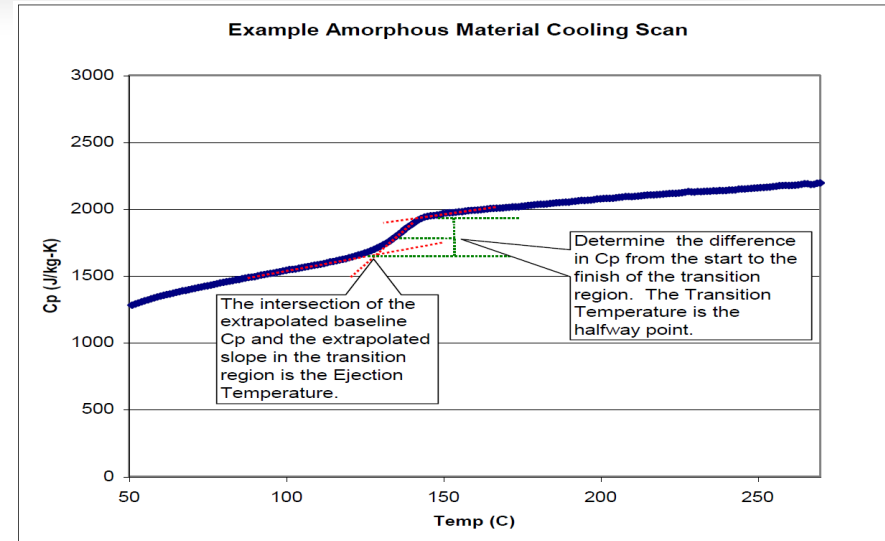
Transition and Ejection Temperatures



Equipment- Diamond DSC

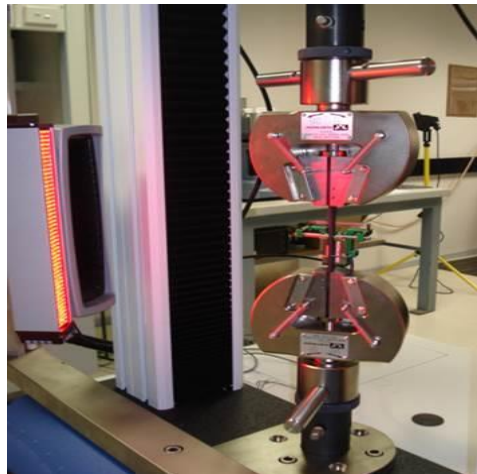
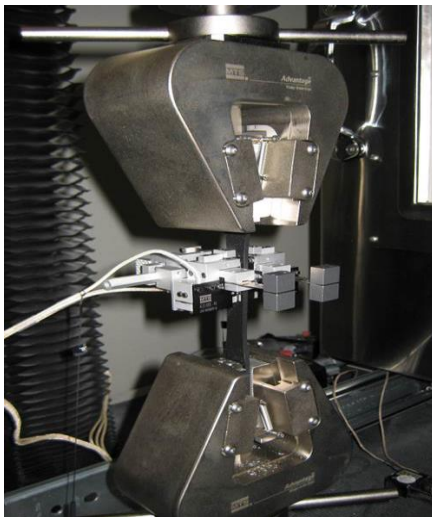
Test Standards-

ASTM D3418 Transition Temperatures of
Polymers by Differential Scanning
Calorimetry



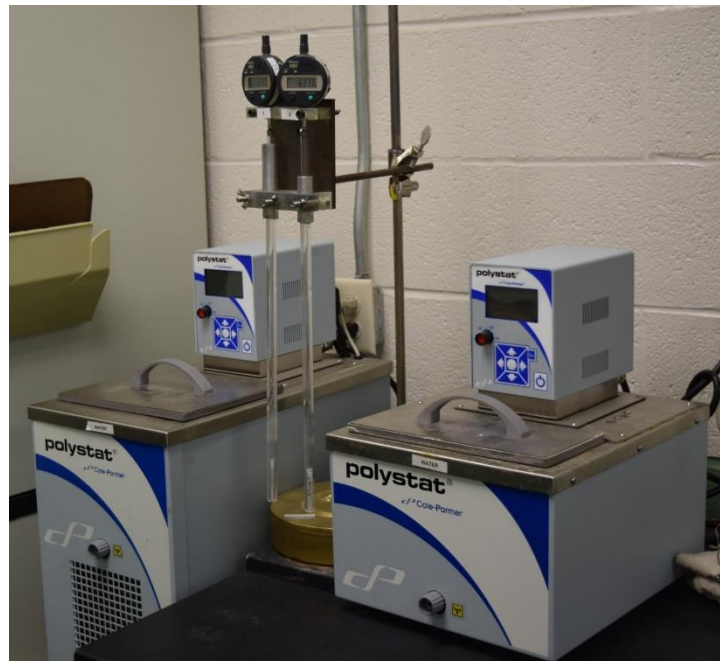
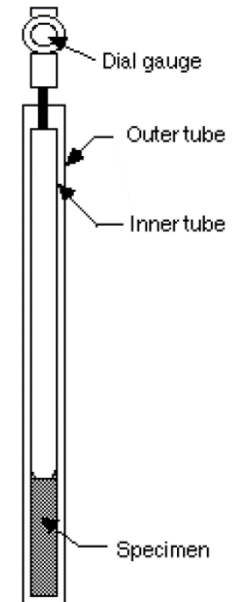
Tensile Modulus and Poisson's Ratio

- **Equipment-** MTS Sintech 5/G
- **Test Standards-**
 - ASTM D638 Standard Test Method for Tensile Properties of Plastics
 - ASTM E132 Standard Test Method for Poisson's Ratio at Room Temperature



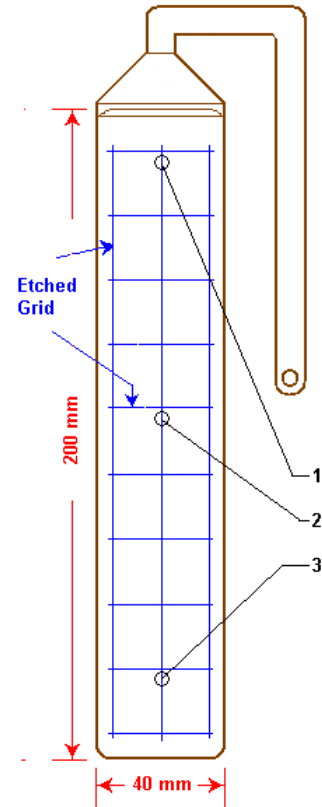
Coefficient of Linear Thermal Expansion

- **Test Standards-**
 - ASTM D696 Coefficient of Linear Thermal Expansion of Plastics
 - ISO-11359 Measurement of Conductive Liquid Flow in Closed Conduits



Shrinkage

- **Equipment-** Krauss Maffei KM 160-1000CX; OGP Flash 400



Mold Verification



Equipment- Krauss Maffei KM 160-1000CX

Pressure Dependent Viscosity

- D3 term in Moldflow



Factors that Affects Accuracy

- Solver Technology

$$u_{t+\Delta t} = u_t + \dot{u}_t \Delta t + \left[\left(\frac{1}{2} - \alpha \right) \ddot{u}_t + \alpha \ddot{u}_{t+\Delta t} \right] \Delta t^2$$

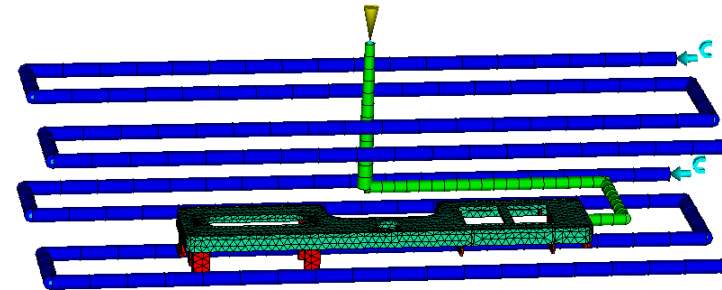
$$\Leftrightarrow u_{t+\Delta t} - u_t + \dot{u}_t \Delta t - \left(\frac{1}{2} - \alpha \right) \ddot{u}_t \Delta t^2 = \alpha \ddot{u}_{t+\Delta t} \Delta t^2$$

$$\Leftrightarrow \ddot{u}_{t+\Delta t} = \frac{u_{t+\Delta t} - u_t}{\alpha \Delta t^2} - \frac{\dot{u}_t}{\alpha \Delta t} - \left(\frac{1/2 - \alpha}{\alpha} \right) \ddot{u}_t$$

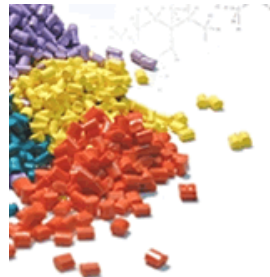
mit $a_0 = \frac{1}{\alpha \Delta t^2}$; $a_2 = \frac{1}{\alpha \Delta t}$; $a_3 = \frac{1}{2\alpha} - 1$

$$\ddot{u}_{t+\Delta t} = a_0 (u_{t+\Delta t} - u_t) - a_2 \dot{u}_t - a_3 \ddot{u}_t$$

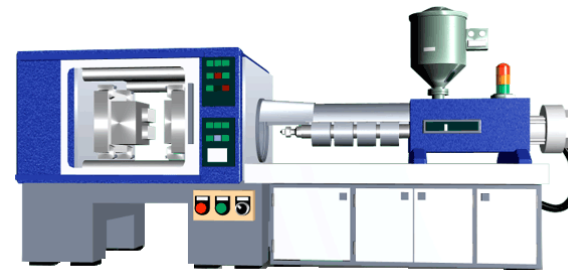
- Component Modeling



- Material Data



- Process Conditions



Material Properties



- Material Characterization
 - When was it tested?
 - Material formulations may have changed
 - What data is available?
 - Bronze, silver, gold (Autodesk Moldflow)
 - Indicates level of characterization
 - Data (Moldflow .udb file)
 - PVT
 - Melt density
 - Thermal conductivity
 - Specific heat
 - Transition temperatures
 - Etc...

pvT Properties		
Melt density	0.029082	lb/in ³
Solid density	0.035982	lb/in ³
2-domain modified Tait pvT model coefficients		
b5	446.15	K
b6	6.5e-008	K/Pa
b1m	0.001162	m ³ /kg
b2m	8.695e-007	m ³ /kg-K
b3m	8.30021e+007	Pa
b4m	0.005539	1/K
b1s	0.001081	m ³ /kg
b2s	5.141e-007	m ³ /kg-K
b3s	1.35109e+008	Pa
b4s	0.00476	1/K
b7	8.076e-005	m ³ /kg
b8	0.06237	1/K
b9	2.048e-008	1/Pa

Plot pvT data...

View test information...

Mechanical properties data		
Elastic modulus, 1st principal direction (E1)	289065	psi
Elastic modulus, 2nd principal direction (E2)	263103	psi
Poissons ratio (v12)	0.381	
Poissons ratio (v23)	0.466	
Shear modulus (G12)	97757	psi
Transversely isotropic coefficient of thermal expansion (CTE) data		
Alpha1	3.511e-005	1/F
Alpha2	3.928e-005	1/F

Description

Thermoplastics material

Optical Properties	Environmental Impact	Quality Indicators	Crystallization Morphology	Stress - Strain (Tension)	Stress - Strain (Compression)		
Description	Recommended Processing	Rheological Properties	Thermal Properties	pvT Properties	Mechanical Properties	Shrinkage Properties	Filler / Fiber
Family name							
Trade name							
Manufacturer							
Link							
Family abbreviation	PP						
Material structure	Crystalline						
Data source	Moldflow Plastics Labs : pvT-Measured : mech-Supplemental						
Date last modified	16-MAR-09						
Date tested	27-FEB-09						
Data status	Non-Confidential						
Material ID							
Grade code							
Supplier code							
Fibers/fillers	Unfilled						

Filling quality indicator
Gold [View details...](#)

Packing quality indicator
Gold [View details...](#)

Warpage quality indicator
Gold [View details...](#)

Moldflow Plastics Labs : pvT-Measured : mech-Supplemental

Processing



Thermoplastics material



Optical Properties	Environmental Impact	Quality Indicators	Crystallization Morphology	Stress - Strain (Tension)	Stress - Strain (Compression)		
Description	Recommended Processing	Rheological Properties	Thermal Properties	pvT Properties	Mechanical Properties	Shrinkage Properties	Filler / Fiber
Mold surface temperature		<input type="text" value="77"/>	F				
Melt temperature		<input type="text" value="428"/>	F				
Mold temperature range (recommended)							
Minimum		<input type="text" value="50"/>	F				
Maximum		<input type="text" value="185"/>	F				
Melt temperature range (recommended)							
Minimum		<input type="text" value="347"/>	F				
Maximum		<input type="text" value="550.4"/>	F				
Absolute maximum melt temperature		<input type="text" value="604.4"/>	F				
Ejection temperature		<input type="text" value="239"/>	F				
			View test information for ejection temperature...				
Maximum shear stress		<input type="text" value="36.26"/>	psi				
Maximum shear rate		<input type="text" value="100000"/>	1/s				

Rheological

Thermoplastics material

Optical Properties Environmental Impact Quality Indicators Crystallization Morphology Stress - Strain (Tension) Stress - Strain (Compression)

Description Recommended Processing **Rheological Properties** Thermal Properties pvT Properties Mechanical Properties Shrinkage Properties Filler / Fiber

Viscosity

Default viscosity model **Cross-WLF** View viscosity model coefficients... Plot Viscosity

Juncture loss method coefficients

c1 0.9038 Pa^{1-c2}

c2 1.203

Transition temperature 253.4 F

Moldflow Viscosity Index VI(219)0085

Melt mass-flow rate (MFR)

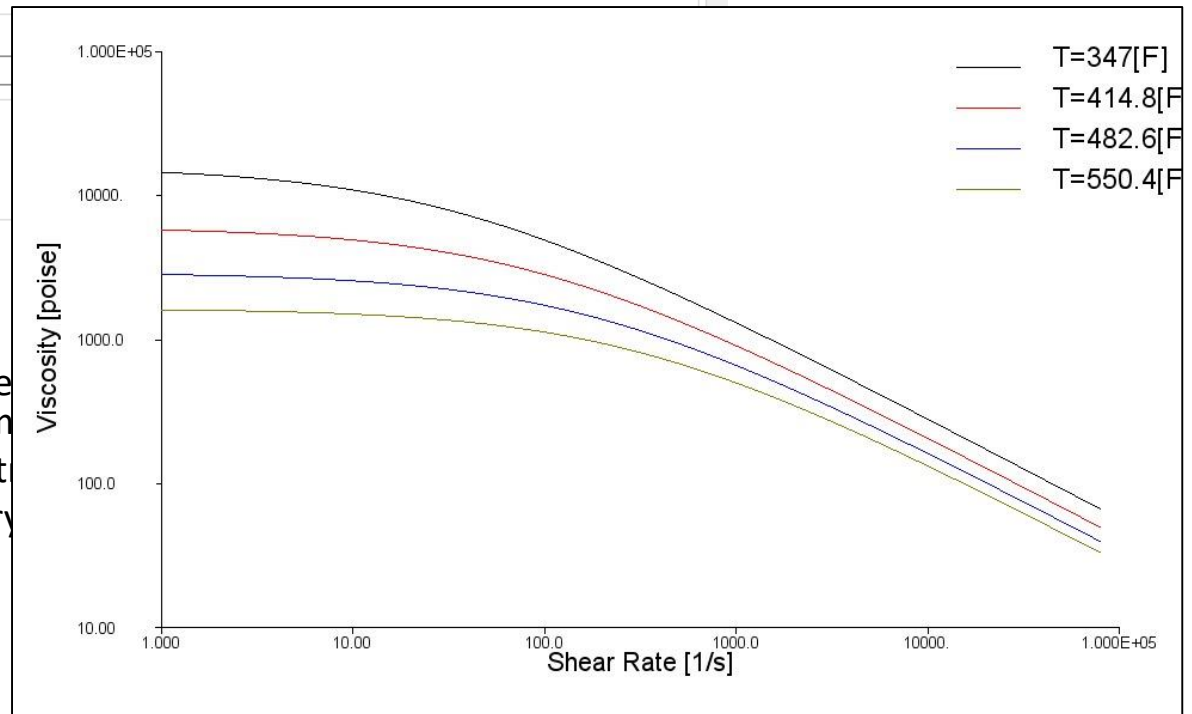
Temperature 230 C

Load 2 Kg

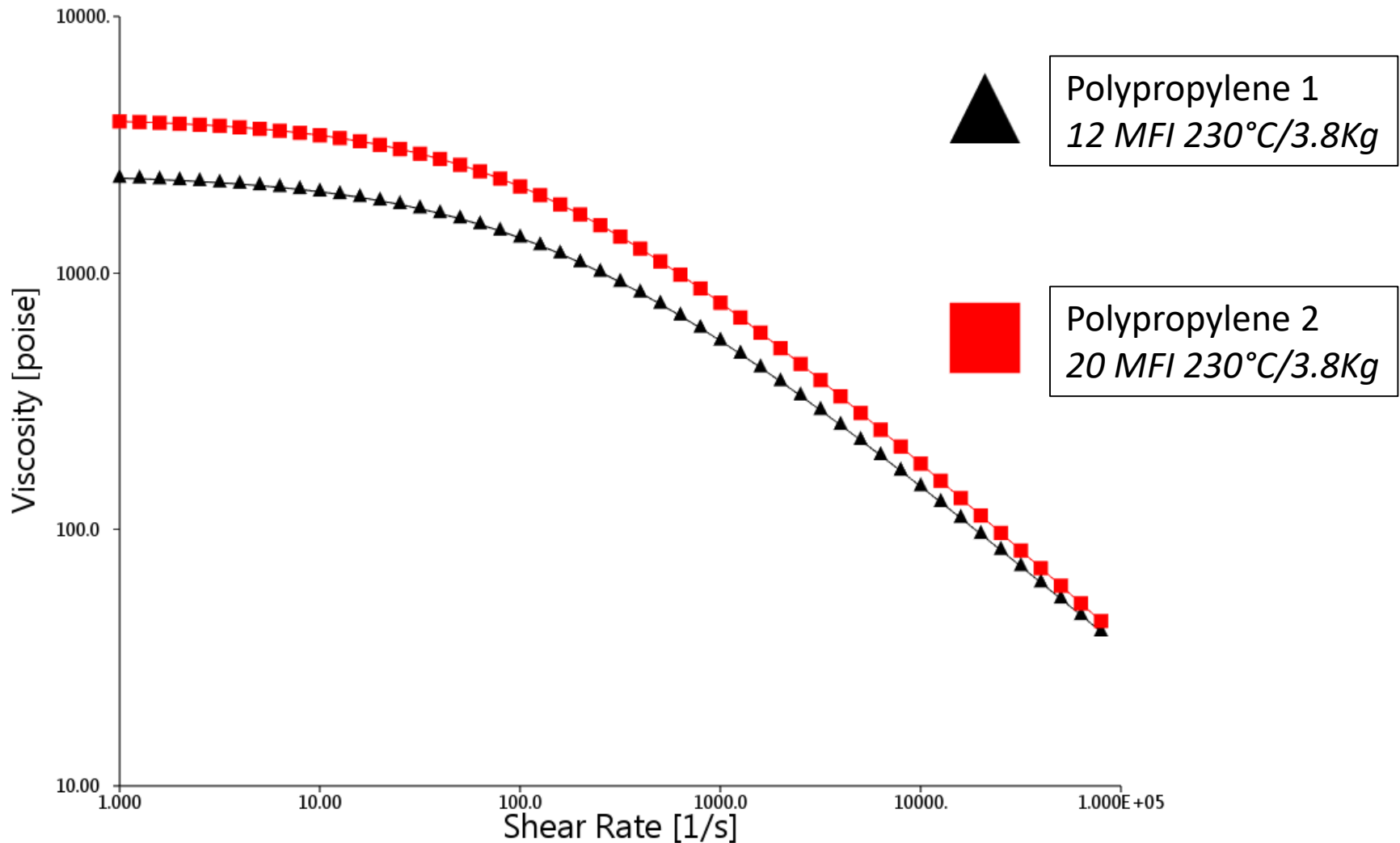
Measured MFR 20 g/10min

☐ Extension viscosity

- Transition temperature is the polymer transitions from a m
 - Amorphous: (T_g) glass-t
 - Semi-Crystalline: (T_c) cry



Comparing Viscosity



Juncture Loss

- The pressure drop observed when the melt passes through contractions in the feed system
- Used in beam feed systems for MP, DD or 3D
- Helps improve pressure prediction
- If JLC are not available on your selected material
 - run the analysis with and w/o JLC using typical values
- If the analysis results show that juncture loss is significant
 - Get the material characterized for JLC

Juncture loss method coefficients		
c1	<input type="text" value="0.9038"/>	$Pa^{(1-c2)}$
c2	<input type="text" value="1.203"/>	

Table C-1. Bagley Constants for Juncture-Loss Calculations

Generic Class	C1	C2
POM	2.20e-05	2.055
PE-HD	6.79e-02	1.399
LCP	1.94e+01	1.000
PE-LD	3.37e-01	1.321
PA 66	2.15e+01	1.000
PBT	2.75e-02	1.577
PC	1.15e+01	1.000
PET	8.26e+00	1.099
PP	3.60e-05	2.098
PPS	3.31e+00	1.075
PS	3.30e-05	2.108
PC ABS	5.26e+00	1.000
PBT PET	1.31e+01	1.019

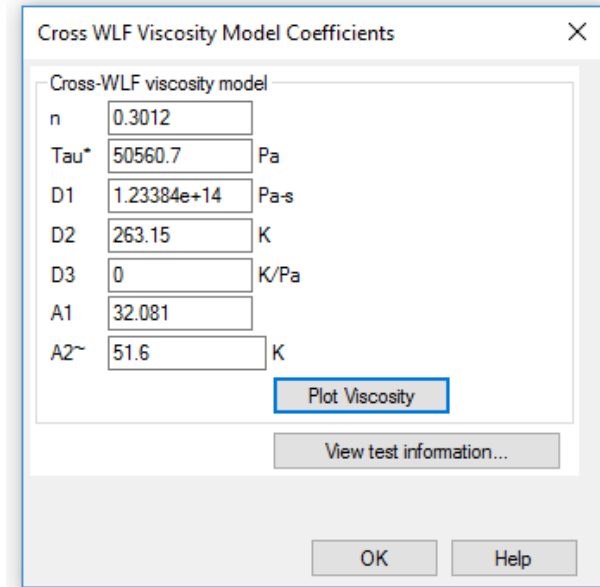
Extensional Viscosity



- A measure of the resistance of a polymer to stretching forces
 - When a polymer flows through a large cross section to a smaller one, it will be stretched longitudinally, which will result in a pressure drop.
- Pressure drop due to extensional effects often occurs when a material flows from a large runner into a very small gate.
- Only used in 3D elements
- Helps improve pressure prediction
- Use when the extension rate is higher than 200 1/s
 - as the EV may significantly increase the injection pressure required

Pressure Dependence

- Typically D3 for Cross-WLF = zero
- Increases pressure prediction
- Not in the standard testing
 - Must request specific characterization
- Important for:
 - Thin wall molding, less than 2mm
 - Flow length to thickness ratios are greater than 100
 - Injection pressures are greater than 100 MPa
 - Polymers that exhibit a tendency for pressure dependence



Cross WLF Viscosity Model Coefficients

Cross-WLF viscosity model

n	0.3012	
Tau*	50560.7	Pa
D1	1.23384e+14	Pa-s
D2	263.15	K
D3	0	K/Pa
A1	32.081	
A2~	51.6	K

Plot Viscosity

View test information...

OK Help

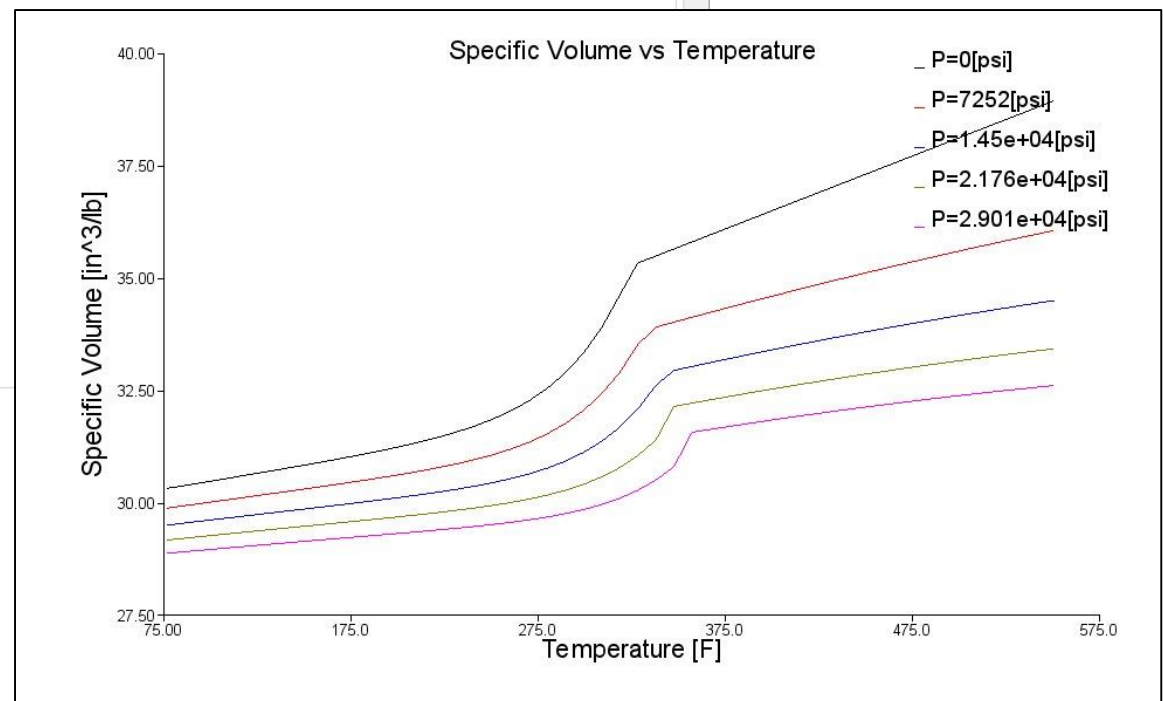
pvT

Thermoplastics material

Optical Properties	Environmental Impact	Quality Indicators	Crystallization Morphology	Stress - Strain (Tension)	Stress - Strain (Compression)
Description	Recommended Processing	Rheological Properties	Thermal Properties	pvT Properties	Mechanical Properties
Melt density	0.027058	lb/in ³			
Solid density	0.032974	lb/in ³			
2-domain modified Tait pvT model coefficients					
b5	436.15	K			
b6	7.5e-08	K/Pa			
b1m	0.001275	m ³ /kg			
b2m	1.056e-06	m ³ /kg-K			
b3m	8.06452e+07	Pa			
b4m	0.005863	1/K			
b1s	0.001157	m ³ /kg			
b2s	4.448e-07	m ³ /kg-K			
b3s	1.55891e+08	Pa			
b4s	0.004364	1/K			
b7	0.0001172	m ³ /kg			
b8	0.05352	1/K			
b9	8.721e-09	1/Pa			

Plot pvT data...

View test information...



Thermal Data



Thermoplastics material



Optical Properties		Environmental Impact		Quality Indicators		Crystallization Morphology		Stress - Strain (Tension)		Stress - Strain (Compression)					
Description		Recommended Processing		Rheological Properties		Thermal Properties		pVT Properties		Mechanical Properties		Shrinkage Properties		Filler / Fiber	

Specific heat data

	Temperature (T) F	Specific heat (Cp) Btu/lb-F	Heating/cooling rate F/s
1	123.8	0.49946	-0.5999
2	176	0.52286	-0.5999
3	212	0.56896	-0.5999
4	231.8	0.65257	-0.5999
5	239	1.0954	-0.5999
6	246.2	4.5001	-0.5999
7	253.4	0.89071	-0.5999
8	258.8	0.60169	-0.5999
9	275	0.58927	-0.5999
10	392	0.64158	-0.5999
11	482	0.68195	-0.5999
12	521.6	0.70082	-0.5999

Plot specific heat data...

View specific heat test information...

Thermal conductivity data

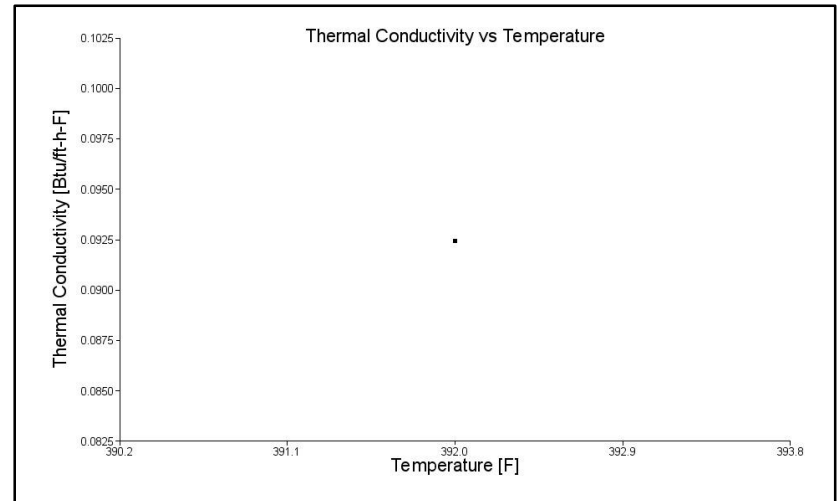
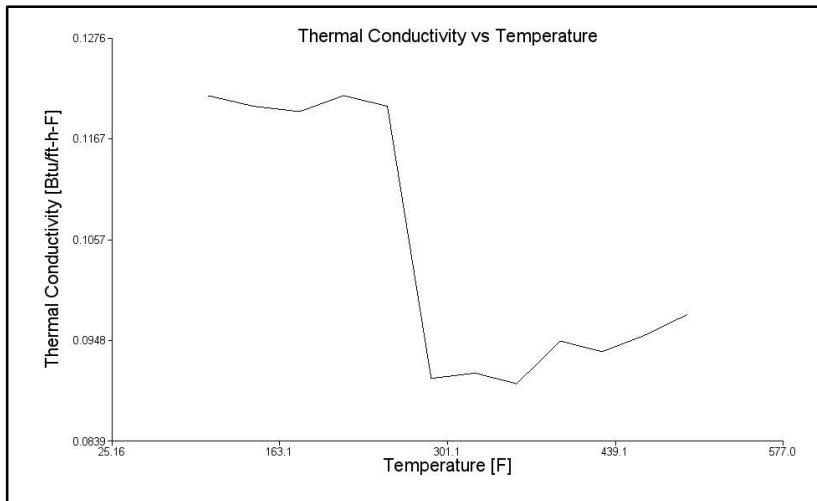
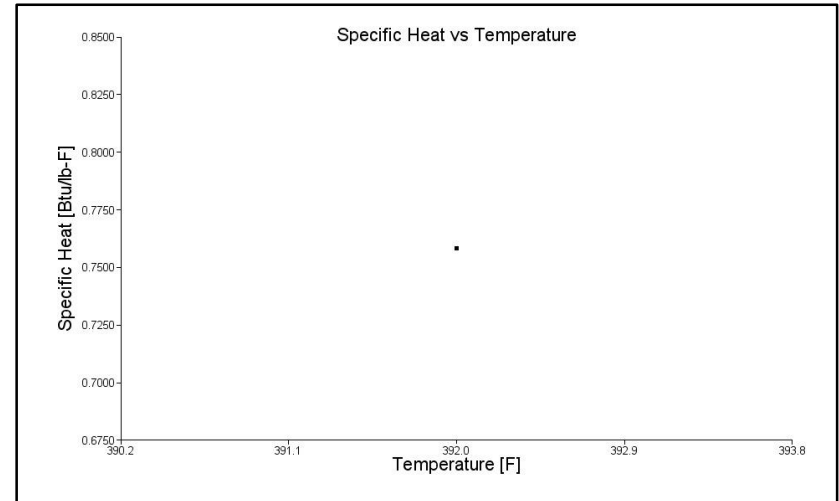
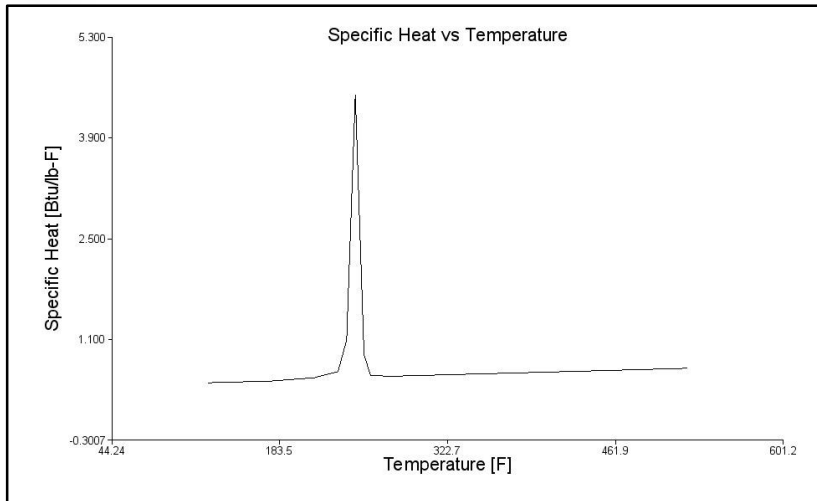
	Temperature (T) F	Thermal conductivity (k) Btu/ft-h-F	Heating/cooling rate F/s
1	104	0.1213	0
2	141.8	0.1202	0
3	179.6	0.1196	0
4	215.6	0.1213	0
5	251.6	0.1202	0
6	287.6	0.09072	0
7	323.6	0.09129	0
8	357.8	0.09014	0
9	393.8	0.09476	0
10	428	0.09361	0
11	462.2	0.09534	0
12	498.2	0.09765	0

Plot thermal conductivity data...

View thermal conductivity test information...

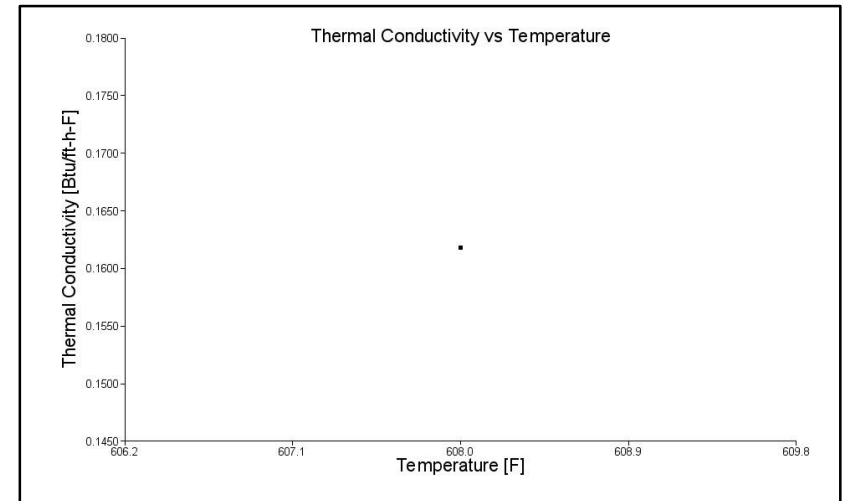
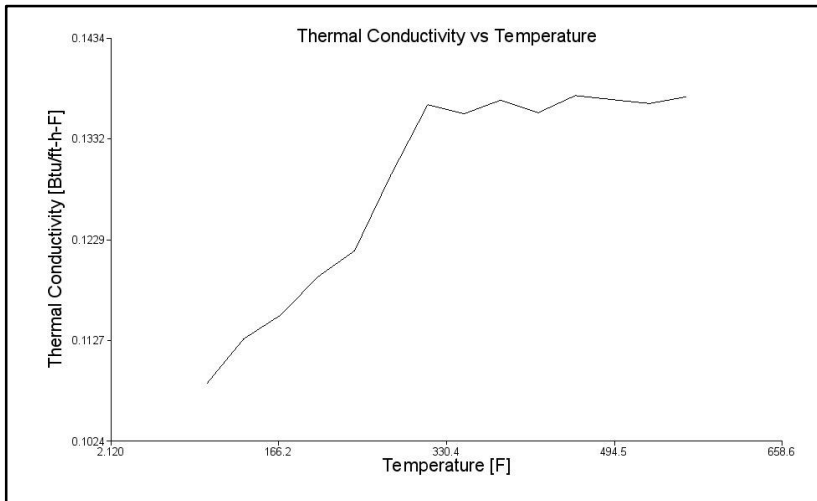
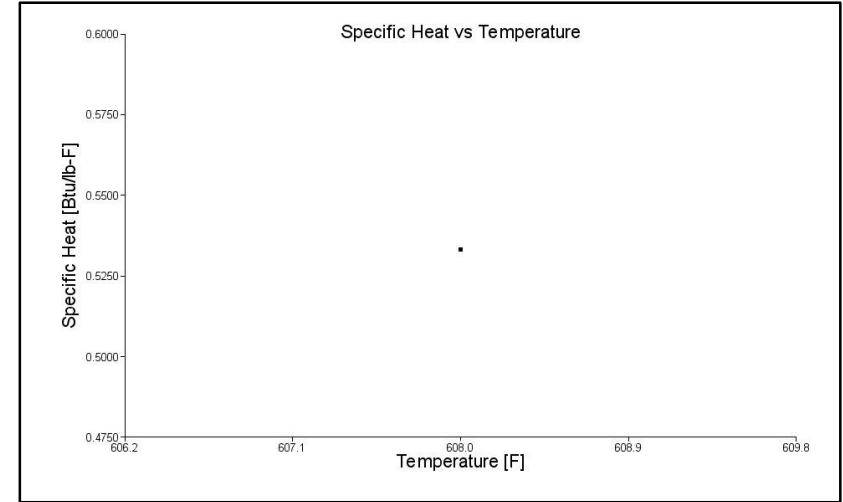
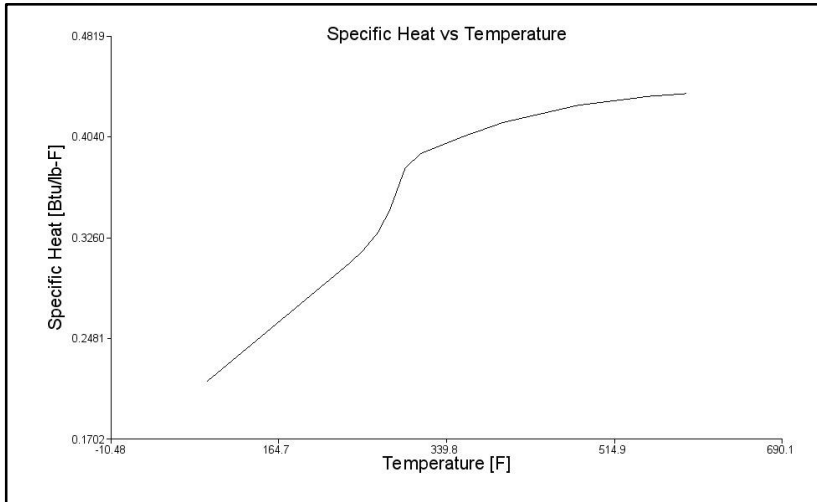
Thermal Data

Multi point data



Thermal Data

Multi point data



Shrinkage



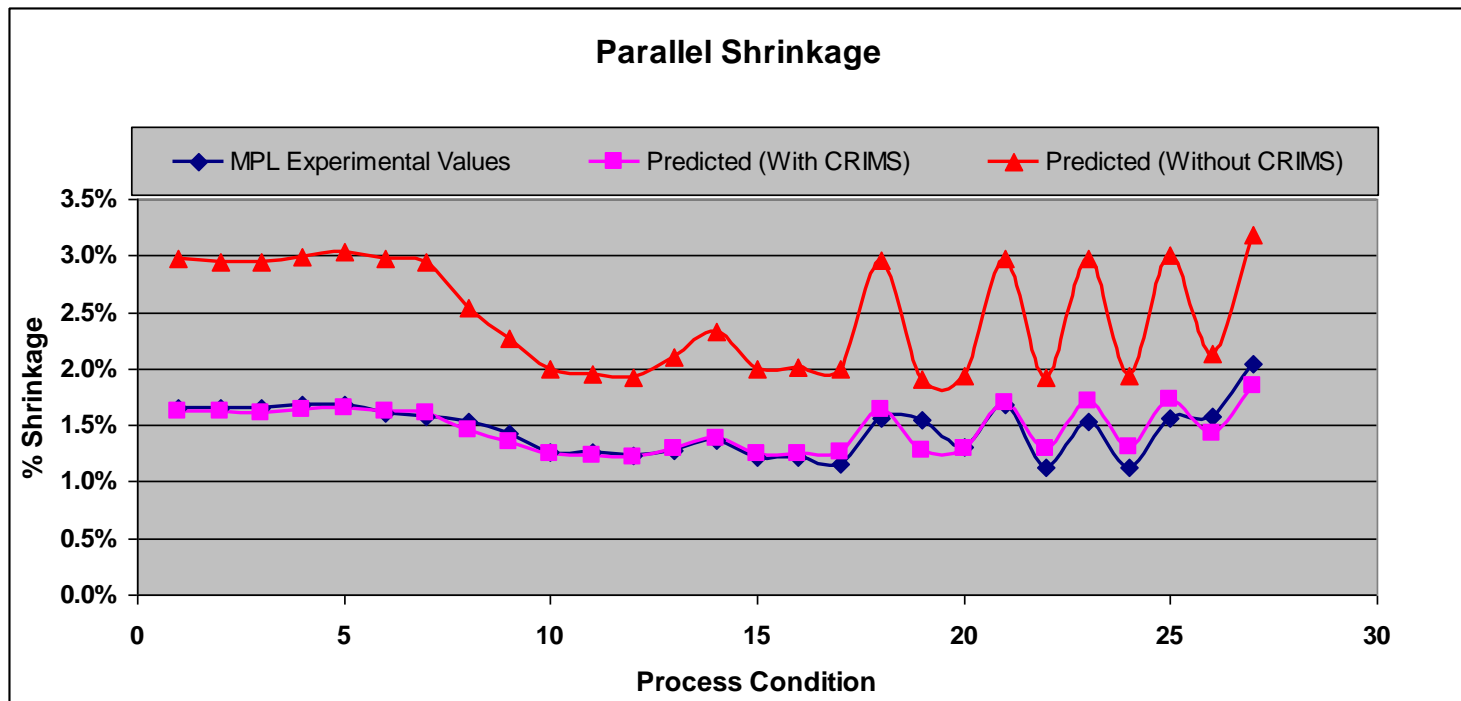
Thermoplastics material

×

Quality Indicators		Crystallization Morphology			Stress - Strain (Tension)			Stress - Strain (Compression)					
Description	Recommended Processing	Rheological Properties	Thermal Properties	pVT Properties	Mechanical Properties	Shrinkage Properties	Filler / Fiber	Optical Properties	Environmental Impact				
Select a shrinkage model (Midplane and Dual Domain)													
Corrected residual in-mold stress (CRIMS)		Examine CRIMS model		Default Flow/Fiber set		View model coefficients...							
Select a shrinkage model (3D)													
Uncorrected residual stress													
Observed nominal shrinkage													
Parallel	1.393	%											
Perpendicular	1.404	%											
Observed shrinkage													
Minimum Parallel	1.239	%											
Maximum Parallel	1.604	%											
Minimum Perpendicular	1.236	%											
Maximum Perpendicular	1.58	%											
View observed shrinkage test information...													
Shrinkage Molding Summary													
	Melt Temperature F	Mold Temperature F	Flow Rate (R) in ³ /s	Flow Rate (F) in ³ /s	Ram Diameter in	Ram Displacement in	Thickness in	Packing Pressure psi	Packing Time s	Cooling Time s	Parallel Shrinkage %	Perpendicular Shrinkage %	Volumetric Shrinkage %
1	442.22	91.58	1.52558	1.34861	0.98425	2.14566	0.07874	3118.36	10	20	1.33	1.42	3.2
2	440.42	92.3	1.52558	1.34861	0.98425	2.12598	0.07874	3103.86	10	20	1.31	1.41	3.21
3	440.42	95.72	1.51947	1.43404	0.98425	2.12204	0.07874	3553.48	9.9	20	1.44	1.41	3.09
4	440.42	92.48	1.51947	1.27538	0.98425	2.12598	0.07874	3205.38	10	20	1.34	1.42	3.17
5	440.42	92.84	1.51947	1.14723	0.98425	2.12598	0.07874	3263.4	10	20	1.3	1.4	3.15
6	440.42	97.52	2.30057	2.08699	0.98425	2.12598	0.07874	4090.13	9.9	20	1.38	1.33	2.92
7	440.42	93.56	1.52558	1.27538	0.98425	2.12204	0.07874	3248.9	9.9	20	1.45	1.41	3.18
8	440.42	91.04	0.76889	0.634639	0.98425	2.12598	0.07874	2987.82	9.9	20	1.44	1.47	3.2
9	440.42	102.38	1.52558	1.20215	0.98425	2.51968	0.11811	3045.84	15	20	1.54	1.54	5.43
10	440.42	100.04	1.52558	1.25097	0.98425	2.52362	0.11811	3074.85	15	20	1.51	1.55	5.4
11	440.42	101.3	1.53168	1.25097	0.98425	2.51968	0.11811	3118.36	14.9	20	1.48	1.54	5.39
12	440.42	103.1	1.52558	1.16554	0.98425	2.51968	0.11811	3147.37	14.9	20	1.6	1.58	5.28
13	440.42	101.66	1.52558	1.25097	0.98425	2.51968	0.11811	3118.36	15	20	1.49	1.5	5.39
14	440.42	104.36	2.30667	1.6049	0.98425	2.51968	0.11811	3422.94	15	20	1.47	1.54	5.29
15	440.42	99.86	1.52558	1.25097	0.98425	2.51968	0.11811	3132.86	14.9	20	1.44	1.5	5.38
16	440.42	102.02	0.762788	0.646844	0.98425	2.51968	0.11811	2987.82	14.9	20	1.48	1.61	5.03
17	441.14	82.76	1.53778	1.00078	0.98425	1.74015	0.03937	5105.41	4.9	20	1.31	1.26	2.81
18	440.24	84.56	1.51337	0.915345	0.98425	1.74015	0.03937	5090.9	5	20	1.29	1.3	2.82
19	440.96	86.72	1.55609	1.00078	0.98425	1.72047	0.03937	5047.39	5	20	1.36	1.28	2.77
20	440.42	85.28	1.51947	1.00078	0.98425	1.73622	0.03937	5119.91	5	20	1.33	1.29	2.76
21	440.96	83.12	1.51947	1.00078	0.98425	1.72441	0.03937	5018.38	5	20	1.24	1.27	2.84
22	440.96	86.36	2.27616	1.56829	0.98425	1.72441	0.03937	5293.96	5	20	1.25	1.24	2.74
23	440.42	87.44	1.51947	1.00078	0.98425	1.72441	0.03937	5090.9	4.9	20	1.26	1.27	2.76
24	440.42	83.3	0.756685	0.475979	0.98425	1.73622	0.03937	5105.41	5	20	1.38	1.3	2.65

Moldflow Shrinkage Testing

- Corrected Residual In-Mold Stress coefficients (CRIMS)
 - Dual Domain and Midplane only
 - Corrects for gap between lab vs. production environment



Mechanical

Thermoplastics material



Optical Properties	Environmental Impact	Quality Indicators	Crystallization Morphology	Stress - Strain (Tension)	Stress - Strain (Compression)		
Description	Recommended Processing	Rheological Properties	Thermal Properties	pvT Properties	Mechanical Properties	Shrinkage Properties	Filler / Fiber
Mechanical properties data							
Elastic modulus, 1st principal direction (E1)		194354	psi				
Elastic modulus, 2nd principal direction (E2)		194354	psi				
Poissons ratio (v12)		0.392					
Poissons ratio (v23)		0.392					
Shear modulus (G12)		69807.8	psi				
Transversely isotropic coefficient of thermal expansion (CTE) data							
Alpha1		5.028e-05	1/F				
Alpha2		5.028e-05	1/F				
View test information...							
Do not use matrix properties							
Weld Line Strength							
WLSC1			1/K-s				
WLSC2			1/K^2-s				
Phi Critical			rad				

*Supplemental Data
shows in red text

Moldflow Plastics Labs : pvT-Measured : mech-Supplemental

Material Quality Indicators



- MQI's are simple 3 tier descriptions of the quality of material properties (Gold, Silver, or Bronze)
- Thermoplastic materials only
- Weighted scale used
- Accurate Material Data = Accurate Simulation Results
- How data is measured matters
 - Test Methodology, Single/Multiple Point
- Source of data matters
 - Supplemental data, Tested in certified Lab
- MQI is not a static measure
 - Data quality reduces with time

Thermoplastics material

Description	Recommended Processing	Rheological Properties	Thermal Properties
Optical Properties	Environmental Impact	Quality Indicators	
Filling quality indicator			
Gold		View details...	
Packing quality indicator			
Gold		View details...	
Warpage quality indicator			
Gold		View details...	

Material Quality Indicators



- Fill Quality Indicator – Investigates the quality of the Viscosity, Specific Heat Capacity and Thermal Conductivity data

A screenshot of a software dialog box titled "Filling Data Quality Details". The dialog box has a close button (X) in the top right corner. It contains three sections of checkboxes for data quality indicators. The first section, "Viscosity data details", has five checkboxes: "Recently modified" (unchecked), "Tested by Autodesk Moldflow Plastics Labs" (checked), "Tested using injection-molding rheometry" (checked), "Includes pressure-dependent data" (unchecked), and "Includes juncture-loss data" (checked). The second section, "Specific heat data details", has four checkboxes: "Recently modified" (unchecked), "Data source specified" (checked), "Data tested in cooling" (checked), and "Multi-point data" (checked). The third section, "Thermal conductivity data details", has three checkboxes: "Recently modified" (unchecked), "Data source specified" (checked), and "Multi-point data" (checked). At the bottom, there is a label "Filling quality indicator Expiry Date" followed by a text box containing "01-Dec-18". At the very bottom right, there are two buttons: "OK" and "Help".

Filling Data Quality Details

Viscosity data details

- ☐ Recently modified
- ☒ Tested by Autodesk Moldflow Plastics Labs
- ☒ Tested using injection-molding rheometry
- ☐ Includes pressure-dependent data
- ☒ Includes juncture-loss data

Specific heat data details

- ☐ Recently modified
- ☒ Data source specified
- ☒ Data tested in cooling
- ☒ Multi-point data

Thermal conductivity data details

- ☐ Recently modified
- ☒ Data source specified
- ☒ Multi-point data

Filling quality indicator Expiry Date 01-Dec-18

OK Help

Material Quality Indicators

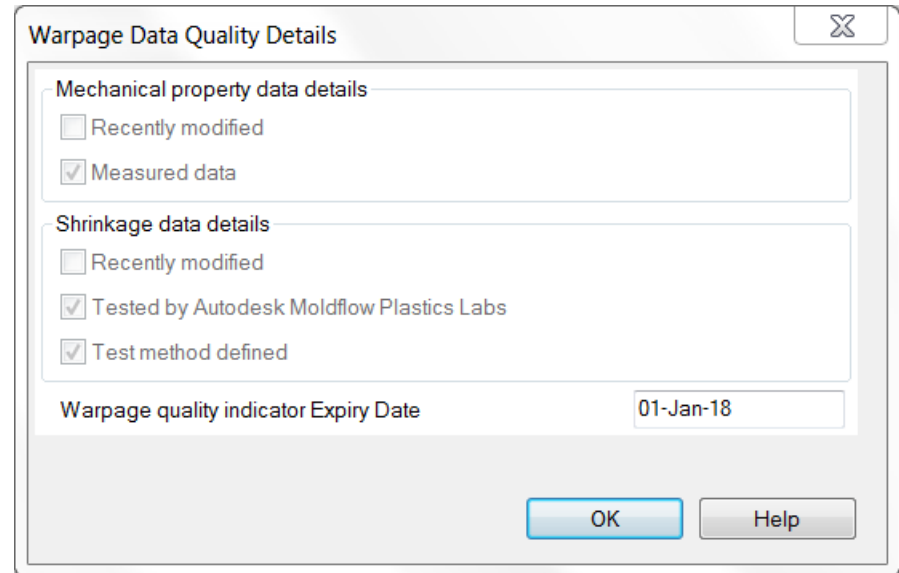


- Packing Quality Indicator – Incorporates the quality of the Fill Quality Indicator results and the pvT data
- The Packing and Warpage Quality Indicator cannot exceed the previous Quality Indicator

A screenshot of a software dialog box titled "Packing Data Quality Details". The dialog has a close button (X) in the top right corner. Inside, there is a section titled "pvT data details" containing four checkboxes: "Recently modified" (unchecked), "Measured data" (checked), "Tested by indirect dilatometry" (checked), and "Data tested in cooling" (checked). Below this section is a label "Packing quality indicator Expiry Date" followed by a text box containing the date "01-Dec-18". At the bottom right of the dialog are two buttons: "OK" and "Help".

Material Quality Indicators

- Warpage Quality Indicator – Incorporates the suitability of the Packing Quality Indicator along with the Mechanical Property and Shrinkage data
- Warpage requires either:
 - Mechanical data or Shrinkage data
- This is a mesh type specific concern for analysis.
 - DD/Midplane mesh uses shrinkage data (like CRIMS)
 - 3D mesh uses mechanical properties

A screenshot of a software dialog box titled "Warpage Data Quality Details". The dialog has a close button (X) in the top right corner. It contains two main sections: "Mechanical property data details" and "Shrinkage data details". Under "Mechanical property data details", there are two checkboxes: "Recently modified" (unchecked) and "Measured data" (checked). Under "Shrinkage data details", there are three checkboxes: "Recently modified" (unchecked), "Tested by Autodesk Moldflow Plastics Labs" (checked), and "Test method defined" (checked). At the bottom, there is a text field labeled "Warpage quality indicator Expiry Date" with the value "01-Jan-18". At the very bottom right, there are two buttons: "OK" and "Help".

MQI Ratings



- A Gold rating indicates a high confidence in the quality of the material data for the analysis type. When accurate analysis results are critical, it is recommended that a material with a Gold rating should be used.
- A Silver rating can result from a combination of well tested, and supplemental material data. For example, a material might have a Gold Packing Quality rating but use supplemental Mechanical Properties data. This could result in a Silver Warpage Quality Indicator rating.
- Bronze ratings can reflect problems such as incomplete data sets, the extensive use of supplemental data and untested material properties. The use of Bronze-rated materials can still generate good results, but these results should not be relied upon to determine critical requirements such as precise warpage or shrinkage allowances used for the cutting of molds.

The Future



- Duplicate
- Low hanging fruit
 - Ease of ordering

How do I order material characterization?



- Online ordering @ www.beaumontinc.com

A screenshot of the Beaumont website's 'Moldflow Material Characterization' page. The page has a blue header with the Beaumont logo and navigation links: ABOUT, INJECTION MOLDING GLOSSARY, NEWS, EVENTS, SHOP, CART, CONTACT, and a phone number (814) 899-6390. Below the header is a secondary navigation bar with links to MELTFLIPPER®, MOLDING SIMULATION, MATERIAL TESTING (highlighted), EDUCATION & TRAINING, DIAGNOSTIC SOFTWARE, and INJECTION MOLDING. A breadcrumb trail shows the path: HOME > MATERIAL TESTING > MOLDFLOW® MATERIAL CHARACTERIZATION. The main content area features a large orange heading 'Moldflow® Material Characterization' and a dark grey sidebar with links: MOLDFLOW® MATERIAL CHARACTERIZATION, TEST SPECIMEN MOLDING, THERMA-FLO™, and REQUEST INFORMATION. The text below the heading describes the services offered by Beaumont Advanced Processing Lab, including plastic material characterization and data fitting services for Autodesk's Moldflow and Heliux software packages. It mentions 'Gold' certification material characterization tests and lists various techniques. A paragraph explains the importance of material characterization for reducing development time and improving part quality. At the bottom, there is a blue call-to-action button that says 'ORDER ONLINE TODAY'.

How do I order material characterization?



Moldflow® Material Characterization Order Form

OPTION 1:

Autodesk Moldflow Package

OPTION 2:

Autodesk Moldflow Package - 5 Packs

OPTION 3:

Order Individual Tests

Fill In Your Material

Data Status: ☒ Not Confidential ☐ Confidential (\$845 surcharge applies)

Family Abbreviation *Required

Trade Name *Required

Lot Number *Required

Manufacturer *Required

Filler 1 Status (% and type)

Filler 2 Status (% and type)

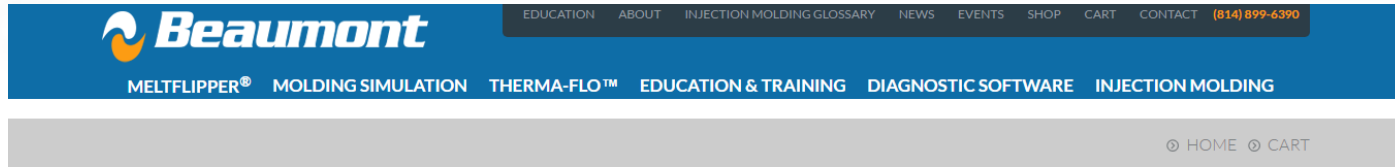
Filler Status

☐ Not Confidential ☐ Confidential



Pick Test"s" To Be Performed

Test	Description	Material	Price	
Filling (MPL-110)	Includes: Shear Viscosity by IMR, Specific heat, Thermal Conductivity and Mold Validation, Supplemental CTE and mechanical data is used, unless provided by customer.	25 kg	\$1,550	▼
Filling (MPL-110)	Includes: Shear Viscosity by IMR, Specific heat, Thermal Conductivity and Mold Validation, Supplemental CTE and mechanical data is used, unless provided by customer.	25 kg	\$1,550	
Filling and Packing (MPL-125)	Includes: pvT, Shear Viscosity by IMR, Specific heat, Thermal Conductivity and Mold Validation. Supplemental CTE and mechanical data is used, unless provided by customer.	25 kg	\$3,045	
Filling, Packing, and Shrinkage (MPL-135)	Includes: Moldflow Filling and Packing plus Shrinkage test. Supplemental CTE and mechanical data is used, unless provided by customer.	50 kg	\$6,195	
Filling, Packing, Shrinkage and Warpage (MPL-150)	Includes: Moldflow Filling, Packing and Shrinkage plus CTE and Mechanicals test.	50 kg	\$7,545	

How do I order material characterization?



Cart

	Product	Price	Quantity	Total
	 Material Tests of asdf Filling and Packing - 25 kg	\$3,045.00	<input type="text" value="1"/>	\$3,045.00
<input type="text" value="Coupon code"/>	<input type="button" value="Apply Coupon"/>			<input type="button" value="Update Cart"/>

Cart Totals

Subtotal	\$3,045.00
Shipping	Shipping costs will be calculated once you have provided your address.
Total	\$3,045.00

[Proceed to Checkout](#)

The Future



- Duplicate
- Low hanging fruit
 - Ease of ordering
 - Decrease lead times
 - Online ordering
 - Collaboration with Beaumont Advanced Processing
 - Machining of test specimens from mechanical plaques
- Future research
 - Collaboration with Australia
 - Internal research

The Future



1999



QUESTION EVERYTHING

The Future



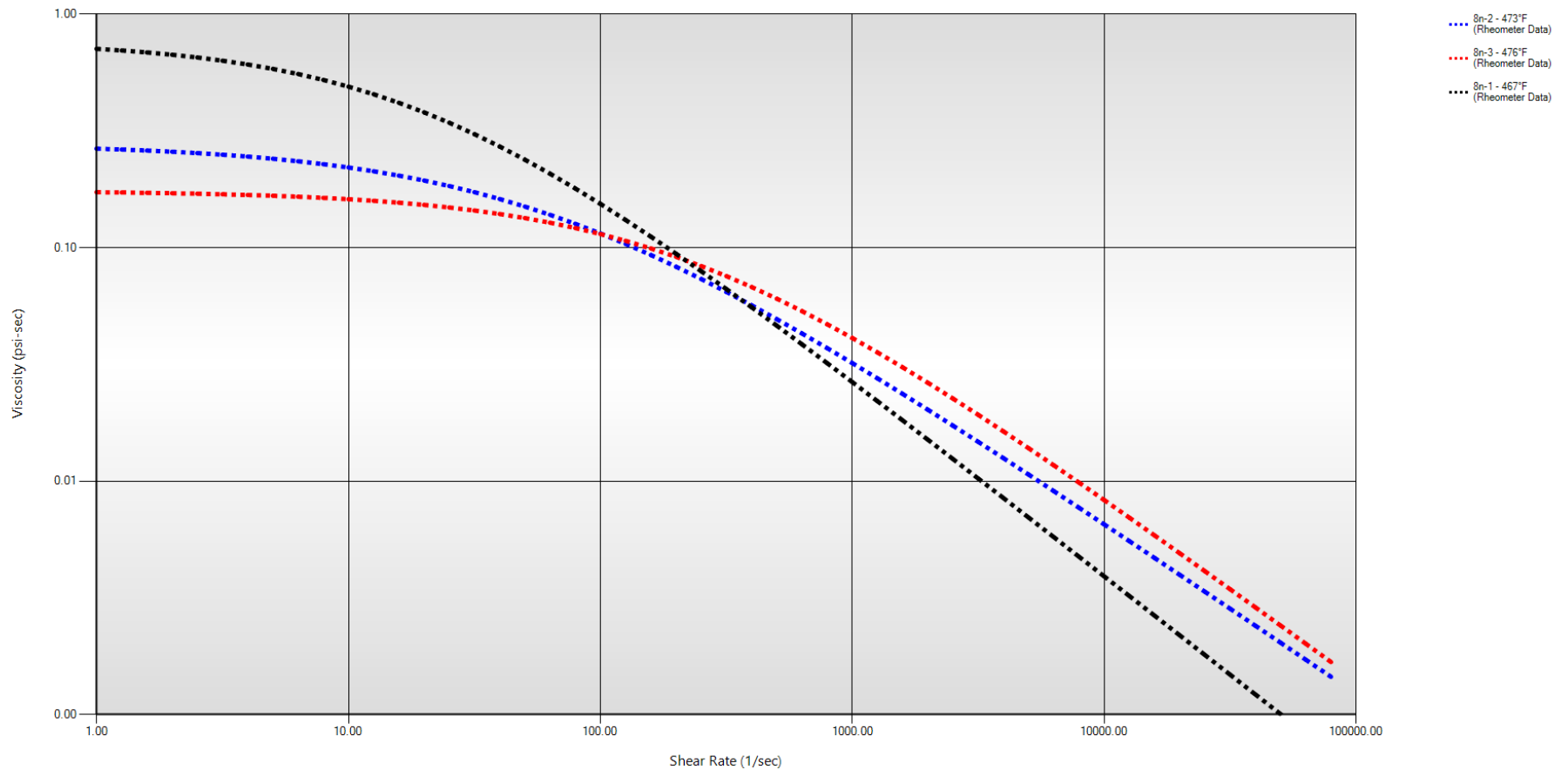
REVOLUTIONIZING Injection Molding

QUESTION EVERYTHING

The Future

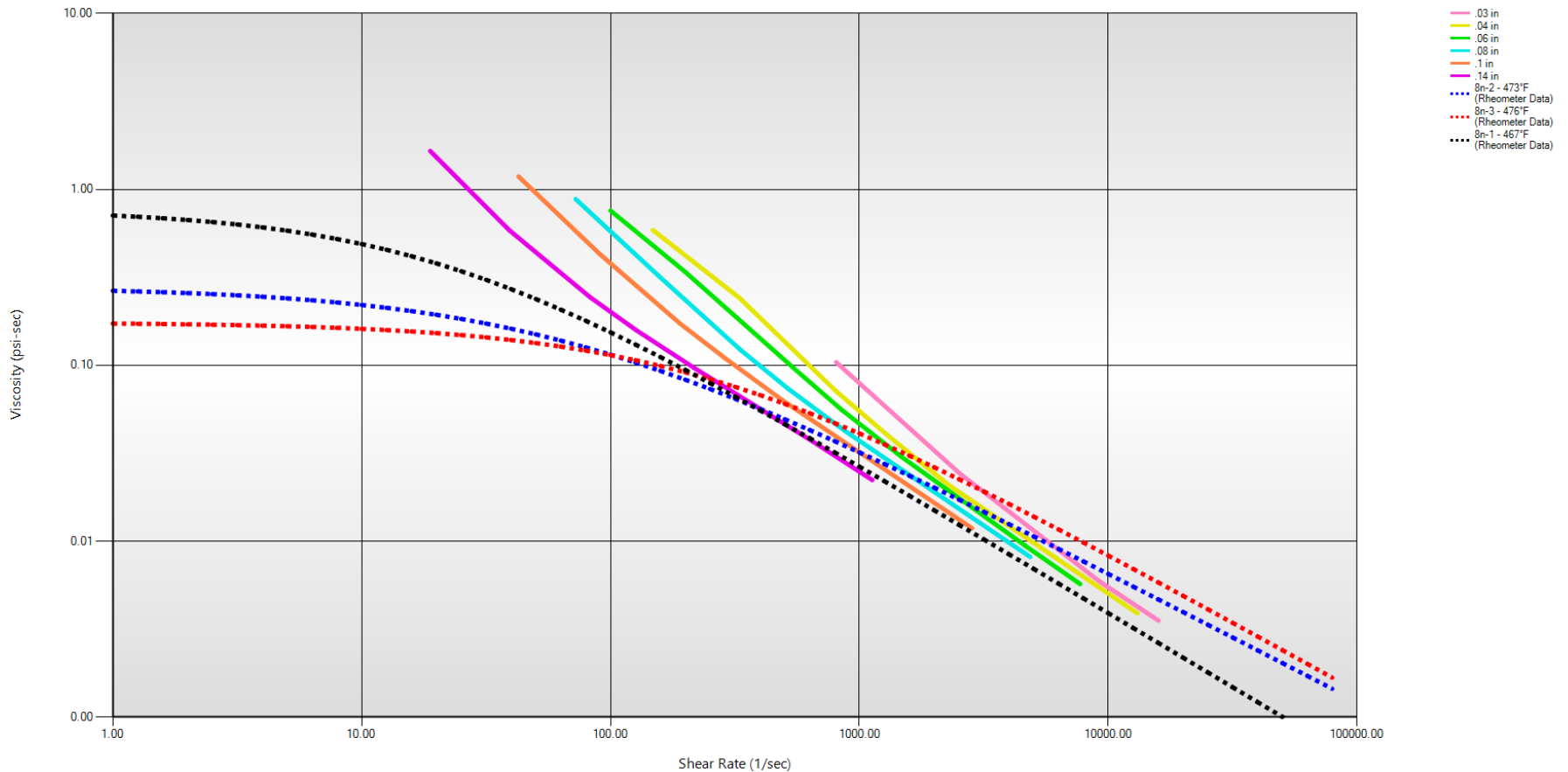


Viscosity vs. Shear Rate (Acrylite 8N 60299069 470°F)



The Future

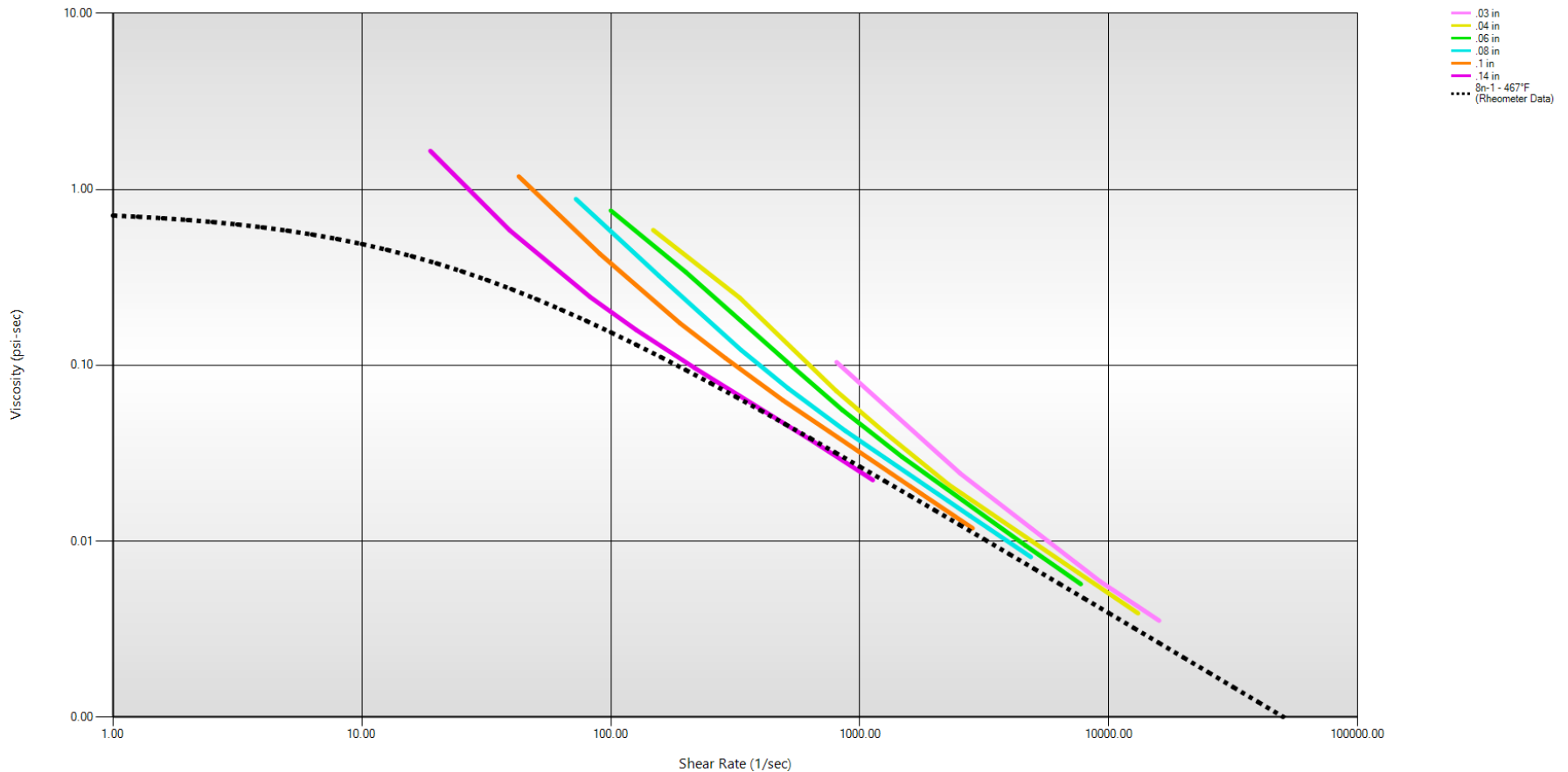
Viscosity vs. Shear Rate (Acrylite 8N 60299069 470°F)



The Future



Viscosity vs. Shear Rate (Acrylite 8N 60299069 470°F)



Beaumont Contact info



Webpage: [http://www.beaumontinc.com/material-testing/
moldflow-material-characterization/](http://www.beaumontinc.com/material-testing/moldflow-material-characterization/)

Email: info@beaumontinc.com

Phone: 814-899-6390

Current Address: 1524 East 10th St. Erie, PA

New Address: 6100 W. Ridge Rd. Erie, PA