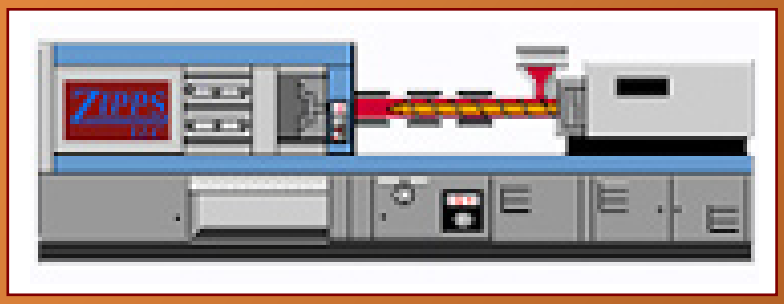
ZIPPS POCKET PAL

Thermoplastic Injection Molding



Process Troubleshooting Guide

As a manufacturer you face many challenges such as quality improvement, cost reduction, on time delivery and attempting to stay ahead of the competition. We understand these demands and pride ourselves in serving our clients to be successful in these areas.

ZIPPS LLC mission is to consult, teach and represent solutions in injection molding and lean systems. Our focus is to assist companies with the latest injection molding process technologies, improve employee knowledge, and incorporate scientific problem solving methodologies. While we are highly capable of providing troubleshooting advice from over 65 years of injection molding experience, our approach of teaching personnel basic and advance injection molding skills promotes long term success. We pride ourselves in teaching the processing theory from the "plastic's point of view" and immediately apply it to everyday process circumstances with a hands on approach. We also provide a computer simulation program if machine time is limited.

Of the many injection molding technological advances over the years, cavity pressure technology has overwhelming improved the overall quality process by reducing the variation among the numerous variables that are inherent to the injection molding process. Part of the implementation involves comprehensive machine and mold testing that on its own can resolve nagging quality issues. Reduction in scrap rate, part weight, and cycle time are just some of the benefits that drive the process to a Six Sigma level.

For a free consultation Call ZIPPS LLC today

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MATERIALS	MOLD SHRINKAGE	SPECIFIC GRAVITY	DRYING CONDITION	MELT TEMP °F	MOLD TEMP °F
ABS	.003-.009	1.04	2-4 hrs./180-200	425-500	100-170
ABS /Nylon	.010-.012	1.06	1-3 hrs./175-190	485-530	70-200
ABS/TPU	.005-.007	1.12	3-4 hrs./ 170 (-40)***	410-425	80-100
Acetal*	.015-.023	1.41	1-4 hrs./185	400-440	180-220
Acrylic	.002-.008	1.18	2-3 hrs./165-200**	425-510	175-220
Nylon: Type 6	.01-.025	1.13	2-4 hrs./180	450-550	100-200
Poly-Carbonate	.005-.008	1.2	4 hrs/ /250	530-640	160-210
PC/ABS	.005-.008	1.2	4 hrs./250	530-640	120-210
PC/ Polyester	.006-.008	1.18	3-4 hrs/ 175-230**	485-510	70-185
Poly-Ethylene*	.008-.01	1.21	3-4hrs/ 240 (-20)***	350-430	60-110
Poly-propylene	.012-.024	0.80-0.95	N/A	375-450	60-110
Polysulfone	.01-.05	0.91-0.96	1-2 hrs./120-150	375-575	60-140
Poly-Urethane	0.003	1.38	4 hrs./250-274		
Polyester:	008-.020	1.2	1-4 hrs./180-220	340-360	80-150

GENERAL PROCESSING GUIDELINES FOR THERMOPLASIC RESINS

MATERIALS	MOLD SHRINKAGE	SPECIFIC GRAVITY	DRYING CONDITION	MELT TEMP °F	MOLD TEMP °F
PBT			8 hrs./215-225		
PET			2-4hrs./275	540-570	220
ELAST-OMER			2-3 hrs./225(hot air)		
Liquid. Crystal Polymer		1.35	2-4 hrs./300	640-680	180-250
PVC*	.005-.007		2 hrs./140-150 cube	385-400	70-100
	.002-.007	1.07	2 hrs./170-180 pellet		
SMA		1.07	2 hrs./180-200**	490-510	120-180
SAN			2-3 hrs./180-200	450-500	150-200
Styrene Butadiene*			1-2 hrs./150-170		
TPE: MRP*	.012-.014	0.89	1-2 hrs./212		
ETE			2-3 hrs./225**		
TPO*			1-2 hrs./120-150**	430-470	90-120

NOTE: Values reflect general purpose, unfilled grades for Injection Molding.
Check manufactures recommendations.

* Denotes materials that typically do not need drying.

** Denotes that temperature is dependent on specific material grade.

*** Denotes minimum Dew Point degrees Fahrenheit.

Chart of Crystalline and Amorphous Polymers:

Abbreviation	Full common name	Type of resin
ABS	Acrylonitrile-Butadiene-Styrene	Amorphous
Acetal (POM)	Acetal or polyoxymethylene	Semi-Crystalline
Acrylic (PMMA)	Polymethyl methacrylate	Amorphous
ASA	Acrylonitrile-Stryrene-Acrylate	Amorphous
CAP	Cellulose Acetate Propionate	Amorphous
Crystal PS	Crystal Polystyrene (GPPS)	Amorphous
CPVC	Chlorinated Polyvinyl Chloride	Amorphous
EVA	Ethylene Vinyl Acetate	Semi-Crystalline
EVOH	Ethylene Vinyl Alcohol	Semi-Crystalline
GPPS	General Purpose Polystyrene	Amorphous
HDPE	High Density Polyethylene	Semi-Crystalline
HIPS	High Impact Polystyrene	Amorphous
Ionomer	Ionomer	Semi-Crystalline
IMPS	Impact Polystyrene	Amorphous
LCP	Liquid Crystal Polymer	Semi-Crystalline
LDPE	Low Density Polyethylene	Semi-Crystalline
Nylon (PA)	Polyamide	Semi-Crystalline
PA	Polyamide, Nylon	Semi-Crystalline
PB	Polybutylene	Semi-Crystalline
PBT	Polybutylene Terephthalate	Semi-Crystalline
PC	Polycarbonate	Amorphous
PE	Polyethylene	Semi-Crystalline
PEEK	Polyetheretherketone	Semi-Crystalline

Chart of Crystalline and Amorphous Polymers:

Abbreviation	Full common name	Type of resin
PEI	Polyetherimide	Amorphous
PEK	Polyetherketone	Semi-Crystalline
PES	Polyethersulfone	Amorphous
PET	Polyethylene Terephthalate	Semi-C & Clear
PETG	Polyethylene Terephthalate Glycol	Amorphous
PMMA	Polymethyl methacrylate, Acrylic	Amorphous
POM	Acetal, Polyacetal	Semi-Crystalline
PP	Polypropylene	Semi-Crystalline
PPE	Polyphenylene ether	Amorphous
PPO/Styrene	Polyphenylene- Styrene	Amorphous
PPS	Polyphenylene Sulfide	Semi-Crystalline
PS	Polystyrene	Amorphous
PS syn.	Syndiotatic Polystyrene Questra	Semi-Crystalline
PSU or PPSU	Polysulfone Polyphenylenesulfone	Amorphous
PTFE	Polytetrafluoroethylene	Semi-Crystalline
PU	Polyurethane	Amorphous
PVC	Polyvinylchloride; Flexible & Rigid	Amorphous
TPO	Thermoplastic Olefins	Semi-Crystalline

BLACK STREAKING Amorphous

POSSIBLE SOLUTIONS

- Check for contamination in feed resin or residue from previous resins in barrel. Purge machine as needed.
- Check cushion position (run minimum).
- Make sure nozzle is seated and sized correctly.
- Increase nozzle size.
- Slow down injection speed.
- Lower back pressure.
- Reduce screw speed rpm.
- Check for grease or oil in cavities or on tool.
- Clean the mold.
- Check mold to make sure it has adequate venting.
- Decrease nozzle temperature.
- Decrease cycle time.
- Lower processing melt temperature.
- Increase gate size.
- Increase manifold temperature.

BREAKS OR CRACKS Amorphous

POSSIBLE SOLUTIONS

- Decrease molecular orientation (fill slower).
- Decrease injection speed.
- Lower plastic melt temperature.
- Check for contaminated resin.
- Reduce packing.
- Lower peak cavity pressure (post gate).
- Adjust the mold temperature (raise or lower).
- Decrease screw forward time.
- Increase gate size.
- Increase nozzle size.
- Reduce amount of regrind.
- Reduce generations of regrind.
- Change material grade. Higher impact strength.

BRITTLENESS Amorphous

POSSIBLE SOLUTIONS

- Make sure resin is dry (use descant dryer).
- Check material for contamination.
- Check moisture content of material.
- Pre-dry material.
- Lower melt temperature.
- Increase mold temperature.
- Lower nozzle temperature.
- Increase nozzle size.
- Decrease screw speed rpm.
- Decrease backpressure.
- Change location of gate.
- Check for bad heater bands.
- Check processing melt temperatures.
- Decrease the amount of regrind.
- Check for sharp corners, notches, or thread. Adjust tooling.
- Add impact modifiers to resin.
- Change material.

COLD SLUGS Amorphous

POSSIBLE SOLUTIONS

- Raise nozzle temperature.
- Raise melt temperature.
- Raise the manifold temperature.
- Increase mold temperature Stationary half.
- Use full taper in nozzle.
- Increase nozzle size.
- Use sprue break option on machine.
- Provide cold slug well in runner system.
- Provide cold slug well in mold.
  (Reverse nipple opposite of gate).

DELAMINATION Amorphous

POSSIBLE SOLUTIONS

- Check for contamination from the hopper.
- Check moisture content of material.
- Verify dryer is working properly.
- Increase melt temperature.
- Increase mold temperature.
- Reduce Regrind.
- Raise backpressure.
- Reduce backpressure.
- Excessive decompression.
- Purge barrel.
- Change gate size (increase or decrease).
- Increase injection rate.
- Decrease injection rate.
- Reduce screw RPM.
- Decrease injection pressure.
- Use a larger nozzle orifice.
- Use small nozzle length.
- Verify nozzle heating is uniform.
- Verify feed throat is not sweating or leaking water.

DIMENSIONAL Amorphous

POSSIBLE SOLUTIONS

- Perform dynamic check ring test.
- Perform machine Hydraulic response test.
- Perform 30/30 melt.
- Maintain consistent (cushion).
- Verify Mold temperature to be accurate.
- Run even cooling temperatures on the mold (front and back halves).
- Sometimes it is necessary to run uneven cooling temperatures on the mold halves.
- Decrease injection hold time (parts to big).
- Increase injection hold time (parts to small).
- Decrease overall injection speed (parts to big).
- Increase overall injection speed (parts to small).
- Decrease final fill speed (parts to big).
- Increase final fill speed (parts to small).
- Decrease backpressure (parts to big).
- Increase back pressure (parts to small).
- Verify mold shrinkage factor for polymer.
- Adjust mold design if necessary.
- Additives are available to aid in reducing part shrinkage.

DISCOLORATION Amorphous

POSSIBLE SOLUTIONS

- Check material for contamination.
- Check hopper and feed zone for Contaminants.
- Clean magnet in the hopper.
- Verify L/D ratio of colorant.
- Add more colorant.
- Perform 30/30 melt test.
- Purge heating barrel.
- Add Backpressure.
- Lower screw RPM.
- Raise melt temperatures.
- Lower melt temperature
- Lower manifold temperatures.
- Check barrel and screw for excessive wear.

DROOLING Amorphous

POSSIBLE SOLUTIONS

- Verify screw suckback.
- Check for moisture in resin.
- Dry resin.
- Increase melt decompression (suckback).
- Lower nozzle temperature.
- Lower back pressure.
- Decrease melt temperature.
- Lower manifold temperature.
- Lower hot drop temperature.
- Use reverse taper nozzle.
- Use a nozzle shutoff valve.
- Decrease residual pressure in barrel.
- Decrease overall cycle time.
- Reduce screw RPMs.
- Use nozzle with smaller orifice.
- Lower mold temperature.
- Use valve gate mold.

FLASH Amorphous

POSSIBLE SOLUTIONS

- Check clamp tonnage. (Increase if necessary).
- Clean mold check for build up or debris on parting line.
- Check for obstructions in the mold.
- Check vents clean, or add if necessary.
- Perform dynamic check ring test.
- Perform injection speed linearity test.
- If multi cavity perform cavity imbalance test (correct imbalance if necessary).
- Perform hydraulic response test (look for over damp conditions).
- Lower peak cavity pressure (Post Gate).
- Decrease injection speed.
- Decrease injection pressure.
- Reduce injection fill rate.
- Reduce packing pressure.
- Lower back pressure.
- Try lower melt temperature.
- Verify temperatures on Themolaters are correct.
- Decrease mold water temperature.
- Decrease cavity pressure (End of fill).
- Decrease pack and hold pressures and time.
- Increase sprue, runner, or gate size.
- Add gates and runners.
- Verify mold manifold temperature.
- Spot tool (Repair mold if necessary).
- Use molding machine with higher clamp tonnage.
- Check for misalignment of mold surfaces.
- Verify platens are clean of debris and build up.
- Verify machine platens are parallel.
- Verify machine tie bar stretch is consistent.
- Verify adequate support pillars in core half of tool.
- Verify material is dried.

GAS BURNS Amorphous

POSSIBLE SOLUTION

- Clean mold, vents and parting line.
- Measure vents - open or add if necessary (refer to vent depth guide). Suggestion use plastigage.
- Use proper clamp tonnage for mold running.
- If multi cavity perform cavity imbalance test.
- Perform injection speed linearity test.
- Perform hydraulics response test.
- Decrease injection speed final stage of filling.
- Lower processing temperatures.
- Check proper gate placement.
- Increase runner size
- Check for uneven wall thickness in part.
- Check gate placement (Relocate gate if necessary).
- Slow injection speed.
- Lower injection high pressure.
- Lower processing temperatures.
- Lower back pressure.
- Decrease screw RPM.
- Lower nozzle temperature.
- Decrease barrel temperatures.
- Lower material temperature.
- Verify accurate drying temperature.
- Check for faulty heater bands.
- Check material temperature (pyrometer).
- Check for contamination.
- Decrease injection speed/pressure/time.
- Decrease nozzle temperature.
- Add more vents in burning area.
- Install porecrex insert.
- Clean or add vents.
- Lower material temperature.
- Check for faulty heater bands.
- Check material temperature (pyrometer).
- Decrease injection speed/pressure/time.

GATE BLIMISH / BLUSH Amorphous

POSSIBLE SOLUTIONS

- Clean mold.
- Use slow injection speed until molten resin has filled area around gate. Then fill fast.
- Lower nozzle temperature.
- Lower manifold temperatures.
- Increase mold temperature.
- Check for contaminated material.
- Dry material.
- Change gate location.
- Increase gate size.
- Change gate type.
- Check mold surface for stains, clean if necessary.
- Possible bad mold surface.
- Increase runner and gate size.
- Reduce injection pressure during hold period.
- Decrease injection speed.

INTERNAL BUBBLES Amorphous

POSSIBLE SOLUTIONS

- Use resin dryer.
- Use descant dryer.
- Verify Dryer is working properly
- Clean mold vents - open if necessary.
- Measure vent depth (use plastigage, refer to material supplier specification sheet)
- Decrease decompression (suck back).
- Increase peak cavity pressure.
- Increase screw-forward time.
- Decrease injection speed.
- Decrease melt temperature
- Improve melt uniformity.
- Improve gate size or location.
- Eliminate any restrictions in runner or nozzle.
- Increase shot size.
- Decrease cushion.
- Increase backpressure.
- Decrease screw RPM.
- Increase runner size.
- Increase barrel temperature.
- Remove part hot and cool in water bath.

JETTING Amorphous

POSSIBLE SOLUTIONS

- Increase or decrease mold temperature.
- Increase or decrease initial injection speed.
- Increase or decrease melt temperature.
- Increase or decrease nozzle temperature.
- Increase nozzle size.
- Increase gate size.
- Change gate location.
- Change type of gate.

NOZZLE FREEZE OFF Amorphous

POSSIBLE SOLUTIONS

- Use sprue break option if available.
- Raise nozzle temperature.
- Raise mold temperature.
- Move heater band closer to the nozzle.
- Check for burned out heater band.
- Decrease cycle time.
- Use reverse taper nozzle.
- Use sprue break option if available.
- Check for proper temperature at nozzle raise if necessary.
- Increase heater band watt density.
- Add more heater bands to the nozzle.

PART WARPAGE Amorphous

POSSIBLE SOLUTIONS

- Verify proper mold water line connections.
- Verify Temperature control is working.
- GPM in and out—Accurate temperature in and out.
- Verify actual mold temperature both halves.
- Increase cooling time.
- Use lower and possible differential mold temperature.
- Decrease the melt temperature.
- Adjust post gate cavity pressure.
- Adjust screw-forward time.
- Adjust injection pressure.
- Jig cool or water-cool parts.
- Check mold-cooling Themolaters.
- Decrease mold temperature.
- Increase time cycle.
- Decrease injection speed.
- Increase injection speed.
- Decrease backpressure.
- Change water channels.
- Add support ribs to reduce clamshell type warp.

SHORT SHOTS Amorphous

POSSIBLE SOLUTIONS

- Confirm cushion position. Increase shot size.
- Perform dynamic check ring test.
- Clean the Mold & Vents.
- Verify vent depths, open if necessary. (Refer to vent depth guide).
- Add more gas vents (Refer to vent depth guide).
- Increase peak cavity pressure (post gate).
- Increase overall injection speed.
- Make sure nozzle and runners are clear of obstructions.
- Verify material is dried (Refer to drying guide).
- Caution some materials can be over dried (Refer to drying guide).
- Increase plastic melt temperature.
- Increase mold water temperature.
- Increase nozzle temperature.
- Verify operation on non-return check valve on screw.
- Perform dynamic check ring test.
- Increase backpressure.
- Increase plastic hold pressure.
- Lengthen molding cycle.
- Redesign cold slug to prevent gate obstruction.
- In multi-cavity molds, be sure all gate sizes are uniform to prevent unbalanced melt flow.
- Perform Cavity Imbalance test.

SHORT SHOTS Amorphous

POSSIBLE SOLUTIONS

- Increase sprue, runner, or gate size.
- Check part design for restrictions.
- Verify mold manifold temperature.
- Install porecrex insert if needed.
- Add gates and runners.
- Decrease gate land length.
- Increase nozzle size.
- Change vent location.
- Increase overall cycle.
- Use larger machine or injection unit.
- Use booster and maximum injection speed.
- Preheat resin in hopper.
- Check for contamination.
- Check for thick-to-thin sections in molded part. Core out if needed.

POSSIBLE SOLUTIONS

- Confirm cushion position. Increase shot size.
- Perform dynamic check ring test.
- Clean the Mold & Vents
- Verify vent depths - open if necessary. (Refer to material supplier vent depth guide).
- Insure gate seal- if sink is located at the gate area.
- Verify material is not over dried (Refer to material specification sheet).
- Check normal wall thickness.
- Make stand off 50% of nominal (i.e. ribs doghouses, clip tower, stand offs, etc.).
- Increase peak cavity pressure (post gate).
- Increase overall injection speed.
- Make sure nozzle and runners are clear of obstructions.
- Decrease mold water temperature
- Increase mold water temperature.
- Decrease nozzle temperature
- Increase nozzle temperature.
- Verify operation on non-return check valve on screw. (perform dynamic check ring test).
- Increase backpressure.
- Increase plastic hold pressure.
- Lengthen molding cycle.
- Redesign cold slug to prevent gate obstruction.
- In multi-cavity molds, be sure all gate sizes are uniform to prevent unbalanced melt flow.
- Perform Cavity Imbalance test.

POSSIBLE SOLUTIONS

- Check part design to make sure there are no restrictions. (Shallow ribs hard to fill)
- Verify mold manifold temperature.
- Increase sprue, runner, or gate size.
- Decrease sprue, runner, or gate size.
- Add gates and runners.
- Increase nozzle size.
- Use larger machine or injection unit.
- Use booster and maximum injection speed.
- Check for thick-to-thin sections in molded part. Correct tool/mold if possible.
- Reduce cooling time in mold.
- Increase cooling time in mold
- Check that the shot size of machine is large enough for the part to be made.
- Increase mold closed time.

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SPLAY Amorphous

POSSIBLE SOLUTIONS

- Check dryer for proper operation.
- Check moisture content of material.
- Check for contaminated resin.
- Decrease decompression (suckback).
- Clean mold and Check venting.
- Measure the vents - open if necessary (refer to material supplier vent depth guide).
- Decrease melt temperature. Increase melt temperature
- Increase or decrease injection speed.
- Increase size of Nozzle orifice
- Increase size of gate and runners.
- Splay may be off of sharp angles or radius angles.
- Use desiccant dryer.
- Verify dryer is working properly.
- Increase backpressure.
- Increase injection pressure.
- Decrease injection pressure.
- Increase mold temperature.
- Decrease mold temperature.
- Check for water leak in mold.
- Check for condensation on mold.
- Lower nozzle temperature.
- Raise nozzle temperature.
- Check for burrs in runner/gates.
- Verify manifold temperatures.
- Some colorants may cause splay. (Check with colorant supplier if other colorants don’t splay with same process)

SPLAY Amorphous

POSSIBLE SOLUTIONS

Due to excessive moisture

- Dry resin.

Due to drooling at nozzle

- Reduce melt temperature.
- Reduce nozzle temperature.
- Reduce mold open time.
- Reduce injection time.
- Reduce cushion.
- Decrease backpressure.
- Increase suck back.

SPRUE STICKING Amorphous

POSSIBLE SOLUTIONS

- Polish sprue bushing and/or use bushing with greater taper.
- Check bushing or burns or rough surface.
- Check nozzle and bushing for seating
- Decrease peak cavity pressure (post gate).
- Decrease injection pressure.
- Decrease pack and hold pressure.
- Check action of sprue puller, an increase in cycle may be needed.
- Check for material degradation.
- Decrease mold temperature.
- Verify material melt temperature.
- Decrease injection hold time.
- Check for undercuts and good draft angles.
- If “Z” puller is used, check whether knockout travel is enough to clear.
- Decrease plastic melt temperature.
- Check heater band on sprue.
- Adjust mold temperature.
- Check to make sure nozzle orifice is compatible with orifice on tool.
- Increase nozzle temperature.
- Correct alignment between sprue and nozzle.
- Decrease screw-forward time.
- Increase mold-cooling time.

VOIDS Amorphous

POSSIBLE SOLUTIONS

- Verify Dryer is working properly
- Clean mold vents - open if necessary.
- Decrease decompression (suckback).
- Increase injection pressure.
- Increase peak cavity pressure.
- Raise mold temperature (cool Slower).
- Increase screw-forward time.
- Decrease injection speed.
- Decrease melt temperature.
- Improve melt uniformity.
- Improve gate size or location.
- Eliminate any restrictions in runner or nozzle.
- Increase shot size.
- Decrease cushion.
- Eliminate any restrictions in runner or nozzle.
- Increase backpressure.
- Decrease screw RPM.
- Increase feed zone temperature.
- Reduce barrel temperature.
- Increase polymer temperature in hopper.
- Remove part hot and cool in water bath.

WELDLINES Amorphous

POSSIBLE SOLUTIONS

- Clean mold surface.
- Clean mold vents- open if necessary.
- Enlarge vents. Measure using plastigage.
- Add more vents.
- Adjust injection speed. Use fill speed profile.
- Increase injection pressure.
- Increase plastic melt temperature.
- Decrease plastic melt temperature.
- Increase mold temperature.
- Decrease mold temperature.
- If dried material is used verify drying condition.
- Re-gate mold to change flow pattern.
- Add porecrex insert if necessary.
- Increase peak cavity pressure.
- Increase the backpressure.
- Fill mold quicker.
- Increase venting-verify proper vent location.
- Check moister content of resin.
- Vent the cavity in the weld area.
- Check tool surfaces for dirt or scratches.
- Increase injection pressure and packing time.
- Dry resin thoroughly.
- Check gate size/location.
- Lower clamp tonnage.

WRINKLES Amorphous

POSSIBLE SOLUTIONS

- Clean the vents & verify vents are open.
- Measure vents with plastigage (refer to material supplier specification spec sheet).
- Enlarge vents. If necessary.
- Add more vents.
- Increase injection speed.
- Increase post gate cavity pressure.
- Increase screw-forward time.
- Increase mold temperature.
- Increase plastic melt temperature.
- Check thick and thin sections for design problems.
- Increase gate size or relocate.

BLACK STREAKING Semi-Crystalline

POSSIBLE SOLUTIONS

- Check for contamination in feed resin or residue from previous resins in barrel. Purge machine as needed.
- Check cushion position (run minimum).
- Make sure nozzle is seated and sized correctly.
- Increase nozzle size.
- Slow down injection speed.
- Lower back pressure.
- Reduce screw speed rpm.
- Check for grease or oil in cavities or on tool.
- Clean the mold.
- Check mold to make sure it has adequate venting.
- Decrease nozzle temperature.
- Decrease cycle time.
- Lower processing melt temperature.
- Increase gate size.
- Increase manifold temperature.

BREAKS OR CRACKS Semi-Crystalline

POSSIBLE SOLUTIONS

- Decrease molecular orientation (fill slower).
- Decrease injection speed.
- Lower plastic melt temperature.
- Check for contaminated resin.
- Check the sprue puller and knockouts.
- Reduce packing.
- Lower peak cavity pressure (post gate).
- Adjust the mold temperature (raise or lower).
- Decrease screw forward time.
- Increase gate size.
- Increase nozzle size.
- Reduce amount of regrind.
- Reduce generations of regrind.

BRITTLENESS Semi-Crystalline

POSSIBLE SOLUTIONS

- Lower melt temperature.
- Increase mold temperature.
- Lower nozzle temperature.
- Increase nozzle size.
- Decrease screw speed rpm.
- Decrease backpressure.
- Change location of gate.
- Check for bad heater bands.
- Check processing melt temperatures.
- Decrease the amount of regrind.
- Check for sharp corners, notches, or thread. Adjust tooling.
- Add impact modifiers to resin.
- Change material.

COLD SLUGS Semi-Crystalline

POSSIBLE SOLUTIONS

- Raise nozzle temperature.
- Raise melt temperature.
- Raise the manifold temperature.
- Increase mold temperature Stationary half.
- Use full taper in nozzle.
- Use a reverse taper in nozzle (nylon and acetals).
- Increase nozzle size.
- Use sprue break option on machine.
- Provide cold slug well in runner system.
- Provide cold slug well in mold.
  (Reverse nipple opposite of gate).

DELAMINATION Semi-Crystalline

POSSIBLE SOLUTIONS

- Check for contamination from the hopper.
- Increase melt temperature.
- Increase mold temperature.
- Reduce Regrind.
- Raise backpressure.
- Reduce backpressure.
- Excessive decompression.
- Purge barrel.
- Change gate size (increase or decrease).
- Increase injection rate.
- Decrease injection rate.
- Reduce screw RPM.
- Decrease injection pressure.
- Use a larger nozzle orifice.
- Use small nozzle length.
- Verify nozzle heating is uniform.
- May want to dry this material (Refer to manufacture specification sheet).
- Verify feed throat is not sweating or leaking water.

POSSIBLE SOLUTIONS

- Perform dynamic check ring test.
- Perform machine Hydraulic response test.
- Perform 30/30 melt.
- Maintain consistent (cushion).
- Verify Mold temperature to be accurate.
- Run even cooling temperatures on the mold (front and back halves).
- Sometimes it is necessary to run uneven cooling temperatures on the mold halves.
- Decrease hold time (parts to big).
- Increase hold time (parts to small).
- Decrease overall injection speed (parts to big).
- Increase overall injection speed (parts to small).
- Decrease final fill speed (parts to big).
- Increase final fill speed (parts to small).
- Decrease backpressure (parts to big).
- Increase backpressure (parts to small).
- Verify mold shrinkage factor for polymer.
- Adjust mold design if necessary.
- Additives are available to aid in reducing part shrinkage.

DISCOLORATION Semi-Crystalline

POSSIBLE SOLUTIONS

- Check material for contamination.
- Check hopper and feed zone for contaminants.
- Clean magnet in the hopper.
- Verify L/D ratio of colorant.
- Add more colorant.
- Perform 30/30 melt test.
- Purge heating barrel.
- Add Backpressure.
- Lower screw RPM.
- Raise melt temperatures.
- Lower melt temperature
- Lower manifold temperatures.
- Check barrel and screw for excessive wear.

DROOLING Semi-Crystalline

POSSIBLE SOLUTIONS

- Verify screw suckback
- Increase melt decompression (suckback).
- Lower nozzle temperature.
- Lower back pressure.
- Decrease melt temperature.
- Lower manifold temperature.
- Lower hot drop temperature.
- Use reverse taper nozzle.
- Use a nozzle shutoff valve.
- Decrease residual pressure in barrel.
- Decrease overall cycle time.
- Reduce screw RPMs.
- Use nozzle with smaller orifice.
- Lower mold temperature.
- Use valve gate mold.

POSSIBLE SOLUTIONS

- Check clamp tonnage. (Increase if necessary).
- Clean mold check for build up of debris on parting line.
- Check for obstructions in the mold.
- Check vents clean, or add if necessary.
- Perform dynamic check ring test.
- Perform injection speed linearity test.
- If multi cavity perform cavity imbalance test (correct imbalance if necessary).
- Perform hydraulic response test (look for over damp conditions).
- Lower peak cavity pressure (Post Gate).
- Decrease injection speed.
- Decrease injection pressure.
- Reduce injection fill rate.
- Reduce packing pressure.
- Lower back pressure.
- Try lower melt temperature.
- Check Themolaters for proper operating temperature.
- Decrease mold water temperature.
- Decrease cavity pressure (End of fill).
- Decrease pack and hold pressures and time.
- Increase sprue, runner, or gate size.
- Add gates and runners.
- Verify mold manifold temperature.
- Spot tool (Repair mold if necessary).
- Use molding machine with higher clamp tonnage.
- Check for misalignment of mold surfaces.
- Verify platens are clean of debris and build up.
- Verify machine platens are parallel
- Verify machine tie bar stretch is consistent.
- Verify adequate support pillars in core half of tool.

POSSIBLE SOLUTION

- Clean mold, vents and parting line.
- Measure vents - open if necessary (refer to vent depth guide).Suggestion use plastigage.
- Add vents to the mold (refer to vent depth guide).
- Use proper clamp tonnage for mold. running (Calculate proper clamp tonnage for mold).
- If multi cavity perform cavity imbalance test.
- Perform injection speed linearity test.
- Perform hydraulics response test.
- Balance fill before changing process.
- Decrease injection speed final stage of filling.
- Lower processing temperatures.
- Check proper gate placement.
- Increase runner size
- Check for uneven wall thickness in part.
- Check proper gate placement (Relocate gate if necessary).
- Slow injection speed.
- Lower injection high pressure.
- Lower processing temperatures.
- Lower back pressure.
- Decrease screw RPM.
- Lower nozzle temperature.
- Decrease barrel temperatures.
- Lower material temperature.
- Check for faulty heater bands.
- Check material temperature (pyrometer).
- Check for contamination.
- Decrease injection speed/pressure/time.
- Decrease nozzle temperature.
- Add more vents in burning area.
- Install porecrex insert.

GATE BLIMISH / BLUSH Semi-Crystalline

POSSIBLE SOLUTIONS

- Clean mold.
- Use slow injection speed until molten resin has filled area around gate. Then fill fast.
- Lower nozzle temperature
- Lower manifold temperatures.
- Increase mold temperature.
- Change gate location
- Increase gate size.
- Change gate type.
- Check mold surface for stains, clean if necessary.
- Possible bad mold surface.
- Increase runner and gate size.
- Reduce injection pressure during hold period
- Decrease injection speed.

INTERNAL BUBBLES Semi-Crystalline

POSSIBLE SOLUTIONS

- Clean mold vents - open if necessary.
- Measure vent depth (use plastigage, refer to material supplier specification sheet)
- Decrease decompression (suck back).
- Increase peak cavity pressure.
- Increase screw-forward time.
- Decrease injection speed.
- Decrease melt temperature
- Improve melt uniformity.
- Improve gate size or location.
- Eliminate any restrictions in runner or nozzle.
- Increase shot size.
- Decrease cushion.
- Increase backpressure.
- Decrease screw RPM.
- Increase runner size.
- Increase barrel temperature.
- Remove part hot and cool in water bath.

POSSIBLE SOLUTIONS

- Increase or decrease mold temperature.
- Increase or decrease initial injection speed.
- Increase or decrease melt temperature.
- Increase or decrease nozzle temperature.
- Increase nozzle size.
- Increase gate size.
- Change gate location.
- Change type of gate.

NOZZLE FREEZE OFF Semi-Crystalline

POSSIBLE SOLUTIONS

- Use sprue break option if available.
- Raise nozzle temperature.
- Raise mold temperature.
- Move heater band closer to the nozzle.
- Check for burned out heater band.
- Decrease cycle time.
- Use reverse taper nozzle.
- Use sprue break option if available.
- Check for proper temperature at nozzle raise if necessary.
- Increase heater band watt density.
- Add more heater bands to the nozzle.

PART WARPAGE Semi-Crystalline

POSSIBLE SOLUTIONS

- Verify proper mold water line connections.
- Verify Temperature control is working.
- GPM in and out—Accurate temperature in and out.
- Verify actual mold temperature both halves.
- Increase cooling time.
- Use lower and possible differential mold temperature.
- Decrease the melt temperature.
- Adjust post gate cavity pressure.
- Adjust screw-forward time.
- Adjust injection pressure.
- Jig cool or water-cool parts.
- Check mold-cooling Themolaters.
- Decrease mold temperature.
- Increase time cycle.
- Decrease injection speed.
- Increase injection speed.
- Decrease backpressure.
- Change water channels.
- Add support ribs to reduce clam shell type warp.

SHORT SHOTS Semi-Crystalline

POSSIBLE SOLUTIONS

- Confirm cushion position. Increase shot size.
- Perform dynamic check ring test.
- Clean the Mold & Vents
- Verify vent depths, open if necessary. Or add more (Refer to vent depth guide).
- Increase peak cavity pressure (post gate).
- Increase overall injection speed.
- Make sure nozzle and runners are clear of obstructions.
- Increase mold water temperature.
- Increase nozzle temperature.
- Verify operation on non-return check valve on screw. (perform dynamic check ring test).
- Increase backpressure.
- Increase plastic hold pressure.
- Lengthen molding cycle.
- Redesign cold slug to prevent gate obstruction.
- In multi-cavity molds, be sure all gate sizes are uniform to prevent unbalanced melt flow.
- Perform Cavity Imbalance test.
- Check part design to make sure there are no restrictions.
- Verify mold manifold temperature.
- Install porecrex insert if needed.
- Increase sprue, runner, or gate size.
- Decrease sprue, runner, or gate size.
- Add gates and runners.
- Decrease gate land length.

SHORT SHOTS Semi-Crystalline

POSSIBLE SOLUTIONS

- Change vent location.
- Increase overall cycle.
- Use larger machine or injection unit.
- Use booster and maximum injection speed.
- Preheat resin in hopper.
- Check for contamination.
- Check for thick-to-thin sections in molded part. Core out if needed.

POSSIBLE SOLUTIONS

- Confirm cushion position. Increase shot size.
- Perform dynamic check ring test.
- Clean the Mold & Vents
- Verify vent depths, open if necessary. (Refer to material supplier vent depth guide).
- Insure gate seal- if sink is located at the gate area.
- Check normal wall thickness.
- Make stand off 40% of nominal (i.e. ribs doghouses, clip tower, stand offs, etc.).
- Increase peak cavity pressure (post gate).
- Increase overall injection speed.
- Make sure nozzle and runners are clear of obstructions.
- Decrease mold water temperature
- Increase mold water temperature.
- Decrease nozzle temperature
- Increase nozzle temperature.
- Verify operation on non-return check valve on screw. (perform dynamic check ring test).
- Increase backpressure.
- Increase plastic hold pressure.
- Lengthen molding cycle.
- Redesign cold slug to prevent gate obstruction.
- In multi-cavity molds, be sure all gate sizes are uniform to prevent unbalanced melt flow.
- Perform Cavity Imbalance test.
- Check part design to make sure there are no restrictions. (Shallow ribs hard to fill)

POSSIBLE SOLUTIONS

- Increase sprue, runner, or gate size.
- Decrease sprue, runner, or gate size.
- Add gates and runners.
- Increase nozzle size.
- Use larger machine or injection unit.
- Use booster and maximum injection speed.
- Check for thick-to-thin sections in molded part.
- Correct tool/mold if possible.
- Reduce cooling time in mold.
- Increase cooling time in mold.
- Check shot size of machine is large enough for the part to be made.
- Increase mold closed time.

SPLAY Semi-Crystalline

POSSIBLE SOLUTIONS

- Decrease decompression (suckback).
- Clean mold and Check venting.
- Measure the vents - open if necessary (refer to material supplier vent depth guide).
- Decrease melt temperature.
- Increase melt temperature
- Increase or decrease injection speed.
- Increase size of Nozzle orifice
- Increase size of gate and runners.
- Splay may be off of sharp angles or radius angles.
- Refer to material supplier for drying specifications.
- Increase backpressure.
- Increase injection pressure.
- Decrease injection pressure.
- Increase mold temperature.
- Decrease mold temperature.
- Check for water leak in mold.
- Check for condensation on mold.
- Lower nozzle temperature.
- Raise nozzle temperature.
- Check for burrs in runner/gates.
- Verify manifold temperatures.
- Some colorants may cause splay. (Check with colorant supplier if other colorants don’t splay with same process)

POSSIBLE SOLUTIONS

Due to excessive moisture

- Dry resin.

Due to drooling at nozzle

- Reduce melt temperature.
- Reduce nozzle temperature.
- Reduce mold open time.
- Reduce injection time.
- Reduce cushion.
- Decrease backpressure.
- Increase suck back.

SPRUE STICKING Semi-Crystalline

POSSIBLE SOLUTIONS

- Polish sprue bushing and/or use bushing with greater taper.
- Check bushing or burns or rough surface.
- Check nozzle and bushing for seating
- Decrease peak cavity pressure (post gate).
- Decrease injection pressure.
- Decrease pack and hold pressure.
- Check action of sprue puller, an increase in cycle may be needed.
- Check for material degradation.
- Decrease mold temperature.
- Verify material melt temperature.
- Decrease injection hold time.
- Check for undercuts and good draft angles.
- If “Z” puller is used, check whether knockout travel is enough to clear.
- Decrease plastic melt temperature.
- Check heater band on sprue.
- Adjust mold temperature.
- Check to make sure nozzle orifice is compatible with orifice on tool.
- Increase nozzle temperature.
- Correct alignment between sprue and nozzle.
- Decrease screw-forward time.
- Increase mold-cooling time.

VOIDS Semi-Crystalline

POSSIBLE SOLUTIONS

- Clean mold vents - open if necessary.
- Decrease decompression (suckback).
- Increase injection pressure.
- Increase peak cavity pressure.
- Raise mold temperature (cool Slower).
- Increase screw-forward time.
- Decrease injection speed.
- Decrease melt temperature
- Improve melt uniformity.
- Improve gate size or location.
- Eliminate any restrictions in runner or nozzle.
- Increase shot size.
- Decrease cushion.
- Eliminate any restrictions in runneror nozzle.
- Increase backpressure.
- Decrease screw RPM.
- Increase feed zone temperature.
- Reduce barrel temperature.
- Increase polymer temperature in hopper.
- Remove part hot and cool in water bath.

POSSIBLE SOLUTIONS

- Clean mold surface.
- Clean mold vents- open if necessary
- Enlarge vents. Measure using plastigage.
- Add more vents.
- Adjust injection speed. Use fill speed profile.
- Increase injection pressure.
- Increase plastic melt temperature.
- Decrease plastic melt temperature.
- Increase mold temperature.
- Decrease mold temperature.
- Re-gate mold to change flow pattern.
- Add porecrex insert if necessary.
- Increase peak cavity pressure.
- Increase the backpressure.
- Fill mold quicker.
- Increase venting-verify proper vent location.
- Check moister content of resin.
- Vent the cavity in the weld area.
- Check tool surfaces for dirt or scratches.
- Increase injection pressure and packing time.
- Check gate size/location.
- Lower clamp tonnage.

WRINKLES Semi-Crystalline

POSSIBLE SOLUTIONS

- Clean the vents & verify vents are open.
- Measure vents with plastigage (refer to material supplier specification spec sheet).
- Enlarge vents. If necessary.
- Add more vents.
- Increase injection speed.
- Increase post gate cavity pressure.
- Increase screw-forward time.
- Increase mold temperature.
- Increase plastic melt temperature.
- Check thick and thin sections for design problems.
- Increase gate size or relocate.

DRYING GUIDE

ABS	A	2-4	180-200
ABS /Nylon	D	1-3	175-190 max
ABS/TPU	D	3-4	170-(-40)
Acetal*	A	1-4	185
Acrylic	D	2-3	165-200**
EVA*	A	1-2	**
Nylon			
Type 6	D	2-4	180
Type 6/6	D	2-4	175
Polycarbonate	D	4	250
PC/ABS	D	3-4	175-230**
PC/Polyester	D	3-4	240(-20)
PPS	A	2-3	300-340
	D	2	300(-40)
Polypropylene *	A	1-2	120-150
PPO	D	2-4	200-250**
Polystyrene*	A	1-2	150-170
Polysulfone	D	4	250-274
Polyurethane	D	1-4	180-220**
Polyester:			
PBT	D	2-4	250-280
PBT	D	8	215-225
PET	D	2-4	275

DRYING GUIDE

PET	D	>4	225
ELASTOMER	D	2-3	225

ELASTOMER	A	4-6	225
PVC*	A	2	140-150 cube
	A	2	170-180 pellet
SMA	A	2	180-200**
SAN	A	2-3	180-200
TPE:	A		
MPR*	A	1-2	212
ETE	D	2-3	225**
TPO*	A	1-2	120-150**

Notes:

A Denotes HOT AIR type dryer minimum.

D Denotes DESICCANT type drying system minimum.

* Denotes materials that typically do not need drying.

** Denotes that temperature is dependent on specific material grade.

Check manufacturers Material Specification Sheet for recommendations

SELECTING SCREW DESIGN OPTIMUM

MATERIAL	SCREW PROFILE (A)	COMPRESSION RATIO (B)	METER DEPTH (C)
ABS	Long	Low	Deep
Acetal	Short	Medium	Shallow
Acrylic	Long	Low	Deep
HDPE	Medium	Medium	Shallow
LDPE	Medium	Medium	Medium
Nylon	Short	High	Shallow
PBT	Medium	Low	Deep
PC	Medium	Low	Medium
PEI	Medium	Medium	Medium
PES	Medium	Medium	Medium
PET	Medium	Medium	Medium
PE	Medium	Medium	Medium
PP	Medium	Medium	Shallow
PPO	Medium	Low	Medium
PS	Medium	Low	Medium
PVC (F)	Medium	Low	Medium
PVC (R)	Long	Low	Deep
SAN	Medium	Low	Medium
TPO	Medium	Medium	Shallow

Notes:

(A) Transition length: short-4 turns or less;
Medium- 5 to 8 turns Long - 8 turns or more.

(B) Low-Less than 1.9: 1; Medium-2.0 to 3.0: 1;
High-3.1: 1or higher.

(C) Degree of depth: Example-medium for 2 in. diameter
.100 in. to .125 in.

COMMON VENT DIMENSIONS FOR THERMOPLASTICS

MATERIAL	VENT DEPTH (in.)	LAND (in.)
ABS ,SAN	.003-.004	.030-.060
Acetal	.0005-.0015	.040-.060
Acrylic	.0015-.003	.040-.080
Nylon	.0005-.001	.020-.040
Nylon-filled	.0005-.0025	.030-.080
Polycarbonate	.001-.004	.030-.080
Polyester	.0005-.002	.030-.050
Polyester-filled	.0005-.0025	.030-.060
Polyethylene	.001-.0025	.020-.050
Polypropylene	.001-.0025	.020-.050
PPO	.001-.002	.030-.050
Polystyrene	.001-.003	.030-.050
PVC-rigid	.001-.003	.040-.060
PVC-flexible	.0005-.002	.030-.060
TPO	.0015-.0025	.020-.050

Notes:

The actual vent width should never be narrower than .125 in., and can be as wide as feasible. Peripheral venting is always a welcome sight, but unfortunately cannot be utilized on every part configuration.

Venting of the runner is always a good idea and can be done at a deeper depth than the part if minor flash in this area is not objectionable.
(This refers to Small parts or multi– cavities).

SHRINKAGE VALUES FOR RESINS

MATERIAL	SHRINK* (in./in.)
ABS…high impact	0.005-0.007
ABS…heat resistant	0.004-0.005
ABS…medium impact	0.005
Acetal	0.020-0.035
Acrylic…easy flow	0.002-0.007
Acrylic…general purpose	0.002-0.009
Acrylic…heat resistant	0.003-0.010
Acrylic…high impact	0.004-0.008
Nylon..8/6	0.010-0.025
Nylon…6	0.007-0.015
Nylon…6/10	0.010-0.025
Nylon…12	0.008-0.020
Nylon…glass filled	0.005-0.010
Polybutylene	.020 (molded)
Polybutylene	.04 (aged)
Polycarbonate	0.005-0.007
Polyester .025-.050 thick	0.006-0.012
Polyester.050-.100 thick	0.012-0.017
Polyester .100-.180 thick	0.016-0.022
Polyester PBT	0.010-0.020
Polyester PET 30% GF	0.001-0.002
Polyester PBT 30% GF	0.003-0.005
Polyetherimide	0.005-0.007

SHRINKAGE VALUES FOR RESINS

Polyethylene…low dens	0.015-0.035
Polyethylene…high dens	0.015-0.030
PPO/Styrene CO (Noryl)	0.005-0.007
Polypropylene	0.010-0.030
Polystyrene…G.P.	0.002-0.008
Polystyrene…heat resistant	0.002-0.008
Polystyrene…impact mold	0.003-0.006
Polysulphone	0.008
PVC…rigid	0.002-0.004
PVC…semi-rigid	0.005-0.025
PVC…flexible	0.015-0.030
SAN	0.002-0.006

*ASTM D955

-Shrink rates can vary with process conditions, mold design, ect.

-Shrink may be less in direction perpendicular to flow due to differences in orientation. (Divide by 1.8 for transverse direction) more pronounced with crystalline resins.

-When possible, prototype the job to determine shrink factors for a given mold and product design.

-Refer also to manufactures guidelines, if available.

PYSICAL AND MECHANICAL PROPERTIES OF MOLD MATERIALS

Mold Material	Additional Description	Thermal Strength (ksi)	Conductivity Avg. (BTU/hr/fl2/f/fl) (x106/inch/F)	Coefficient Thermal Expansion	Density (lb/inch2)
Alcoa	79-68	167 B	80	12.8	0.100
Aluminum	(1-6 in. plate)	(16 Rc)			
Aluminum	48-47	120 B	70	12.9	0.101
	(1-4 in. plate)	(11 Rc)			
Aluminum	73-48	150 B	75	13.1	0.101
	(1-6 in. plate)	(14 Rc)			
Aluminum	42-40	95 B	96	13.1	0.098
	(1-6 in. plate)	(8 Rc)			
Alcan	50-35	110-128 B	76	13.4	0.100
Aluminum	(7-12 in. plate)	(13 Rc)			
Alumax Cast	20	65 B	83	13.1	0.101
Mold Steel	125-135	28-32 Rc	20	7.1	0.284
Alloy Tool Steel	210	59-61 Rc	21	6.99	0.283
Hot work	225	52-54 Rc	16.3	6.1	0.280
Die steel					
Stainless Steel	215	52 Rc	14.4	5.7	0.280
Med Carbon	100	20 Rc	24.7	6.2	0.282
Alloy Steel					
Ampco Copper	75	210 B (20 Rc)	120	9.7	0.315
Ampco Copper	115	290 B (31 Rc)	70	9.7	0.310
Ampco Copper	52	192 B (18 Rc)	36	9	2.390
Beryllium Copper	155	36-42 Rc	60	9.7	0.298
Brush-Wellman	200-165	36-42 Rc)	60	9.7	0.298
Beryllium Copper					
Brush-Wellman	100-80	17-22 Rc	145	9.8	0.298
Beryllium Copper					

MISCELLANEOUS/TECHNICAL

METRIC EQUIVALENTS CONVERSION TABLE

Temperature		**Inches to Millimeters**		**Oz (A) to Grams**	
F=(Cx1.8)+32		in = mm x 0.03937		oz = gm x 0.0352739	
C=(F-32)/1.8		mm = in x 25.4		gm = oz x 28.349527	
F	**C**	**in.**	**mm**	**0z (A)**	**grams**
-0.4	-18	1/64	0.3969	1	28.35
14.0	-10	1/32	0.794	2	56.7
23.0	-5	1.16	1.5875	3	85.05
26.6	-3	1.8	3.175	4	113.4
28.4	-2	1/4	6.35	5	414.75
30.2	-1	1/2	12.7	6	170.1
32.0	0	1/3	19.05	7	198.45
33.8	1	1	25.4	8	226.8
35.6	2	2	50.8	9	255.15
37.4	3	3	76.2	10	383.5
41.0	5	4	101.6	16	453.6
50.0	10	5	127	32	907.18
68.0	20	**Lbs (A) to Kilograms**		**Metric Units**	
86.0	30	lbs = kg x 2.205		milli	
122.0	50	kg = lbs x 0.454		centi	
212.0	100	**lbs**	**kg**	deci	
257.0	125	1	0.454	meters	
302.0	150	3	1.36	liters	
347.0	175	5	2.3	kilo	
392.0	200	7	3.18	deka	
437.0	225	9	4.08	grams	
482.0	250	20	9.07	hecto	
527.0	275	40	18.14		
572.0	300	60	27.21		
	Conversion Factors				
From	**To**	**Multiply By**			
lbs/ft2	kg/m2	4.88241			
lbs/in2(psi)	kg/cm2	0.070307			
gallons (gal)	liters (l)	3.78533			
gal/min	1/sec	0.063088			
miles	km	1.609			

COMMON ACRONYMS

ABS		**EPDM**
Acrylonitrile-butadiene-styrene		Ethylene propylene diene monomer rubber
ASA		**ESCR**
Acrylic-styrene-acrylonitrile		Environmental stress crack resistance
ASTM		**ETFE**
American Society for Testing Materials		Ethylene-tetrafluoroethylene
CA		**EVA**
Cellulose Acetate		Ethylene-vinyl acetate
CAB		**FDA**
Cellulose acetate-butyrate		Food & Drug Administration
CAP		**FR**
Cellulose acetate-propionate		Fiber reinforced plastics
CPE		**GP**
Chlorinate polyethylene		General polymers
CPVC		**HDPE**
Chlorinated Polyvinyl Chloride		High-density polyethylene
EC		**HDT**
Ethyl cellulose		Heat-deflection test
EMA		**HIP**
Ethylene-methyl acryl ate		High Impact polystyrene
EMI		**HLMI**
Electromagnetic interferences		High-load melt index
EP		**HM**
Ethylene propylene		High-modulus

COMMON ACRONYMS

HMC		**PAI**
High-strength molding compound		Polyamide-imide
HME		**PAN**
High-vinyl modified epoxy		Polyacrylonitrile
HMW		**PB**
High molecular weight		Polybutylene
LCP		**PBT**
Liquid crystal polymer		Polybutylene Terphthalate
LDPE		**PBTP**
Low-density polyethylene		Polybutylene Terphthalate
LIM		**PC**
Liquid injection molding		Polycarbonate
LLDPE		**PCTFE**
Linear low-density polyethylene		Polychlorotrifluoroethyl ene
LMC		**PE**
Low-pressure molding compound		Polyethylene
LMW		**PEH**
Low molecular weight		Polyphenylene ether homopolymer
MSDS		**PETP**
Material Safety Data Sheet		Polyethylene Terphthalate
MW		**PF**
Molecular weight		Phenyl-formaldehyde
PA		**PFA**

COMMON ACRONYMS

PI		**RH**
Polyimide		Rockwell hardness
PIB		**RIM**
Polyisobutylene		Reaction injection molding
PMMA		**RP**
Polymethyl methacrylate		Reinforced plastics
PMS		**RTM**
Paramethylstyrene		Resin-transfer molding
PMT		**SAN**
Polymethylpentene		Styrene-acrylonitrile
POE		**SBR**
Polyolefin elastomers		Styrene-butadiene (rubber)
POM		**SMA**
		Styrene-maleic anhydride
POP		**SMC**
Polyolefin plastomers		Sheet molding compounds
PP		**SP**
Polypropylene		Softening point
PTFE		**SPE**
Polytetrafluoroethylene		Society of Plastics Engineers
PU		**TFE**
Polyurethane		Polytetrafluoroethylene
PVC		**TMC**
Polyvinyl chloride		Thick molding compound

COMMON ACRONYMS

TPE		
Thermoplastic elastomers		
TPO		
Thermoplastic Olefin		
TPU		
Thermoplastic polyurethane		
TPX		
Polymethylpentene		
UHM		
Ultra-high-modulus		
UHMW		
Ultra-high-molecular weight		
UL		
Underwriter's Laboratories		
UV		
Ultraviolet		
VAE		
Vinyl acetate-ethylene		

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Brittle Temperature	A measure for judging the relative merits of material for low temperature flexing or impacting i.e., the temperature at which materials rupture by impact under specific conditions.	F	C	D746
Compressive Strength	The ability of material to resist a force that tends to crush it.	lb/in2	kg/cm 2	D695
Continuous Service Temperature	The highest temperature at which a material can perform reliably in a long-term application-long term being, however, inconsistently defined by the manufacturers.	F	C	

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Deflection Temperature, 66lb/in2	The measure of temperature at which a specimen deflects 0.01 inches under a load of 66 lb/in2.	F	C	D648
Deflection Temperature, 264 lb/in2	The measure of temperature at which a specimen deflects 0.01 inches under a load of 264 lb/in2.	F	C	D648
Density	The Equivalent property to specific gravity; measured by displacement.	lb/ft3	g/cm3	D792

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Dielectric Constant	The ratio of capacity of a condenser made with a particular dielectric material to the capacity of the same condenser with air as the dielectric. Measured at a frequency of 10(6).	Con-stant	Con-stant	D150
Elongation, Yield	The increase in distance between two gauge marks at a yield point divided by the original distance between the marks. A zero value in the field indicates that it measured less than one.	%	%	D638

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Flexural Modulus	The ratio, within the elastic limit, of the applied stress on a test specimen in flexure to the corresponding strain in the outermost fibers of the specimen.	lb/in2	kg/cm 2	D790
Flexural Strength, Yield	The measure of resistance of the material to fracture during bending.	lb/in2	kg/cm	D638
Hardness	The resistance if a material to compression, indentation and scratching. There are several scales, and the data in the book gives both the scale used and the value on it.			

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Injection Molding Pressure	The pressure applied to the cross-sectional area of the molding cylinder.	lb/in2	kg/cm2	
Izod, Notched, LT	The energy to break a v-notch specimen, which has, initial stress point but measured at low temperature (-40C). (The value 999 in the tables indicates that the specimen did break.)	ft lb/in kg	cm/cm	D256
Linear Mold Shrinkage	The difference between the size of the part and the size of the mold cavity. Values given are often the average of a range.	in/in	in/in	D955

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Linear Thermal Expansion	The fractional change in length of a material for a unit change in temperature.	in/in F	cm/cm C	D696
Melt Flow	Rate of extrusion of molten resin through a die of a specific length and diameter. The conditions of the test (e.g. temp and load) are given. Frequency is not. Manufactures' data list only the value, not the conditions as well.	g/10 min	g/10 min	D1238

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Processing Methods	Processing techniques recommended by the manufacturer.			
Processing Temperature	An average value is given rather than the temperature range often specified by the manufacturer.	F	C	
Refractive Index, Sodium D	The ratio of the velocity and light in a vacuum to its velocity in the material	Con-stant	Con-stant	D542
Surface Resistivity	The ratio of the potential gradient parallel to the current along its surface to the current per unit width of the surface.	0hm	0hm	D257

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
Tensile Modulus	(Called modulus of elasticity). The ratio of nominal stress to the corresponding strain below the proportional limit of the material.	lb/in2	kg/cm 3	D638
Thermal Conductivity	The rate of heat flow under steady state conditions through unit area per unit temperature gradient in a direction perpendicular to an isothermal surface.	BTU in/hr ft2 F	cal cm/see cm2 C	C177

NOTES ON PROPERTIES, UNITS, AND DATA LISTINGS

Property	**Significance / Comments**	**Units**		
		English	Metric	ASTM Test
U.L. Temperature Index	The maximum temperature below which a material maintains its electrical and mechanical integrity over a reasonable period.	C/mm	C/mm	
Volume Resistivity	The measure of ratio of the potential gradient parallel to the current in the material to the current density.	0hm cm	0hm cm	D257
Water Absorption, 24 hours	The percentage of water absorbed by a material when immersed in water for 24 hours; water absorbed in a material chiefly affects its electrical properties.	%	%	D570

PLASTICS GLOSSARY FOR INJECTION MOLDING

A

ABS. Acrylonitrile-Butadiene-Styrene. A termopolymer produced from acrylonitrile, butadiene, and styrene in a variety of ratios to produce the family of ABS resins. These resins are used for their balance of appearance, toughness, heat distortion and ease of processing. Needs to be dried for processing. Amorphous.

Abrasion resistance. Ability of a plastic to withstand mechanical actions such as rubbing, scraping, etc.

Accelerator. A chemical additive that hastens a chemical reaction.

Accumulator. An auxiliary ram cylinder for fast delivery of plasticated melt. It is filled from the main barrel. Used on injection molding machines and blow molding machines. Also, a container for storing hydraulic oil under pressure and used on a molding machine to boost injection rate.

Acetal (POM). Highly crystalline (as high as 97%) thermoplastic made from linear pollyoxymethylene. Excellent creep resistance and fatigue endurance. Two main classes: homopolymer and copolymer. May need to be dried for processing. Semi-crystalline.

Acrylic. A polymer made from acrylic acid or a derivative thereof. Clarity is the property for which the resin is known.

Adaptive control. A method by which input from sensors automatically and continuously adjusts in an attempt to provide near optimum processing conditions. In cyclic processes such as injection molding, this means adjusting the process with data from one cycle for the next cycle. This algorithm assumes a process trend. The technique should not be used in a process under statistical control.

Addition polymerization. Chemical reaction in which simple molecules (monomers) are added to each other to form long-chain molecules (polymers) and no by-products are formed (as opposed to condensation polymerization).

Additive. Materials added in minor amounts to basic resins or compounds to improve a polymer's performance during processing, or tailor a polymer's performance capabilities for end use.
Adiabatic. A process condition in which there is no gain or loss of heat from the environment.
Aging. The chemical and/or physical changes, which occur in a material after exposure to environmental conditions over a period of time.
Air shot. Injecting plastic into the air from the nozzle of an injection molding machine.
Alkyd molding compound. Compound based on unsaturated polyester resins and formulated with relatively low amounts of cross-linking monomer and fillers, lubricants, pigments, and catalysts into a thermosetting material for use in compression, transfer, or injection molding.
Alloy. In plastics, a blend of polymers with other polymers or copolymers.
Alumina trihydrate. An inert mineral filler which provides flame retardance and arc/track resistance.
Amino plastics. Thermoset plastic made of amino compounds (compounds derived from ammonia) such as ureformaldehyde and melamine formaldehyde. Amorphous.
Amorphous. Without structure.
Amorphous phase. Devoid of crystallinity (non crystalline). Most plastics are amorphous at processing temperatures.
Amorphous polymers. A family of polymers characterized by the randomness of entangled polymer chains. Generally have lower shrinkage than semi crystalline polymers.
Anisotropy. The tendency of a material to react differently to stresses applied in different directions, especially with respect to flow orientation.
Antistrophic shrinkage. Shrinkage that is not the same in all directions. Occurs in filled material due to the restriction of shrinkage along the fiber length, which tends to be in the flow direction.
Annealing. Heating, then gradually cooling, a molded part to relax stress with no shape distortion.
Antimony oxide. A white, odorless, fine powder, which is used as a flame retardant as well as pigment, catalyst, chemical intermediate, and lubricant (Sb_2O_3).

Antioxidant. Additive to prevent degradation of plastics through exposure to either processing or the environment. Deterioration may be caused by heat, age, radiation, chemicals, stress, etc.

Antistatic agent. An additive in resin or substance applied to the surface of the plastic part for the purpose of eliminating or lessening static electricity. Acts to permit the surface (or body) of the material to be slightly conductive preventing the formation of static charges. Usually highly dependent on % humidity.

Aramid fiber. Lightweight pollyaromatic amide fibers offer excellent high temperature, flame, and electrical properties. These fibers are used in protective clothing and as high strength reinforcement in plastic composites, tires, flack jackets.

Arc resistance. The time required for an arc to establish a conductive path in a material.

Aspect ration. The ratio of length to diameter of a fiber or other object.

ASTM. American Society for Testing and Materials. Located at 1916 Race Street, Philadelphia, PA. 19103.

Atactic. A random arrangement of pendant groups on a polymeric chain.

Autoclave. Closed vessel for conducting a chemical reaction or other operation under pressure and heat.

Automation. The science and practice of machinery or mechanisms, which are so self-controlled and automatic that manual input is not necessary during operation. The technique of making a process automatic or self-controlling.

Average molecular weight. The molecular weight of a polymer in solution at a specific temperature. This gives an average molecular weight of the molecular chains in the polymer independent of the specific chain length. The value falls between weight average and number average molecular weight.

B

Back pressure. The hydraulic pressure developed in the injection cylinder of an injection molding machine during plasticating to cause more shear heating and mixing of the material.

Band heater. Electrical heaters used as the primary source of heat on barrels and nozzles of injection molding machines and extruders.
Barcol hardness. The hardness value obtained by measuring the resistance to penetration of a steel point into the surface of the test material. The instrument, called the Barcol Impressor, gives a direct reading on a 0-100 scale.
Barrel. Cylinder portion of the plasticating chamber of an extruder or injection molding machine. The cylinder forms the chamber within which the plastic resin is converted from a solid form into a viscous melt. The barrel also contains the plasticating screw or plunger.
Barrel capacity. The maximum weight of material a machine can produce from one forward motion of the ram, screw, or plunger.
Batch. The quantity of resin made in one operation. Sometimes identical to a "lot."
Birefringence. Difference between any two refractive indexes. When the refractive indexes measured along three mutually perpendicular axes are identical, the plastic is classified as optically isotropic. When the plastic is stretched (molecular reorientation) and the refractive index parallel to the direction of stretching is altered so that it is no longer identical to that which is perpendicular to these directions, the material displays birefringence.
Bisphenal A. A condensation product formed by reaction of two (bi) molecules of phenol with acetone (A). This phenol with carbonyl chloride makes up polycarbonate. Bisphenol A and epichlorohydrin produce many epoxy resins.
Bleed. Escape of material or gases through a passage in the mold; migration or additives to the surface of an article or to an adjacent article; release of color in an article in contact with water or solvent.
Bleed hole/vent. Hole in the mold which serves to release excess pressure (material, gases) during molding.
Blend. Technically, a blend is a physical mixture of different polymers. However, in practice, some blends involve copolymers and there are cases where some chemical interaction occurs between components.
Blind hole. Hole molded or drilled into a part but not entirely through the part.

Bloom. A cloudy, greasy film or dry powder on the surface of a plastic part. Usually caused by the exudation of an additive, such as a lubricant, stabilizer, flame retardant, etc.

Blowing agent. Additive for resins to be foamed. When heated to a specific temperature, it decomposes to yield a large volume of gas that creates cells in foamed plastics.

Blow molding. A method of processing in which a parison (hollow tube) is forced into the shape of the mold cavity by internal air pressure.

Extrusion blow molding. Extruder is operating continuously and the output either feeds an accumulator or flows through the die as an endless parison. Basic equipment consists of an extruder, crosshead die (and accumulator), clamping arrangement, and mold.

Injection blow molding. Suited for containers that have very close tolerance threaded necks, wide mouth openings, and highly styled shapes. In the basic process, plastic melt is injected as a parison into a perform cavity forming the perform around a core rod. A completely finished injection molded neck is formed at this station. The perform is indexed to the blow station where it is blown through an opening in the core rod into the final shape.

Reheat blow molding. For critical containers for foods, cosmetics, carbonated beverages, etc., this process gives many resins improved physical properties. I biaxial orientation, parisons are stretched lengthwise by an external gripper, or by an internal stretch rod, and then stretched radically by blow air to form the finished container against the walls of the mold. This aligns the molecules along two planes – a configuration that gives substantially better barrier properties.

Blow pressure. Air pressure used to expand the parison within a blow mold.

Blow rate. The speed at which the air enters and expands the parison during blow molding.

Boss. Small projection from part’s surface designed to add strength, facilitate alignment with another part during assembly, or permit attachment to another part. May result in sink if not designed properly.

Bottom plate. A steel plate fixed to the lower section of a mold. It is often used to join the lower section of the mold to the platen of the press.

Branched. Chemistry term referring to side chains attached to original chain (in a direction different from that of the original chain) in molecular structure of polymers.
Branched polymers. Polymer chains with additional monomer chains growing off the primary chain.
Breakdown voltage. The voltage at which plastic insulation between two conductors will break down.
Breathing. Opening and closing the mold to let gases escape. Usually employed in compression molding.
Brinell. Indentation hardness test using calibrated machine to force a hard ball into the surface of material under test. The diameter of the resulting impression is measured.
Bubble. A spherical, internal void; globule of air or other gas trapped within a molded plastic product. Differs from a blister in that the bubble is contained within the part with no surface protrusion. Also differs from a void, which is developed by formation of a vacuum during cooling.
Bulk density. Mass per unit volume of a molding powder as determined in a reasonably large volume. See ASTM D1182-54 test method.
Bulk molding compound (BMC). Thermosetting resins mixed with stranded reinforcement, fillers, etc., into a viscous compound for injection or compression molding.
Burned. Showing evidence of thermal decomposition through some discoloration, distortion, or destruction of the surface of the plastic.
Butadiene styrene, thermoplastic. See high impact polystyrene.
Butadiene styrene, thermoset. Copolymers used in bulk molding compounds, wet and dry friction materials, air-drying enamels, baked coatings, laminates for circuit boards, ran domes, and other electromagnetic applications. Can be formulated for injection, compression, and transfer molding.

C

CAD. (Computer Aided Design). The use of a computer to develop the design of a product to be manufactured. The use of a computer to develop the design and necessary NC programs for use by the manufacturing equipment which will produce a product.

CAM. (Computer Aided Manufacturing). The use of computers and computer technology to control, manage, operate, and monitor manufacturing processes.
CSA. Canadian Standards Association. Similar to U.L. Standard #222: 416-747-4044.
Calcium carbonate. Also referred to as ground limestone, marble dust, chalk, whiting, and calcite filler extender. Each shares the common mineral form, calcite (CaCO3). Used as a filler and extender.
Carbon black. A multi-functional pigment used in plastics as a conductor of electricity, a pigment, a filler-extender, and a stabilizer.
Carbon fiber. Fibers produced by pyrolysis of an organic precursor fiber in an inert atmosphere at temperatures higher than 1800 F. Reinforcement for light weight, high strength, and high stiffness structures. The high stiffness and the high strength of fibers depend on the degree of preferred orientation.
Cartridge heater. Cylindrical-bodied, electrical heater for providing heat for injection, compression, and transfer molds; Injection nozzles; runnerless mold system; hot stamping dies; sealing, etc.
Cast. To form an object by pouring a fluid monomer-polymer solution into an open mold where it finished polymerization. Also, forming film and sheet by pouring liquid resin onto a moving belt or roll.
Cast film. A film made by depositing a continuous layer or resin, either molten, in solution, or in a dispersion, onto a chilled surface. Resin solidifies and is removed as a film.
Catalyst. An agent that initiates a chemical reaction but usually does not become part of the final product. A chemical substance added in minor quantities that markedly speed up polymerization.
Cavity. A depression, or a set of matching depressions, in a plastics forming mold which forms the outer surfaces of the molded parts.
Cellulose resin. Family of three resins: cellulose acetate, cellulose acetate butyrate, and cellulose acetate propionate. Amorphous.
Center gate. In injection and transfer molding, the opening (gate) through which the plastic in injected which is located in the center of the part.
Check ring. The sliding ring of the non return valve on the front of the screw which, together with the seat, allows the flow of

melted plastic forward to in front of the screw during plasticating and provides flow back over the flights during injection. A high wear item that often leaks during injection.
Chiller. A self-contained system comprised of a refrigeration unit and a coolant circulation mechanism consisting of a reservoir and a pump. Chillers maintain the optimum heat balance in thermoplastic processing by constantly recirculating chilled cooling fluids to injection molds.
Chlorinated PVC. Produced by the post chlorination of polyvinyl chloride resins. Used extensively in pipe, fittings, and valves in water piping systems.
Clamping area. Largest molding area an injection molding machine can hold closed under full pressure.
Clamping force. The force generated by the clamp on the mold to hold it closed.
Clamping plate. A mold plate fitted to the mold and used to fasten the mold to the machine.
Clamping pressure. Pressure which is applied to an injection mold to hold it closed.
Clamping system. Part of the injection molding machine that provides the capability to open and close the mold to hold the mold closed during injection and to eject the part.
Clamping tonnage. Rated clamping capacity of an injection molding machine.
Coefficient of friction. Resistance to siding or rolling of surfaces of solid bodies in contact with each other is stated as k = F/W in which F is the force required to move on surface over another and W is the weight pressing the surfaces together.
Coefficient of Thermal Expansion (CTE). Measures how much a material expands and contracts with thermal changes.
Co-injection. The technique of injecting two materials into a single mold from two plasticating cylinders, either simultaneously or in sequence.
Colorant. Dyes and pigments used to color plastics.
Color concentrate. Plastic resin, which contains a high loading of pigment. Concentrates provide dust-free method of handling colors.
Composite. A material containing two or more distinct materials (fillers, reinforcing materials, and compatible plastic resin) designed to develop specific performance properties.
Compounding. The process of mixing the polymer with all the materials necessary for the finished resin to be shipped to the processor.

Compression molding. A technique of Thermoset molding in which the molding compound (generally pre-heated) is placed in the open mold cavity, the mold is closed, and heat and pressure are applied until the material has cured.
Compression ratio. The relationship between the feed depth and the meter depth of the screw. It indicates the degree to which the core of the screw is tapered and is an important indication of the degree to which the plastic will be compressed as it is conveyed from the feed to the metering section of the screw.
Compressive modulus. Ratio of compressive stress to compressive strain below the proportional limit.
Compressive strength. Maximum load at which compressive failure occurs in a specimen divided by the original area of the specimen.
Compressive stress. The compressive load per unit area of original cross-section carried by the specimen during the compression test.
Condensation hot air dryer. A type of dryer that condenses moisture out of the air to lower its dew point but the dew point is still limited by the temperature of the condensation coils.
Condensation polymerization. A chemical reaction in which two or more molecules combine, with the separation of water or some other simple substance. If a polymer is formed, the process is called pollycondensation (as opposed to addition polymerization).
Conductivity. Reciprocal of volume resistively; the conductance of a unit cube of any material.
Continuous use temperature. The recommended temperature at which a material should be used so as to retain its good performance over long periods of time.
Conversion process. The process of converting thermoplastic pellets into parts.
Cooling fixture. A fixture used to maintain the shape or dimensional accuracy of a molded part after it is removed from the mold.
Copolymer. A compound resulting from the chemical reaction of two chemically different monomers with each other.
Co polymerization. The building up of liner or non-linear macromolecules (copolymers) in which many monomers, processing molecules having one or many double bonds, have located in every macromolecule of different size which

constitutes the copolymerizate, following alternations which may be regular or not.

Core. Male part of mold, which shapes the inside of a molded part.

Core pin. A pin similar to an ejection pin with distinct differences, which is used as a core to make a hole in a molded part.

Coupling agent. Agent acts as interface between resin and glass fiber or mineral filler to form a chemical bridge between the two.

Cp. Abbreviation for heat capacity.

Crazing. Minute cracks on or near the surface of plastic materials.

Cross-linking. The establishing of chemical links between the molecular chains in polymers. Cross linking can be accomplished by chemical reactions, vulcanization, and electron bombardment.

Crystal polystyrene. Clear, general purpose polystyrene. Amorphous.

Crystalline polymers. A family of polymers characterized by areas of order in which the molecular chains line up and lay tightly together in an otherwise amorphous mass.

Crystallinity. A state of molecular structure in some resins denoting uniformity and compactness of the molecular chains. This characteristic is attributable to the existence of solid crystals with definite geometric form.

Crystallization temperature. The temperature at which a crystalline resin begins to crystallize upon cooling.

Cure time. In the molding of thermosetting plastics, the time it takes for the material to be properly cured.

Cycle. One full sequence in a molding operation, from a point in the process to the same point in the next sequence.

Cycle time. The time elapsing between a particular point in one cycle or production and the same point in the next cycle. The optimum processing cycle calls for a balance between the filling, cooling, and holding, requirements set forth by the material and the part.

D

DTUL. See Deflection Temperature Under Load.

Daylight opening. The maximum distance that can be obtained between the stationary platen and the moving platen in a mold

clamping system when the actuating mechanism is fully retracted without a mold or spacers installed.
Decoupled. To disconnect.
Decoupled Molding SM. To mold using a technique where filling of the mold is separated from the packing phase of the molding cycle, allowing faster filling and better control of filling and packing.
Decoupled #1. Or Partially DECOUPLED MOLDING is the first method of DECOUPLED MOLDING where transfer from first to second stage happens just after the cavity is full during packing. The final packing is done using the inertia or kinetic energy of the ram moving forward to finish the packing process. Normally used only on thin section, fast fill parts with materials such as nylon.
Decoupled#2. Or Fully DECOUPLED MOLDING is two stage molding where filling is done on first stage and just before the cavity is filled at 95-99% of a full cavity. Packing and holding are done on second stage. This is the most common form of Decoupled molding used.
Decoupled #3. Or Totally DECOUPLED MOLDING divides the process into three stages of fill, pack and hold. Fill is done as fast as possible while packing is done using controlled velocity normally as slow as possible to minimize the kinetic energy effect on the final stopping point of packing. Holding has been done on a separate stage. The transition from packing to holding is normally made from a cavity pressure sensor but can be made with an accurate timer if the check ring is in good condition.
Deep-draw mold. A mold having a core, which is long in relation to the wall thickness.
Deflection temperature under load (DTUL). The temperature at which a D648 test bar deflects 0.010” in. under a load of 66 or 264 psi. ASTM D648. Test specimens can be ½, ¼, or 1/8 inch thick, compression or injection molded (all of which changes DTUL temperature).

Degradation. Deleterious change in the chemical structure of a plastic reflected in the appearance or physical properties many times caused by excessive time at an elevated temperature or the presence of a substance which causes polymerization.
Degree of polymerization. Number of structural units or mers in the average polymermolecule in a sample measure of

molecular weight. Generally, the degree of polymerization is in the thousands.

Density. Mass per unit volume of a substance

Desiccant. A component of the desiccant system in the desiccant bed dehumidifying dryer. Molecular pieces of drying agent that absorb enough moisture from the circulating air to achieve a dew point of -20 F to -40. Air going through the desiccant must be below 130 F for the desiccant to work. Half life is 3000 hours.

Desiccant bed dehumidifying dryer. A type of dryer capable of producing a dew point of -20 F to -40 F which is necessary to dry some plastics. Like other types of dryers, it heats the air to the specified drying temperature; however, the air is circulated in a closed-loop system.

Dew point. The temperature at which moisture in the air begins to condense.

Dew swell ration. Ratio of the thickness of the extrudate to the die opening.

Dielectric. 1) Any insulating medium, which intervenes between tow conductors. 2) A material having the property that energy required to establish an electric field is recoverable in whole or in part, as electric energy.

Dielectric constant. (Permittivity or specific inductive capacity). That property of a dielectric which determines the electrostatic energy stored per unit volume for unit potential gradient. Note: permittivity is the preferred term.

Dielectric heating. The plastic to be heated forms the dielectric of a condenser to which is applied a high frequency (20-80 mc) voltage. Dielectric loss in the material is the basis.

Dimensional stability. The ability of a plastic part to retain the precise shape in which it was molded.

Dimmer. A substance formed from two identical molecules of a monomer.

Disc gate. Mold gate used in an ID of a molded part generally having the same cross section as the mold runner.

Dispersion. Finely divided particles of a resin held in suspension in another material.

Dissipation factor. (loss tangent, tan j, approx. power factor). The tangent of the loss angle of the insulating material.

DMA. Dynamic mechanical analysis.

Draft. The tapered design of a mold wall which facilitates removal of molded parts.

Drooling. Leakage of resin from a nozzle, sprue, or gate in injection molding. Thin strands of plastic that get caught in the mold.
DSC. Differential scanning calorimetric. One of several thermal tests used to characterize plastics.
DTA. Differential thermal analysis. One of several thermal tests used to characterize plastic.
Ductility. Amount of plastic strain a material can withstand before is fractures.
Dwell. Pause in the mold closing cycle of a compression molding operation to permit gas to escape from the molding material. Sometimes synonymous with holding or second stage in injection molding.
Dynamic. During flow, which is always before the cavity is filled.
Dynamic Flow. The flow before the cavity is actually full when a flow front still exists towards the end of the cavity. An area within the mold remains without plastic in it.
Dynamic Pressure. The pressure being built up while flow into the mold during fill is occurring.

E

Effective viscosity. The processing viscosity of a material in response to all process variables as well as material characteristics.
Ejection. Removal of the molded part from the mold by mechanical means or with compressed air.
Ejection bar. See knockout bar.
Ejection pin. See knockout pin.
Ejection ram. Small hydraulic pistons, which operate ejector plates.
Ejection plate. Metal plate used to operate ejector pins; designed to apply a uniform pressure to them in the process of ejection.
Elastic deformation. The portion of deformation of an object under load which can be recovered after load is removed.
Elasticity. The property of plastic materials by which they tend to recover their original size and shape after deformation.
Elastic limit. The greatest stress which a material is capable of sustaining without permanent strain remaining on the complete

release of the stress. A material is said to have passed its elastic limit when the load is sufficient to initiate deformation.

Elastomer. A material which at room temperature can be stretched repeatedly to at least twice its original length and, upon immediate release of the stress, will return with force to its approximate original length.

Electrostatic coating. Process in which the coating material is electrically charged as it leaves the spray gun and is attracted to the party which has an opposite charge.

Elongation. The fractional increase in length of a material stressed in tension.

Elongation at break. Elongation recorded at the moment of rupture of the specimen, often expressed as a percentage of the original length.

Embossing. Technique provides a textured surface to roll goods. It is used in-line with extruders and calendars or off-line in an unwind, emboss, and rewind operation. The focal point of the equipment is the textured roll which imparts the impression into the web material.

Emulsion. A suspension of globules or fine droplets of one liquid in another. Can also include the suspension of solids such as resins and waxes in liquids.

Endothermic. The thermal transition when polymers take in heat.

Engineering thermoplastics. A group of thermoplastics generally considered to have superior properties to commodity materials.

Environmental stress cracking. The susceptibility of the thermoplastic resin to crack or craze when in the presence of surface active agents or other environments.

Epoxy molding compound. Compounds are mineral filled powders which can be molded on compression or transfer molding presses.

Ethylene vinyl acetate. Copolymer member of the polyolefin family, derived from random co-polymerization of vinyl acetate and ethylene. The resins have about the same resistance to chemicals as low density polyethylene and are commonly used in hot melt adhesives, sealants, and coatings, and processed by injection molding and extrusion. Semi-crystalline.

Exotherm. The temperature vs. time curve of a chemical reaction and the amount of heat given off. Maximum temperature occurs at peak exotherm.

Exothermic reaction. A reaction in which heat is given off.
Extender. A substance added to a plastic composition to reduce the amount of resin required per unit volume. Generally has adhesive action.
Extrudate. The film, wire coating, pipe, or other product of the extrusion process.
Extruder, compounding. The basic functions of a compounding extruder are to melt the polymer and evenly disperse and distribute additives or fillers to obtain the specifications of the end product. Large scale compounding is done on either single or twin screw extruders. Single screws are used for basic operations. Twin screw compounders offer better dispersing capabilities.
Extruder, single screw. Basic machine consists of a screw, barrel, drive mechanism, resin feed arrangement, and controls. The constantly turning screw augers the resin through the heated barrel where it is heated to proper temperature and blended into a homogeneous melt. Before the melt can leave the barrel, it must pass through a breaker plate and screen pack. This unit builds up back pressure in the barrel, filters out contaminants, and tends to convert turbulent melt flow into more laminar flow. The melt is then extruded through the die into the desired shape.
Extruder, twin screw. Two screws, side by side, are placed within the extruder barrel, and they are either co-rotating twin screw extruders are used primarily for processing PVC products such as pipe, siding, sheet, pellets and film. The co-rotating units are used for compounding materials where thorough mixing and high output rates are important. The twin screw unit resembles a positive displacement screw pump. It conveys the material at low speeds with controlled shear. The positive action assures that all portions of the material experience a uniform residence time.

Extrusion. Compacting and melting a plastic material and forcing it through an orifice in a continuous fashion. In the extrusion process, the material is conveyed through the heated machine barrel by a helical screw where it is heated and mixed to a homogeneous state and then forced through a die of the shape required for the finished product.
Foam. Process for production plastic sheet of cellular construction. Either a chemical or a gaseous blowing agent is introduced into the polymer melt while the melt is being

prepared in the extruder barrel. As the plastic melt exits the die, it expands a predetermined amount forming a cellular wall.
Exudation. Migration of additives from the interior to the surface of a plastic part. (See bloom),

F

FRP. Fiberglass reinforced plastic: a general term covering plastic which is reinforced with cloth, mat, strands, or any other form of fibrous glass.
Falling dart test. Measures the ability of a material to resist breaking when struck on the surface. Typical names for the test are Gardner Impact and Dynatup Impact. Also see instrumented impact testing.
Fan gate. Opening between the mold runner and the mold cavity which has the shape of a fan. This shape helps reduce stress concentrations in the gate area by spreading the opening over a wider area.
Fatigue life. The number of cycles of deformation required to bring about failure of the test specimen under a given set of oscillating conditions.
Fatigue strength. The maximum cyclic stress a material can withstand for a given number of cycles before failure occurs; the residual strength after being subjected to fatigue.
Feed section of screw. First section or zone of an extruder screw which is fed from the hopper. Picks up pellets and carries them forward.
Fiberglass reinforcement. Major material used to reinforce plastics. Available as mat, roving, fabric, etc. It is incorporated into bother thermosets and thermoplastics. The glass increases mechanical strength, impact resistance, stiffness, and dimensional stability of the matrix.
Fiber orientation. Fiber alignment in a no woven or a mat laminate where the majority of fibers are in the same direction, resulting in a higher strength in that direction.
Fill. Filling a cavity or cavities. Does not include pack or pressurization of the mold.
Filler. A material which is added to plastics to make it less costly. Fillers can be inert or can alter various properties of the plastic.
Fill time. Time to fill a cavity or cavities. Does not include packing or static pressurization of the mold.

Fish eye. Small globular mass which has not blended completely into the surrounding material resulting as a fault in film. Sheet or molded part.
Flame retardant. Reactive compounds and additive compounds to render a polymer fire retardant. Reactive compounds become an integral part of the polymer structure, while additive chemicals are physically dispersed in the polymer.
Flammability. The measure of the extent to which a material will support combustion.
Flash. Excess plastic around the area of the mold parting line on a molded part. Generally undesirable.
Flexural modulus. Ratio of applied stress to strain in outer fibers of plastic specimen during flexure.
Flexural strength. Resistance of a plastic material to cracking or breaking during bending.
Flight. The outer surface of the helical ridge of metal on an extruder or injection molding screw.
Flight depth. The distance from the edge of a flight to the core of the screw. The flight depth of an injection molding screw is greater at the narrower feed section than at the wider metering section.
Floating platen. Moveable platen(s) between the stationary platen and actuated platen on a vertically operating compression press.
Flock. Short fibers of cotton, wood, or glass used as a filler for resins.
Flow. During processing by injection, compression, or transfer molding, the flow of a plastic is a measurement of fluidity.
Flow line. The area of a molded part where multiple masses of plastic meet and weld together during molding.
Flow marks. Distinctive surface marks caused when two flow fronts meet and weld together during molding.
Fluorescent pigments. Pigments which appear to glow. They absorb light at one frequency and remit it at another frequency.
Fluoroplastics. Polyolefin polymers in which fluorine, fluorinated alkyl groups, or other halogens replace hydrogen atoms in the carbon chant. This structure has outstanding electrical properties, excellent resistance to chemical attack, low coefficient of friction, excellent fire resistance, exceptionally good performance at high and low temperatures, low moisture absorption, and outstanding weather ability.
Foamed plastics. Process by foam molding or extrusion to achieve lower material densities for high rigidity, especially in

large structural parts. Most processes for producing structural parts correspond to injection molding. To produce the foamed product, inert gas is dispersed through the polymer melt by blowing gas directly into the melt or by pre-blending with a chemical blowing agent, which releases inert as in the presence of processing heat.

Foil, hot stamping. A laminate consisting of a carrier film to which a series of coatings have been applies: a release coat, a decorative coat, and an adhesive coat.

Force. Defined as pressure time's area.

Fracture. A material's failure to absorb impact.

Free shrinkage. Allowing a part with no critical dimensions to shrink freely during post mold crystallization.

Full DECOUPLED MOLDING. See Decouples #2.

G

Gate. In injection molding, the channel through which the molten resin flows from the runner into the cavity. Generally, it is small and solidifies first.

Gate mark. Blemish on the molded part left by the mold gate.

Gel. A semi-solid system consisting of a solid held in liquid.

Glass fiber. See fiberglass reinforcement.

Glass filament. A form of glass that has been drawn to a small diameter and extreme length (Most filaments are less than 0.005 inch in diameter.)

Glass finish. A material applied to the surface of a glass reinforcement to enhance the bond between the glass and the plastic binder.

Glass, percent by volume. The product of the specific gravity of a laminate and the percent glass by weight, divided by the specific gravity of the glass.

Glass transition temperature. The approximate midpoint of the temperature range at which a non-crystalline (amorphous) polymer changes from brittle (glass) to rubbery.

Green strength. The ability of the material, while not completely cured, to undergo removal form the mold and handling without tearing or permanently distorting.

Guide pin. A pin which guides mold halves into alignment on closing. Also called a leader pin.

Guide pin bushing. The bushing into which the guide pin mates upon closing of the mold.

Gussets. Reinforcement structures used to reinforce the part wall and structural supports without increasing wall thickness.

H

Hardness. The resistance to surface indentation usually measured by the depth of penetration of a blunt point under a given load using a particular instrument according to a prescribed procedure.
Haze. Cloudiness in plastic film or parts.
Heat capacity (Cp). The energy required to heat (in calories) one gram of material one degree centigrade.
Heat capacity trace. Provides a blueprint for polymer heating performance by indicating: 1) at what temperatures the material characteristics change, 2) at what temperature the material can be processed, and 3) the amount of heat required to process the material.
Heat deflection temperature (HDT). See DTUL (deflection temperature under load).
Heat guns. Electrically heated guns for softening, curing, drying, preheating, and welding plastics, coatings, and compounds as well as shrinking of heat shrinkable plastic tubing and plastic films.
Heat of crystallization. The amount of energy that is given off as the polymer builds crystallinity on cooling.
Heat of fusion. The amount of heat needed to melt a crystalline structure (calories per gram or BTUs per pound). Also called latent heat of fusion.
Heat pipe. A device that transfers localized heat to a heat sink (water line).
High impact polystyrene. A copolymer of styrene and butadiene known for its good dimensional stability, impact strength, rigidity, and especially, for its ease of processing. Amorphous.
Hob. Master steel punch which is used to sink or form a mating shape (mold cavity) into mild steel block.
Homopolymer. A polymer that is formed by the polymerization of a single monomer.
Hoop stress. The circumferential stress in a material of cylindrical form subjected to internal or external pressure.
Hopper. In injection molding, the container holding a supply molding material to be fed to the screw.

Hopper blender. Mixes multiple materials such as virgin resin, regrind, blowing agents, fillers, and colorants. Materials to be blended are metered in ratio to a mixing chamber and then discharged into the feed throat of the processing machine.
Hopper dryer. A combination feeding and drying device for extrusion and injection molding of thermoplastics. Hot air flows upward through the hopper containing the feed pellets.
Hot air dryer. A type of dryer that operates by heating the air, thus decreasing the relative humidity but doesn't lower the dew point.
Hot melt adhesive. Thermoplastic adhesives which set by cooling, rather than by absorption or evaporation of water or a solvent.
Hot sprue bushing. Mold element that contains a heating element to keep the resin melt hot within the bushing. The bushing is inserted into the mold to provide a hot channel between the molding machine nozzle and the mold cavity.
Hot stamping. Process in which a decorative image is transferred from a carrier to the part via pressure exerted onto a heated die by the hot stamping machine.
Humidity. The moisture in the air.
Hydraulic clamp. Used in variety of molding and forming machines. Hydraulic clamp consists basically of a high speed, variable hydraulic pump, valving, a fast acting cylinder, and a high pressure cylinder. Cylinders can be single or combination units. The clamp closes the mold halves to form the part.
Hydrolysis. The splitting of a molecule with the addition of water in the presence of heat and pressure, as in processing. Decomposition of a substance by reaction with water.
Hydro mechanical press. Molding machine by which the clamp forces are created partly by a mechanical system and partly by a mechanical system and partly by a hydraulic system.
Hydrophilic. Capable of absorbing water.
Hydrophobic. Capable of repelling water.
Hygroscopic. Capable of absorbing and retaining environmental moisture.

I

Immiscible. Incapable of mixing. Oil and water are immiscible.

Impact bar. A test bar of specified dimensions, used to determine the relative resistance of a plastic to fracture by shock.
Impact modification. A means of modifying a polymer to increase the impact resistance.
Impact modifier. A material such as rubber or an elastomer or some plastics with excellent impact resistance, which is blended with a resin to improve its impact resistance. The impact modifier usually has a glass transition temperature that is well below room temperature.
Impact resistance. A material's ability to absorb a great amount of energy before breaking.
Impact strength. Ability to withstand shock loading.
Impact test. Measures the energy necessary to fracture a standard notched bar by an impulse load.
Initiator. Peroxides used as sources of free radicals. They are used in free radical polymerizations, curing thermosetting resins, as cross linking agents for elastomers and polyethylene, and for polymer modification.
Injection molding. Injection molding is a repetitive process in which plastic is melted or plasticated, and injected into a mold containing a cavity in the shape of the desired article. With thermoplastics the mold is kept at a temperature below the solidifying point of the plastic, causing the injected polymer to "freeze" thus forming the article. When processing thermosets, the material is kept below the temperature where it would cause solidification due to its exothermic reaction until it enters the cavity. In turn the cavity temperature is kept at a high temperature to cause the melt to solidify.

Plunger injection molding. The design of the plunger machine is ideally suited for molding Thermoset molding compounds and bulk molding compounds. In the plunger machine, the molding compound is fed into the heating cylinder (barrel). The plunger or ram forces the compound thought the cylinder where it is heated by conduction of heat from the cylinder wall. As the material is forced forward, it passes over a spreader or torpedo within the barrel which causes mixing. The plunger forces the material through the nozzle and into the mold.

Reciprocating Screw Injection Molding. An extruder type screw rotates within a cylinder, which is typically driven by a hydraulic drive mechanism. Plastic material is moved through the heated cylinder via the screw flights and the material

becomes fluid. The injection nozzle is blocked by the previous shot, and this action causes the screw to pump itself backward through the cylinder. (During this step, material is plasticated and accumulated for the next shot.) When the mold clamp has locked, the injection phase takes place. At this time, the screw advances, acting as a ram. Simultaneously, the non-return valve closes off the escape passages in the screw and the screw serves as a solid plunger moving the plastic ahead into the mold. When the injection stroke and holding cycle is completed, the screw is energized to return, and the non-return valve opens, allowing plastic to flow forward from the cylinder again, thus repeating the cycle.

Injection Pressure. Pressure applied to the injection ram to force the plastic from the barrel and into the mold (measured in psi.)

Insert. An integral part of a plastic molding consisting of plastic, metal, or other material that has been performed and inserted into the mold so it becomes an integral part of the finished molding.

Insert molding. Process by which components, such as terminals, pins, studs, and fasteners, may be molded into a part.

Instrumented impact testing. A mechanically or hydraulically driven dart is driven at a constant velocity through a plastic test specimen. The dart tip or driving mechanism has transducers and high speed data gathering computers to measure and analyze the energy required to break the specimen.

In tumescent coating. Coatings formulated to protect an object from intense heat or flames by decomposing into a foam barrier.

Ionomer. Thermoplastic that combines transparency with toughness, particularly at low temperatures. The polymer’s main component is ethylene but it contains both inorganic and organic materials lined by both covalent and ionic bonds. Film is used in skin packaging.

Irradiation. Subjecting plastics or other compounds to radiant energy to cure or produce some change in the material, or to test the results. Cross linking of thermoplastics is accomplished thus. Some medical applications require parts to be irradiated with gamma rays for sterilization.

Isocyanate resin. One of the two major components in the making of polyurethane foams. It is reacted with a polyol, usually a polyether. The two types most widely used are toluene diisocyanate (TDI) and methylphenylene diisocyanate (MDI).

Isotactic. Pertaining to a type of polymeric molecular structure containing a sequence of regularly spaced asymmetric atoms arranged in like configurations in a polymer chain.
Isotropic. The ability to react the same regardless of direction of measurement. Isotropic materials will react consistently even if stress is applied in different directions. Stress-strength ration is uniform throughout material.
Isotropic shrinkage. Shrinkage that occurs the same in all directions and with unfilled materials.
Izod impact test. A test for shock loading wherein a notched sample bar is held at one end and broken by swinging a pendulum.

J

Jetting. Instability cause by improper gate design and too high flow rate. Result is work tracks on the plastic part.

K

K factor. The coefficient of thermal conductivity. The amount of heat that passes through a unit cube of material in a given time when difference in temperature of 2 faces is 1 degree.
Karl Fischer Titration Test. A quantitative means of accurately determining the moisture level in the pellets as a percentage by weight.
Kirksite. High thermal conductivity alloy of aluminum and zinc used for cast molds.
Knockout bar. A bar which holds and actuates ejector pin(s) in mold. Used in ejection of molded piece from mold.
Knockout pin. A pin that ejects a molded piece from the mold.

L

Latent heat of fusion. See heat of fusion.
LDR. Let down ratio used in coloring plastics with color concentrates, etc. (e.g. 20:1 is 20 lbs. of natural resin to 1 lbs. of colorant).
Leader pin. See guide pin.
Length/Diameter (L/D) Ratio. Describes the relationship between the length of the screw and its diameter. An L/D of

20:1 is suggested to ensure enough residence time for thorough mixing without adding excessive mechanical energy.
Light resistance. The resistance of a plastic to change color, fade, or other characteristics during exposure to sun light.
Limiting oxygen index (LOI). Method of testing the flammability characteristics of a plastic by measuring the concentration of oxygen to maintain burning.
Locating ring. Device which aligns a mold with the center hole in the stationary platen of an injection molding machine. It aligns the sprue bushing with the nozzle tip.
Locking force. The force exerted in the clamping system (hydraulic, toggle, mechanical) of a molding machine to hold the mold closed.
Lot. A quantity of resin produced at one time. See Batch.
Lubricant. Additive compounded into a resin. Can be classified into two areas: internal and external. Lubricants promote resin flow and/or mold release.

M

Manifold. Configuration of piping in block of metal that takes a single channel flow and divides it into various flow channels to feed mote that one area as in hot manifold polymers or water manifold in-mold cooling.
Master batch. A concentration of pigment, additives, filler, etc. in a base polymer. The mixture is added in small amounts to a large volume of material (the same as or compatible to the bas polymer) to produce the desired mix. See LDR.
Mechanical property. Properties of plastics which are classified as mechanical include modulus, strength, impact resistance, hardness, and elongation.
Metering section of screw. Shallow end of screw which does final plastic of the melt in injection molding.
Melt. Plastic which is in a molten state or above the melting point.

Melt air shot. A sample of the melt when taken on cycle under representative molding conditions which will indicate the actual temperature of the melt.
Melt Fracture. An irregularity in the extrudate. Melt fracture may be a slight ripple or a large annular distortion in the entire cross section. Possibly caused by non-uniform or irregular strain in material at die entrance, or sticking and slippage of materials. Can sometimes be observed at the nozzle exit during purging.
Melt index. Extrusion rate of a thermoplastic material through an orifice of specified diameter and length under specified conditions of time, temperature, and pressure.
Melt instability. An instability in the melt flow through a mold or die that causes irregularities in the finished part.
Melt strength. The strength of plastic in the molten state.
Melting point™. The temperature at which the crystalline regions break apart and begin to flow.
Mer. The repeating of structural unit of any high polymer. Derived from the Greek, Mers.
Metalizing. Applying a thin coating of metal to nonmetallic surface. May be accomplished by chemical deposition or by exposing the surface to vaporized metal in a vacuum chamber.
Metering screw. An extrusion or injection screw which has a shallow constant depth and pitch section over a series of flights at the output end.
Microprocessor. The basic element of central processing unit developed on a single integrated circuit chip. A single integrated chip provides the basic core of a central processing unit, even though it may require additional components to operate.
Migration. The extraction of an ingredient from a material by another material; such as the migration of a plasticizer from one material into an adjacent material with a lower plasticizer contact.
Modulus. Stiffness, a material's resistance to deformation under load.
Modulus of elasticity. The ratio of stress to strain below the proportional limit of the material.
Moisture vapor transmission. The speed of permeation of water through a material of specific temperature and relative humidity rate.
Mold. A hollow form or cavity into which molten plastic is forced to give the shape of the required component. The term

generally refers to the whole assembly of parts which go to makeup the section of the molding equipment in which the parts are formed. Also called a tool or die. Also, molding. (v) Action of forming the part; the operation required for forming parts.

Blow mold. Tool used to form hollow plastic products, such as bottles and cans. Generally aluminum, molds can have either water jackets, cast in tubing, or drilled cooling lines. Isolated areas, such as threads or pinch edges, can be inserted in steel for longevity. Molds are equipped with methods for injecting air into the cavities.

Cold runner mold. Developed to provide for injection of the Thermoset material either directly into the cavity or through small sub-runner and gate into the cavity. It may be compared the hot runner molds with the exception that manifold section is cooled rather that heated to maintain softened but uncured material. The cavity and core plates are electrically heated to normal molding temperature and insulated from the cooler manifold section.

Electroformed molds. A reproduction of an item by electrodepositing of an item by electrodeposition of a metal over a model or mandrel which is later removed. Made form iron, nickel, and copper, with nickel being the most prevalent.

Family mold. Designed to produce several different and often unrelated parts. It is most often used when a processor only needs to make a small amount of different parts for a particular application, and all parts are made of the same material. Specific core/cavity inserts can be dropped into the mold base, and they can be easily changed without long production stoppage.

Hot runner mold. A mold in which the runners are kept hot an insulated from the chilled cavities. Plastic freeze-off occurs at gate of cavity, runners ate in separate plate so they are not, as is the case usually, ejected with the piece.

***Injection mold*. Tools used to form a product using the injection molding process. Types include hand two plate, three-plate, insulated runner, hot runner, and structural form molds. Materials commonly used ate tempered aluminum, steel, prehardened steel, harden tool steel, stainless steel, beryllium copper, and kirksite**

Prototype mold, A simplified mold(usually a single cavity) Routinely used when part quantity requirements are low; used for the testing of the new products or the mold its self

Reinforced plastic mold. Designed to form a structure manufactured with any epoxy or polyester based resin with reinforcing fibers, strands, metallic, ceramic, or mineral extenders. There is hard and soft tooling. Hard tooling is manufactured from electroformed nickel, cast aluminum, or machined steel. Used for long run, high surface finish requirements, and high cure temperatures. Soft tooling is manufactured from cast plastics, rubber, or reinforced plastics.
RIM mold. Molds for reaction injection molding may be constructed from epoxy, nickel aluminum, or steel, depending on the life expectancy of the mold. They should be designed to constrain a foaming pressure of 30-50 psi, for molding with a dense outer skin, it is important to use a temperature controlled metal mold.
Rotational mold. Molds are manufactured from electroformed nickel, vapor deposited nickel, and cast aluminum. The thickness of the parts is controlled by heat sinks fabricated into the tool. The toll must be temperature controlled so it will cure the resign within it.
Spray metal and or melt mold. Constructed similarly to those used for conventional injection molding. Majority, are built from forged aluminum plate, generally 6061-T651 grade.
Thermoforming mold. Tools which form a pre-extruded sheets by means of temperature and vacuum and/or pressure. Generally made from aluminum, either cast or machined.
Molded-in stress. Orientation stress within molecules and compressive and tensile stress between molecules as a result of the molding process.
Mold base. An assembly of precision steel pates that holds or retains the cavities or cores in a mold. Provides a means for milt to be injected into the cavities and provides a means to be injected into the cavities and provides a means to eject the solidified parts from the mold.
Mold height. Overall thickness of the mold as it is located between the platens of the machine.
Mold release agent. Provides an interfacial layer between two surfaces to prevent adhesion of one to the other.
Mold shrinkage. See shrinkage.
Molding cycle. The period of time required to complete the molding of a part(s). In injection molding, the cycle begins when the mold closes and ends with the opening of the mold and ejection of the molded part.

Molecule. The smallest unit of a substance which can exist by itself and retain all the properties of the original substance. Molecules are composed of one or more atoms.
Molecular weight. The sum of the atomic weights of all atoms in molecule.
Molecular weight distribution. The relative amounts of polymers of different molecular weights (MW) that make up specific polymer.
Monomer. A single molecule which can join with another monomer chain.
Morphology. Refers to the structure of the polymer material.
Multiple-phase blend. A type of polymer modification in which the parent homopolymers are not miscible in each other and each maintains a distinct phase (distinct area) in melt and solid states. This a physical combination.
Multiple stage screw. Extruder and injection molding machine screws which contain changes in the flight helix to perform specific functions, such as feeding, mixing, and metering

N

Nonpolar. Having no concentration of electrical charges on molecular scale; thus, incapable of significant dielectric loss.
Non-return valve. Valve that permits material to flow in one direction and closes to prevent back flow. In front of injection screw.
Normalization. To make same
Notch sensitivity. Extent to which the sensitivity of a material to fracture is increased by the presence of surface in homogeneity, such as a notch.
Nozzle. Provides a leak proof connection between the injection mold and the molding machine, through which the melt flows.
Nylon resin. Family of thermoplastic resins that is strong, tough, abrasion resistant, has good fatigue resistance, good lubricity, and low coefficient of friction. Tupes include 6, 66, 6/10, 6/12, 11, 12. crystalline.

O

Orange peel. An uneven surface on a plastic part somewhat resembling that of an orange peel.
Orientation. The molecular aligned in a plastic product. Caused by flow or when the plastic is stretched. While hot.

Oven dryer. A method of drying resins using an oven.

P

PBT. Polybutylene Terphthalate.
Packing. The final filling of the mold cavity to build up the proper static pressure distribution in the cavities to achieve proper surface finish, dimensions, and physical properties without over pacing, which creates flash and parts sticking.
Paint mask. Stencil designed to conform to the shape of the part with the areas to be decorated cut out.
Partially DECOUPLED MOLDING. See Decoupled #1.
Parting line. The line formed by the mating surfaces of the mold halves.

Phenylene oxide based resin. Possesses one of the lowest specific gravities of the engineering thermoplastics. It is a tough, rigid material which maintains its excellent mechanical properties, relatively unchanged, up to about 300 F. Also has excellent dimensional stability, low creep, and low moisture absorption. Amorphous.
Pinpoint gate. Gate in an injection mold which is approximately 0.020 – 0.030 inch in diameter. This small gate minimizes the size of the mark left on the molded part.
Plastic deformation. When an object does not return to its original shape or size after pressure, stress, or load is removed.
Plastic memory. The tendency of a thermoplastic material which has been stretched while hot to return to its unstretched shape upon being reheated.
Plasticate. To melt or impart flexibility in a plastic through the input of heat and mechanical work as in the plasticating of the resin in an extruder or injection molding machine.
Plasticize. To impart softness, flexibility in a plastic through the incorporation of a Plasticizers additive.
Plasticizers. Chemical material incorporated into a resin to increase its workability during processing, and to impart flexibility and other desirable properties to the finished product.
Plastics. A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its manufacture or processing into finished articles, can be shaped by flow.

Plate-out. The deposition of additives or pigments on machinery or molds during processing of plastics.
Platen. The steel plates on a molding machine to which the mold is attached. Generally, two platens are used; one being stationary and the other movable, actuated hydraulically to open and close the mold.
Poise. The measure of the specific viscosity of a fluid.
Polyamide resin. A polymer in which the structural units are linked by amide or thioamide groupings. Many amides are fiber-forming. See nylon semi crystalline.
Polyamide-imide. High temperature thermoplastic with excellent mechanical and chemical resistant properties. Amorphous.
Polyarylate resin. Thermoplastics (polyesters of phthalic acids and bisphenols) are naturally transparent with a light gold color. Amorphous
Pollybutadiene (Thermoset) resin. All hydrocarbon in nature and, when cured, has excellent heat, moisture, and chemical resistance. Amorphous.
Polybutylene resin. Polymers made with butane and ethylene as monomers. Uses are pipe, packaging, sealants, and adhesives. Semi crystalline.
Polybutylene Terphthalate. (PBT). A semi crystalline, thermoplastic polyester. Good heat and chemical resistant properties. Must be dried before processing.
Polycarbonate resin. A tough, clear polymer derived from the direct reaction between aromatic and aliphatic dihydroxy compounds with phosgene or by the ester exchange reaction with appropriate phosgene-derived precursors. Must be dried before processing. Amorphous.
Polyester resins. Family of resins produced by reaction of dibasic acids with dihydric alcohols. Polyethylene terephthalate (PET) is a thermoplastic which may be extruded, injection, or blow molded. Unsaturated polyesters are Thermoset and used in the reinforced plastics industry for applications such as boats, auto components, etc.
Polyethersulfone resins. A tough, rigid, amorphous thermoplastic.
Polyethylene resin. A thermoplastic composed by polymers of ethylene. It is normally a translucent, tough, waxy solid which is unaffected by water and a large range of chemicals. Semi crystalline.

Polyimide resin. Aromatic polyimide is made by reacting pyromellitic dianhydride with aromatic diamines.
Polymer. A chemical compound formed by many small molecular units linked together to form a large, chain-like molecule.
Polymerization. Chemical reaction in which the molecules of monomers are linked together to form polymers.
Polyphenylene sulfide resin. A crystalline aromatic thermoplastic polymer with a symmetrical, rigid backbone chain consisting of para-substituted benzene rings connected by a single sulfur atom between rings.
Polypropylene resins. A tough, lightweight, rigid plastic made by the polymerization of high purity propylene gas in the presence of an organometallic catalyst at relatively low pressure and temperatures. Semi crystalline.
Polystyrene resin. A water-white thermoplastic produced by the polymerization of styrene (vinyl benzene). Amorphous.
Polysulfone resin. Amorphous structure, the engineering thermoplastic has inherent resistance to heat, hydrolysis, oxidation, and radiation.
Polyurethane resin, thermoplastic. Polymers which have properties combining the advantages of elastomers and plastics. Formed by the reaction of bifunctional polyols with isocyanides.
Polyurethane resin, Thermoset. Produced by reacting diisocyanate with organic compounds containing two or more active hydrogen's to form polymers with free isocyanate groups. These groups will react with each other under heat or catalysis to form a thermoset.
Polyvinyl acetate resin. A thermoplastic material composed of polymers of vinyl acetate in the form of a colorless solid. Used extensively in adhesives for paper and fabric coatings.
Polyvinyl alcohol resin. A thermoplastic material composed of polymers of the hypothetical vinyl alcohol.
Polyvinyl chloride resin (PVC). Thermoplastic compounds formed by polymerization or co polymerization of vinyl or vinylidene halides and vinyl esters. They are strong with good abrasion resistance. Amorphous.
Porous molds. Molds constructed of a material through which liquids or gases can pass.
Pot life. The time period during which a compound remains suitable for the intended use. After compounding ingredients

such as solvent or catalyst have been added. Also called working life.

Preplastication. Premelting or heating of a resin in a separate chamber prior to transferring to the injection chamber or to the mold, as in transfer molding of thermosets and two-stage injection molding oft thermoplastics

Productivity. The measure of the amount of output, in either goods or services, per unit of input. The higher the productivity the higher the output versus input.

Programmable controller. A control system often used to operate machinery in place of the standard electromechanical relays. The controls are programmed rather than permanently wired as in standard control methods.

Projected area. Area of a molded part which is projected onto a plane at right angles to the direction of the mold.

Properties. The characteristics of a material that indicate how well it will perform in a variety of applications. Properties are used to compare and select thermoplastic materials.

Property loss. A reduction in how well the material will perform caused sometimes by shortening the polymer chain molecules thereby reducing the molecular weight.

Prototype. A mold suitable for use in complete evaluation of form, design, and performance.

Pull-in cylinder. The hydraulic cylinder(s) on an injection molding machine which holds the nozzle to the sprue bushing by pulling the injection unit carriage forward. It also retracts the nozzle for purging and shutdown.

Purging. In extrusion or injection molding, the cleaning of one color or type of material from the machine by forcing it out with the new color or material to be used in subsequent production, or with another compatible purging material.

Purging compound. Used to flush processing machines at the completion of a run of one polymer, color, flow grade, or type and prior to beginning a run of different materials.

Pyrometer. Practically speaking, all thermocouple activated devices are called pyrometers. They consist of a readout device and a sensor.

R

RRIM. Reinforced Reaction Injection Molding.

Radio frequency heating. A heating and drying process utilizing radio frequency energy to generate heat in a dielectric material (non-metallic) by molecular friction.
Ram. Rod, Plunger, or screw which forces the resin through the barrel and into the mold of an injection molding machine.
Ram travel. The distance the ram travels to force the resin through the heating cylinder (barrel) and into the mold of a plunger injection molding machine.
Reaction injection molding. A process which is applied to polyurethane, epoxy, and other liquid chemical systems. Mixing of two of four components in the proper chemical ratio is accomplished by high pressure impingement type mixing head from which the mixed material is delivered into the mold at low pressure.
Reciprocating screw. A combination melting, softening, and injection unit in an injection molding machine.
Regrind. As defined by ASTM D5033, is "a product or scrap, such as sprues and runners, that has been reclaimed by shredding and granulating for use in-house, and that may be dry blended by the molder with the same grade of virgin material."? Regrind is usually cold runners and rejected parts.
Reinforced plastics. Molded, formed, filament wound, or shaped plastic parts consisting of resins to which reinforcing fibers, mats, fabrics, etc. have been added before the forming operation. Strength properties are improved.
Reinforcement. A material used to reinforce, strengthen, or give dimensional stability to another material.
Relative humidity. The percent of moisture in the air relative to the greatest amount the air can hold at a given temperature.
Relative viscosity. The ratio of the viscosity of a solution to that of the pure solvent.
Release agent. See mold release agent.
Repeatability. The ability of a system or mechanism to repeat the same motion or achieve the same points when presented with the same control signals. The cycle-to-cycle error of a system when trying to perform a specific task.
Resin. Natural or synthetic plastic characterized by being polymeric in structure. Most resins are of high molecular weight and consist of long chain or network molecular structure. Usually resins are more soluble in their lower molecular weight forms.
Resin content. The amount of resin in a laminate expressed as either a percent of total weight or total volume.

Resin-rich area. Localized area filled with resin and lacking reinforcing material.
Resin-starved area. Localized area containing excess reinforcement and insufficient resin.
Resistively. The ability of a material to resist passage of electrical current either through its bulk or on a surface. The unit of volume resistively is the ohm-cm, or surface resistively, the ohm.
Restricted gate. A small opening between the cavity and runner in an injection or transfer mold. T o aid separation, the gate breaks cleanly after the piece is ejected.
Reverse temperature profile. A set of barrel temperature settings starting higher in the rear and declining toward the front of the barrel. This is the reverse of normal.
Rheology. The study of flow.
Rib. Configuration designed into a plastic part to provide lateral, horizontal, or other structural support.
Rigid reinforcement. An extremely stiff material such as glass, carbon fibers, or mineral which is blended with resin to give it improved stiffness and strength.
Ring gate. Used on cylindrical shapes, this gate encircles the core to permit the melt to first move around the core before filling the cavity.
Rockwell hardness. A test for hardness (resistance to indentation) of a material in which a hardened steel ball or diamond point is pressed into the material under test.
Rotational molding. In rotational molding, or rotomolding, a product is formed from fine powder within a closed mold which is rotated in a heating chamber and then a cooling chamber. While the mold is slowly turning and tumbling, it is heated by forced hot air in an oven. As the mold wall heats, the resin begins to stick to the inside of the mold forming a hollow part.
Runner. In an injection mold, the feed channel, usually of circular cross section that connects the sprue with the cavity gate. The term is also used for the plastic piece formed in this channel.

S

Screw. A helically flight shaft which rotates within a barrel to mechanically process and advance a material being prepared for extrusion or injection molding.

Screw flight. The helical metal thread of a screw in an extruder or injection molding machine screw.
Screw speed. The revolutions per minute (rpm) of an extruder or injection molding machine screw.
Screw tip. The tip of the reciprocating screw is the ram face that pushes the melt into the mold and it contains the shut-off valve (non-return valve) which prevents the melt from sliding backward along the flights of the screw.
Shear heating. Heat produced within the plastic melt as the polymer layers slide along each other in the plasticating chamber of the processing machine.
Shear modulus. The ratio of the shear stress to the corresponding shear strain for shear stresses below the proportional limit in shear of the material.
Shear strength. The maximum shear stress which a material is capable of sustaining.
Sheet. Any material manufactured in sheet form and cut to suit in processing. In extrusion, the extrudate is considered sheet if it is more than 10 mils thick.
Sheet molding compound. A composite of glass fibers, polyester resins, and pigments, fillers, and other additives which have been compounded and processed into sheet form to facilitate handling in the molding operation.
Shelf life. The time during which a molding compound, adhesive, etc. can be stored without losing its suitable physical properties.
Shore hardness. A test to determine a plastic's hardness using an indentation durometer or scieroscope.
Short Shot. Injection of insufficient material to fill the mold.
Shot. The material ejected during a given cycle.
Shot capacity. See barrel capacity.
Shot size. The amount of plastic injected into a mold that will fill the cavity(ies), runner, and sprue. Should be between 30-73% of the barrel capacity.
Shrinkage. A volume reduction in polymers that occurs during cooling due to a reduction in space between the molecules. A decrease in dimension(s) of a plastic part upon cooling.
Silicone fluid. Silicone additives are clear pollydimethylsioxane liquids which perform two basic types of functions. At low concentrations, silicone additives are used as process improver, increasing mold flow and providing self-release characteristics. At higher concentrations, they are use to form self-lubricating plastics for bearings and other mechanical applications.

Silicone molding compounds. Thermosetting material which may resemble epoxies, Phenolics, rubbers, and other thermosets. However, they have unique heat and chemical stability and purity.
Single-phase blend. A type of polymer modification in which two parent homopolymers are soluble in each other. This is a physical combination.
Sink mark. Depression in a molded part caused by shrinking or collapsing of the resin during cooling.
Sintering. The welding together of powdered particles at temperatures below the melting or fusion point. Particles are fused together to form a mass, but the mass as a whole does not melt.
Slip agent. Provides surface lubrication during and immediately following processing plastics. Compounded into the plastic, the additive acts as an internal lubricant which gradually migrates to the surface.
Software. A name given to instructions, programs, mathematical formulas, and the like utilized in the computer system, in contrast to the actual physical hardware of the system.
Solubility. The tendency or capacity of a solvent (or polymer) to dissolve a substance under specific conditions.
Solvent bonding. The process of joining articles made of thermoplastic resins by applying a solvent. Solvent softens the surfaces to be joined. Then surfaces are presses together. Adhesion comes from evaporation of solvent, absorption of solvent into the material surfaces and/or polymerization of the solvent cement.
Solvent molding. A process for forming thermoplastic articles by dipping a male mold into a solution or dispersion of the resin and drawing off the solvent to leave a layer of plastics film adhering to the mold.
Solvent resistance. Ability of a plastic to resist swelling and dissolving in a solvent.
Specific gravity. The density (mass per unit volume) of any material divided by that of water at a standard temperature. It provides a more accurate means of comparing material costs because plastic parts are sold by volume, not weight.
Specific heat. The amount of heat required to raise the temperatures of a unit mass of a substance one degree under specific conditions.

Specific heat capacity (Cp). The energy in calories required to heat one gram of material one degree centigrade. It is expressed in calories per gram per degree centigrade (cal/gram/C).
SPI. Society of the Plastics Industry. Headquartered in Waldorf, MD. Phone 1-800-541-0736
Spin welding. Bonds two cylindrical plastic parts together by frictional heat. This method is well suited for joining thermoformed container halves. Injection molded cylindrical parts, etc. Because the actual bond is made through heating and then fusing the mating surfaces, only thermoplastic-tics can be joined by spin welding.
Spiral flow test. A method for finding flow properties of either thermoplastic or thermosetting resin, formulated by the distance it will flow under specified pressure and temperature along a spiral runner. Test is usually performed using an injection molding machine and a test mold into which material is fed at the center of the spiral cavity.
Splay marks. Marks or tracks caused by gas or liquid present or trapped in a material migrating to the surface of the mold, which then slid over the surface in the direction of flow or toward a vent, leaving tracks. A cosmetic blemish on a plastic part.
Sprue. In an injection mold, the main feed channel that connects the mold filling orifice with runners leading to each cavity gate. The plastic piece formed in the sprue bushing.
Sprue bushing. The channel or feed opening for the passage of plastic from the nozzle of the injection molding cylinder to the runners of the mold.
Sprue Gate. The passageway through which the resin melt flows from the nozzle directly to the mold cavity.
Sprue puller. A slotted pin used to remove a sprue from a sprue bushing.
Stabilizer. An additive used to inhibit degradation of a polymer which may be caused by oxygen, light, heat, or water.
Stack mold. Two level mold (two sets of cores and cavities stacked one behind the other) for molding large area, flat parts.
Static. When not moving, such as during packing when no flow front exists.
Static pressure. The pressure built up when no flow front exists such as during packing and holding. Static pressure losses are large; in molding utilizing hydraulic systems, there is no static pressure loss.
Stationary platen. In a horizontal injection molding machine, the platen immediately adjacent to the machine nozzle to which

the front half of the mold is attached. This platen does not move during mold cycling.

Stiffness. Load bearing capability without deflection.

Strain. Elastic deformation due to stress. Measured as the change in length per unit of length in a given directions, and expressed in percentage or inches per inch, etc.

Strength. The maximum load a material withstands before breaking or yielding.

Stress. The unit force or component of force at a point in a body acting on a plane through the point. Expressed in psi.

Stress crack. External or, more commonly, internal cracks in a plastic caused by tensile stresses less than that of its short-time mechanical strength. Can be caused by external or internal forces.

Stress-strain curve. The curve plotting the applied stress on a test specimen in tension versus the corresponding strain.

Stripper plate. A plate in a mold which removes a molded piece from the core pins or plunger.

Styrene-acrylonitrile (SAN) resin. Copolymers are thermoplastic resins which impart strength, rigidity, transparency, excellent dimensional stability, and high chemical resistance to finished product.

Submarine gate. Submarine gate breaks the molded item from the runner system upon ejection from the mold. The gate is located where the opening from runner to the mold is below parting line or mold surface (in conventional edge gating, the opening is machined into the mold surface).

Suck Back. Technique used to partially clear resin from the injection nozzle after the injection cycle by pulling the screw rearward, thus drawing the resin back into the injector. Used to prevent gate or nozzle drool.

Surfactant. Chemicals which modify the surface properties of plastics to influence the wetting and flow properties of liquids allowing formation of emulsion or intimate mixtures of normally incompatible substances.

Surging. An unstable pressure build-up leading to variable output and wavy extrudate surface. Surging may cause flow to stop for a moment at intervals.

T

Talc. Refined mineral product (hydrated magnesium silicate) that is a reinforcing filler-extender. Because of it platy configuration, it tends to add stiffness to the resin, while its low cost categorizes it as an extender.
Tc. Abbreviation for crystallization temperature.

Tensile bar. Used to test tensile strength of a material. Material is molded into a tensile bar. As the bar is pulled, the material shows deformation until it finally yields and is no longer able to recover. The material will then continue to deform under the applied stress until it finally breaks. Ultimate elongation measures how far the material will extend before breaking as a percentage beyond its original length. ASTM D638.
Tensile Elongation. The maximum length a material extends before breaking.
Tensile strength. The maximum tensile stress sustained by the specimen before failure in a tension test. Usually expressed in psi. The cross section area is that of the original specimen at the point of rupture, not reduced by the break.
Tg. Abbreviation for glass transition temperature.
TGA. Thermogravimetric analysis.
Thermal conductivity. Measures the rate at which heat is transferred.
Thermal expansion (CTE). The tendency of a plastic to expand in the heat and contract in the cold.
Thermal endurance. The time at a selected temperature for a material or system of materials to deteriorated to some predetermined level of electrical, mechanical, or chemical performance under prescribed conditions of test.
Thermal pin. See heat pipe.
Thermal properties. Thermal properties that are important when selecting and processing a material are heat-deflection temperature (HDT), thermal conductivity, coefficient of thermal expansion (CTE), dynamic mechanical analysis curves, differential thermal analysis (DTA), and TGA.
Thermocouple. A device which uses a circuit of two wires of dissimilar metals or alloys, the two junctions of which are at different temperatures. A net electromotive force (emf) occurs as a result of this temperature difference. The minute electromotive force, or current, is sufficient to drive a galvanometer or amplifier.

Thermo gravimetric Analysis (TGA). The measurement of changes in weight of a specimen as it is heated. Some tests are conducted in air and some in other atmospheres. The resulting data reveal information about thermal stability and polymerization processes.
Thermoplastic. Capable of being repeatedly softened by heating and hardened by cooling.
Thermoset. A plastic which changes into a substantially infusible and insoluble material when cured by application of heat or chemical means. Thermoset processing is irreversible.
Tie bar. In molding machines, the bars that tie the stationary platen and the hydraulic clamping mechanism together. During mold clap-up the tie bars resist the strain created by the hydraulic cylinder clamping moveable against the stationary mold. Also called strain rods.
Tm. Abbreviation for melting point.
Toggle. A mechanism that exerts pressure developed by applying force on a knee joint. It is used to close and exert pressure on a mold in a press.
Tool. In injection molding, the term sometimes used to describe the mold.
Torpedo. A streamlined metal block in the path of the flow of stock within an extruder or molder heating cylinder which spreads the melt into the thin layers which can be heated more efficiently. Also called spreader.
Traditional molding. Original method of molding. Fill and pack are done on first stage usually using time as the criteria for cutoff from first stage (boost) to second stage (hold).
Transducer force. A force measuring device. It has the characteristics of providing an output, usually electrical, which serves as the measurement of load, force, compression, pressure, etc. when placed along the sensitive axis of the force cell.
Transition section of screw. The section of a plasticating screw between the feed and metering sections in which the plastic resin is in both a solid state and molten state.
Two-shot molding. The technique of molding parts in two colors or two materials in a single mold or set of molds. This process is accomplished by injecting the thermoplastic into a closed mold, transferring half of the mold to mate with another mold half of different cavity shape, and injecting the second color or material around the first part.

U

U-V Stabilizer. A chemical compound additive to a thermoplastic resin which selectively absorbs U-V rays.
UL. Abbreviation for Underwriters Laboratories, nonprofit safety testing organization. Phone 312-272-8800
UL Continuous use temperature. The highest constant temperature at which a material will survive relative to the application requirements.
UL flammability. Ratings given to materials after undergoing several tests to describe a material's flammability.
UL properties. Underwriters Laboratory certifies the results of several tests of a material's properties which include: oxygen index, flammability, high voltage arc track rate, and continuous use temperature.
Ultimate elongation. The maximum length a material will extend before breaking.
Ultimate strength. The maximum stress developed in a specimen.
Ultrasonic Welding. Ultrasonic vibrations are produced by mechanical motion of a converter, expanding and contracting some 20,000 times/sec. The vibratory energy is channeled through a horn and applied to thermoplastic materials. This creates the frictional heat to produce a molecular interaction and weld materials.
Unit mold or die. Mold designed for quick changing interchangeable cavity parts.
Urea formaldehyde. See amino-plastics.

V

Variation. Variation is the difference in things that are supposed to be the same.
Vent. Shallow channel in a mold which allows air, gas, or volatile to exit as the melt enters the cavity.
Vented barrel. Port in a barrel through which volatile's moisture can be removed.
Vented screw. Two-stage screw with vent in second stage to remove volatile or water from the plastic.
Vibration welding. Method of fusing two plastic parts by vibrating (rubbing) the mating surfaces together at relatively low frequencies. 90 to 120 Hz.

Vicar softening point. The temperature at which a flattened needle of 1 mm2 circular cross section will penetrate a thermoplastic specimen to a depth of 1 mm under a specified load using a selected uniform rate of temperature rise ASTM D1525

Viscoelasticity. Combination of both viscous and elastic properties in a material.

Viscosity. The measure of the resistance of a fluid to flow (either through a specific orifice or in a rotational viscometer). The absolute unit of viscosity measurement is the poise (or centipoises). Kinematic viscosity is expressed strokes.

Voids. Pockets of unfilled space or vacuum in a molded part generally caused by shrinkage during cooling.

Volatile. Materials which are capable of being driven off as a vapor during molding.

W

Warpage. Distortion caused by nonuniform change of internal stresses.

Water absorption. Ration of the weight of water absorbed by a material to the weight of the dry materials.

Weathering. Exposure of plastics to the outdoor environment.

Weld lines. The marks visible on a finished part made by the meeting of two flow fronts of resin during molding.

Welding. Joining thermoplastic pieces by one of several heat-softening processes.

Whisker. A very short fiber form of reinforcement, usually of crystalline materials.

Y

Yield point. The first point on the stress-strain curve at which an increase in strain occurs without an increase in stress.

Yield strength. The lowest stress at which a material undergoes plastic deformation. Below the stress, the material is elastic; above it, viscous.

Yield stress. The maximum stress that a material can support without breaking. At this point, the material will not return to its initial orientation, even after the load is removed.

WHEN YOU NEED
OUR TECHNICAL HELP

Please be prepared to answer the following:

1. What is the problem? Provide as many details as possible.

2. Material Information? Lot #, color, additives, if material needs drying how? What temp? How long? and are you using regrind? Amount?

3. Machine information: What are the barrel settings? Actual melt temp? Steel temp? Injection speed? Injection pressure? Hold pressure? Back pressure? RPM? shot size.

4. Mold information: What is the Mold temp? Cooling time? Mold close time? Is there any type of action in the tool?

4. EXTRUSION: What are barrel settings? Die settings? Actual melt? Head pressure? Screw diameter?
L/D ratio?

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It is the intent of this troubleshooting guide, to provide you with a quick reference for general problems you may encounter with molding thermoplastic polymers. ZIPPS LLC has made a serious effort to provide you with the most accurate and updated information in his manual. However information included in this manual should only be considered as a general guide and ZIPPS LLC does not represent the information herein as being exact or true. ALL suggestions should be evaluated by you, to determine if it's utilization in your company will yield appropriate results. This guide comes without warranty expressed or implied in any form from the publisher ZIPPS LLC. No part of this manual or the information enclosed may be reproduced by any means, nor transmitted, nor translated into a machine language.

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