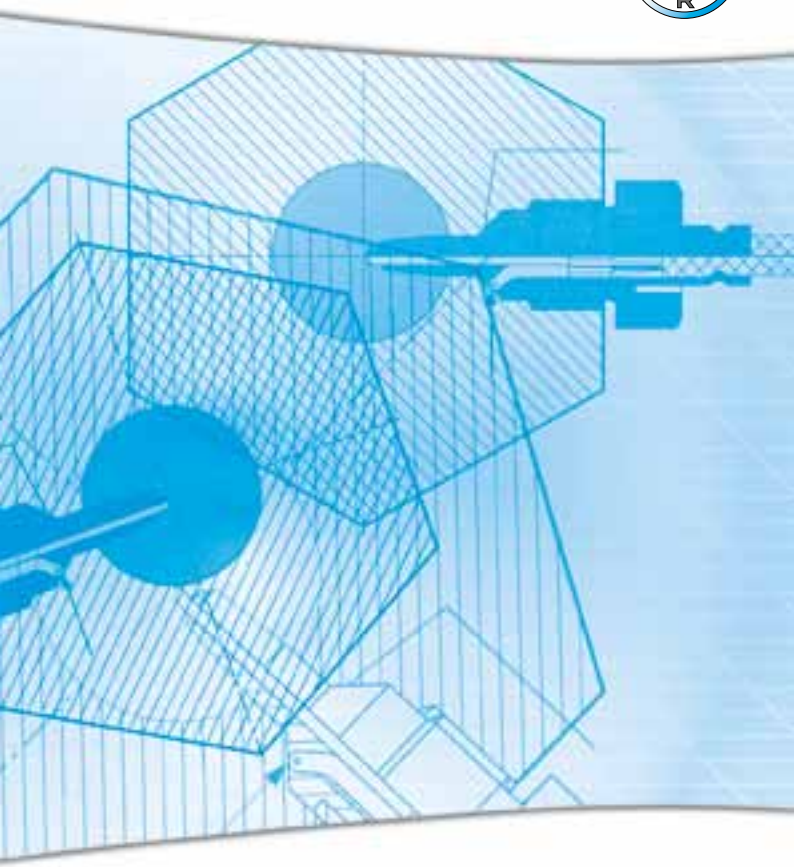


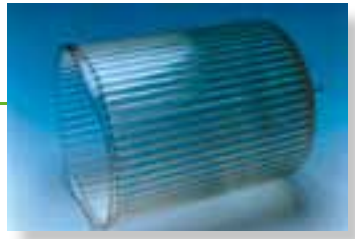
Injection Molding
– defects, causes, remedies

Tips for defect-free extrusion of polycarbonates and their blends

Various problems can arise when extruding polycarbonates and their blends. We have compiled an extensive list of possible defects, explained their causes and described preventive measures. To help you find them more easily, we have divided the defects into groups, such as “Defects caused by moisture” or “Defects commonly associated with blown films”. Please do not hesitate to contact us if this list does not help you solve your problem.

We would be grateful for any hints, suggestions and illustrations you could submit to make this catalog of defects more complete.

1 Fault category: Part dimensions

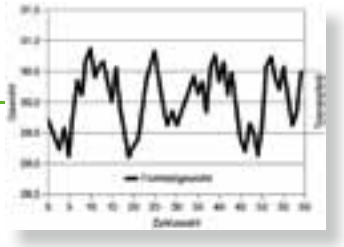


Part fails to fill properly

Description: Incomplete filling of the part, generally at the ends of flow paths or at thin sections

Causes:	Remedial actions:
Unsuitable processing parameters	Optimize processing parameters. Increase melt and mold temperature. Increase injection speed. Switch to holding pressure at a later stage
Excessive loss of pressure in gating system (including hot runner). Gate and runner cross sections too small. Excessive loss of pressure in hot runner. Excessive loss of pressure in shut-off nozzle system	Reduce pressure losses in the gating system. Enlarge gate and runner cross sections. Check cross section of hot runner, optimize torpedo at nozzle point. Use the machine without shut-off nozzle
Insufficient section thickness	Increase section thickness

Variations in weight

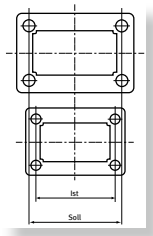


Description: Weight and dimensions of parts vary greatly

Causes:	Remedial actions:
Plasticizing unit worn	Examine plasticizing unit and particularly non-return valve for wear
Fluctuations in temperature of melt and mold	Check temperature control and heating circuits of the plasticizing unit
Material not thoroughly dried	Check drying process
Variations in metering stroke or melt cushion	Check injection stroke and metering stroke of the machine
clamping force too low	Set clamping force higher or use a machine with a higher clamping force

Incorrect dimensions

Description: Molding fails to attain required dimensions



Causes:	Remedial actions:
Excessive moisture in material	Check dryness of material
Shrinkage incorrectly predicted	Check shrinkage calculations with the aid of raw material manufacturer's data or comparable molds
Warping caused by poor part design or gate location	Check part and redesign for minimum warpage. Alter position of gate to ensure regular melt orientation
Machine and mold not in thermal equilibrium	Check temperature control of machine and mold for thermal fluctuations

Flash

Description: Thin web of material forced into crevices between mating mold surfaces during molding and remaining attached to molded part

Causes:	Remedial actions:
Gap between mold halves too wide. Locking force too small. Inadequate mold rigidity. Mold sealing faces worn	Check gap widths. Increase locking force. Increase mold rigidity. Refinish mold sealing faces
Processing parameters not optimized	Optimize processing parameters. Reduce injection speed or melt temperature. Switch from injection to holding pressure earlier, or reduce holding pressure
Material too moist, thus viscosity reduced	Check drying of material

Variations in section thickness (target/actual)

Description: Part thickness does not match up to requirements, or varies a great deal and lies outside tolerance range

Causes:	Remedial actions:
Inadequate mold rigidity	Check rigidity of mold and strengthen it if necessary
Failure to allow for shrinkage, mold dimensions incorrect	Check mold dimensions and compare with raw material manufacturer's data on shrinkage
Cavity pressure too high or locking force too low	Reduce cavity pressure by switching from injection to holding pressure at an earlier stage, reducing holding pressure and increasing locking force
Mold centering mechanism defective or worn	Check mold centering/guide mechanism and replace if necessary.

2 Fault category: Ejection characteristics

Sticking sprue

Description: Sprue is constricted and/or left in the sprue bush or in the cold runner

Causes:	Remedial actions:
Processing parameters not ideal (e.g. timing of changeover from injection to holding pressure, level of holding pressure)	Optimize processing parameters. Reduce cavity pressure by reducing holding pressure and switching to it earlier. Check, and if necessary, extend cooling time
Nozzle radius or aperture too large	Reduce nozzle radius or aperture
Draft angles too small or polishing inadequate	Check components like injection nozzle, cold runner and gate for undercuts and polishing effectiveness, and re-machine in demolding direction if necessary. Optimize draft angles and polish if necessary
Machine nozzle and sprue bush are not flush	Correct position

Ejector marks

Description: Visible ejector marks on part surface

Causes:	Remedial actions:
Cavity pressure too high	Optimize processing parameters. Reduce holding pressure and switch to it earlier.
Mold stiffness not sufficient	Improve mold stiffness
Cooling time too short or mold cavity temperature too high locally	Optimize cooling and/or mold temperature
Mold design unfavorable. Undercuts too extreme, draft angle too low	Optimize mold design. Reduce undercuts, improve draft angles
Mold polishing inadequate. Positions of ejectors unfavorable or ejector surface too small	Optimize polishing. Check ejector positions and/or increase ejector surface

Mold opening noise

Description: Mold makes a lot of noise when opened

Causes:	Remedial actions:
Draft angles too small	Check mold polishing effectiveness and draft angles and re-machine if necessary. Use a suitable mold release agent
Mold centering device defective or worn	Improve mold centering
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure
Inadequate mold rigidity	Strengthen mold
Difference in temperature of mold halves too large Differences in temperature between slides and mold too great	Check temperatures and equalize

Part remains in mold cavity – Causes

Description: Part remains in mold cavity

Causes:	Remedial actions:
Mold overloaded	Reduce injection speed and holding pressure, and switch to holding pressure at an earlier stage
Undercuts too pronounced, draft angles too small	Reduce size of undercuts and improve draft angles
Mold not sufficiently polished at ribs and bosses	Polish cavity surface in direction of demolding
Vacuum between mold surface and part	Optimize mold venting
Premature demold: part sticks or is still too soft	Increase cooling time, reduce mold temperature
Ejector pins poorly positioned or too few in number	Use more ejector pins or optimize their position

Deformation of part – Causes

Description: Part deformed during demolding

Causes:	Description:
Cavity pressure too high	Optimize injection speed. Reduce holding pressure. Switch to holding pressure at an earlier stage
Inadequate mold rigidity	Strengthen mold
Cooling time too short or mold temperature too high in places	Optimize cooling/mold temperature control
Poor mold design. Undercuts too pronounced, draft angles too small	Optimize mold design. Reduce undercuts and optimze draft angles
Mold not sufficiently polished. Ejector pins poorly positioned or surface area too small	Polish mold surface in direction of demolding, choose a suitable surface coating or depth of texture. Optimize position and size of ejectors (in particular, locate near corners or under ribs or bosses)

Part ruptures during demolding – Causes

Description: Part damaged during demolding

Causes:	Remedial actions:
Cavity pressure too high	Optimize injection speed. Reduce holding pressure. Switch to holding pressure at an earlier stage
Inadequate mold rigidity	Strengthen mold
Cooling time too long or mold temp too low in places	Optimize cooling/mold temperature control
Poor mold design. Undercuts too pronounced, draft angles too small	Optimize mold design. Reduce size of undercuts and optimize draft angles

Part ruptures during demolding – Causes

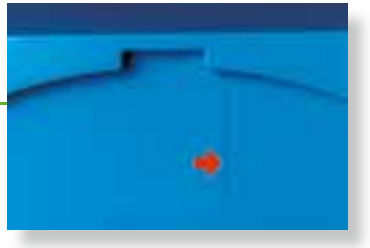
Causes:	Remedial actions:
Mold not sufficiently polished. Ejector pins poorly positioned or surface area too small	Polish cavity surface in direction of demolding, choose a suitable surface coating or depth of texture. Optimize position and size of ejector pins (it is particularly important to locate them near corners, under ribs and bosses)
Material not adequately dried, residence time too long	Check drying of material, residence time and melt temperature
Notch effect due to excessively sharp-edged transitions	Round off, if possible

Mold will not open

Description: Even when the maximum permissible mold opening force is applied, the mold halves cannot be separated

Causes:	Remedial actions:
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure sooner. Reduce holding pressure. Increase melt temperature within acceptable limits
Inadequate mold rigidity	Strengthen mold
Slide control not working	Check position of slides
	Note: Open mold: Use cold water to reduce temperature of mold to room temperature, fit additional hydraulic rams between machine platens to help open mold. If necessary, raise mold temperature above glass transition temperature, pull mold apart

3 Fault category: Colors



Deeper color at weld lines

Description: Found at weld lines or near faster or slower-moving flow fronts fed from neighboring melt streams

Causes:	Remedial actions:
Pigment separation or light refraction effect caused by unfavorable flow at weld lines	Vary flow front velocity
Thermal overloading of the melt leading to discoloration at weld lines	Reduce thermal load on the melt
Oxidation due to insufficient venting	Improve venting, possibly by relocating the weld line
	Note: Tends to occur on light, bright colors such as white, blue, green and orange

Consistent discoloration, color deviations

Description: Consistent deviation from the basic color, particularly with light colors

Causes:	Remedial actions:
Melt temperature too high	Check melt temperature and reduce it if necessary
Residence time too long, because plasticizing unit not working at full capacity	Use a smaller plasticizing unit
Unsuitable masterbatch	Use a suitable masterbatch
Production interrupted without reducing temperature	See notes on production stoppages

Color inconsistencies

Description: Color inconsistencies

Causes:	Remedial actions:
Material not sufficiently homogenized	Increase back pressure, reduce screw speed
Injection and screw speed too high	Reduce injection and screw speed
Gate too narrow	Enlarge gate
Residence time too long	Reduce residence time by using a smaller plasticizing unit

Rings around the gate

Description: Matt rings aligned concentrically around the gate

Causes:	Remedial actions:
Stagnation of melt flow in the mold, melt temperature too low	Try to maintain an even melt flow, raise melt temperature
Stagnation of melt flow in the mold, mold temperature too low	Try to maintain an even melt flow, raise mold temperature
Injection rate too low	Try to maintain an even melt flow, increase injection rate

Black discoloration, burn marks, periodic discoloration

Description: Brown to black, irregular and locally variable discoloration of the molded part

Causes:	Remedial actions:
Unsuitable design of changes in cross section and bends in the hot runner, or faulty sealing faces leading to dead spots where the material becomes charred. Dead spots occurring at sealing faces, changes in cross section and bends in the hot runner	Check and/or redesign the relevant components and sealing surfaces. Eliminate dead spots. Check the pressure relief holes for the needle shut-off mechanism. Inspect sealing faces
Wear on the screw, the non-return valve or the cylinder	Check the screw, the non-return valve and the cylinder for wear

Blackening, Diesel effect

Description: Concentrated blackening at weld lines, e.g. near ribs or bosses, or in corners at the end of flow paths

Causes:	Remedial actions:
Entrapped, compressed air in the mold leading to scorching	Optimize mold venting, particularly where flow fronts meet and at the end of flow paths. Correct flow front profile by adjusting section thickness, gate location or using flow leaders. Check venting channels. Reduce mold locking force. Evacuate mold
	Note: In addition to optical degradation of the molded part, this fault can also damage the mold through corrosion

Stress whitening

Description: Areas of lighter color combined with a velvety matt part surface

Causes:	Remedial actions:
Overstretching of the polymer matrix. Excessive mechanical stress during ejection. Poorly positioned ejector pins and draft angles too small	Reduce mechnical stress during ejection. Correct positions of ejectors, e.g. position ejectors at stress whitening lines
Excessive stress in service	Lower stresses in service
Cavity pressure too high. Inadequate mold rigidity	Lower cavity pressure. Strengthen mold rigidity
	Note: Fault mostly occurs with thermoplastics containing rubber

Cloudiness, grey streaks

Description: Dark, cloudy areas on part surface

Causes:	Remedial actions:
Plasticizing unit contaminated	Clean plasticizing unit. Reduce screw speed
Wear on the plasticizing unit	Replace complete plasticizing unit or individual components. Use a corrosion- and abrasion-resistant plasticizing unit
Melt load too high	Optimize cylinder temperature, circumferential speed of the screw, back pressure

4 Fault category: Specks

Brown or black spots

Description: Sporadically occurring specks, either spherical with irregular outlines or like platelets with clearly defined, straight outlines

Causes:	Remedial actions:
Tearing or peeling off of thin layers of melt which form on the surface of the cylinder and the screw	Clean the plasticizing unit mechanically. See recommended procedure for production stoppages. Check plasticizing unit for wear
Contamination of the granules/regrind	Check granules for possible contamination. Store granules in a dust-free place. Clean contaminated post-consumer articles before regrinding. Do not regrind damp or thermally damaged articles. Check the drying and feed systems for contamination

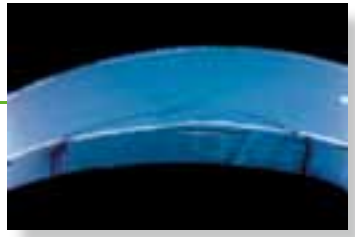
5 Fault category: Surface irregularities

Blisters

Description: Solid, round or elongated bumps or lumps on the surface which are restricted to very small areas and are not necessarily visible on both sides of the molded part

Causes:	Remedial actions:
Unmelted material, or air drawn in during metering: + screw cut too deep	Use a suitable screw
Unmelted material, or air drawn in during metering: + metering stroke exceeds 3D	Keep metering stroke to between 1 and 3D
Unmelted material, or air drawn in during metering: + back pressure too low	Increase back pressure
Unmelted material, or air drawn in during metering: + melt temperature too low	Raise melt temperature
Unmelted material, or air drawn in during metering: + screw speed too high	Reduce screw speed

Delamination



Description: Separation or flaking off of surface material, either over the entire molding or locally near the sprue

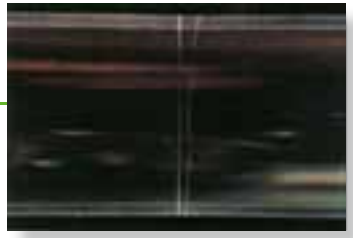
Causes:	Remedial actions:
Excessive shear stress. Gate too thin. Injection speed too high	Reduce shear stress. Widen gate. Reduce injection speed
Contamination caused by incompatible resins	Clean plasticizing unit. Check material in hopper and feed lines for contamination by other materials
Unsuitable pigment masterbatch	Use a suitable pigment masterbatch

Localized sink marks

Description: Distinct, localized hollows in the surface, generally found opposite ribs, at thicker sections, cores, weld lines, constrictions, hot runner nozzles and the end of flow paths

Causes:	Remedial actions:
No compensation for volume contraction during the cooling phase	Compensate for volume contraction: Adjust wall thickness/ rib thickness ratio to suit material, increase holding pressure and holding pressure time, increase nozzle aperture and gate cross section. Reduce temperature of melt and tool (may lead to voids). Check melt cushion. Conceal sink marks if necessary

Notches along weld line, pronounced weld line



Description: Tangible or visible notch along the weld line

Causes:	Remedial actions:
Insufficient mold venting	Improve mold venting, especially at end of flow path
Inadequate flow properties of the resin. Injection speed too low. Walls too thin or flow paths too long	Improve flow properties by increasing temperature of melt and mold. Raise injection speed. Increase section thickness or, if necessary, relocate gate so as to shorten flow paths
	Note: Mostly with high-viscosity or quick-setting thermoplastics. In many cases, variotherm methods can be used to conceal the weld line

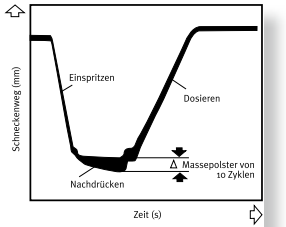
Grooves, record grooves, stick-slip effect

Description: Fine, concentric grooves around the sprue; grooves parallel to the flow front in thin-walled areas

Causes:	Remedial actions:
Pulsating melt flow in the mold, caused by excessive cooling of the flow front, cause:	Try to maintain an even, rapid melt flow
injection speed too low	Increase injection speed
melt temperature too low	Raise melt temperature
mold temperature too low or	Raise mold temperature
walls too thin	Increase wall thickness

6 Fault category: Processing

Melt cushion varies in size



Description: Size of melt cushion fluctuates widely, becoming almost non-existent at times

Causes:	Remedial actions:
Non-return valve defective or worn	Check non-return valve and replace if necessary
Irregular metering	Check cylinder bore for wear and insert a sleeve if necessary, or use a new plasticizing unit

7 Fault category: Warping

General warping

Description: Molded parts do not match specification drawing, suffer warpage at corners or do not fit accurately

Causes:	Remedial actions:
Part poorly designed. Unsuitable orientation of glass fibers. Unsuitable distribution of wall thickness	Optimize part design. Improve orientation of glass fibers by optimizing gate. Optimize distribution of wall thickness
Holding pressure ineffective. Non-return valve worn	Switch from injection to holding pressure at a later stage. Inspect non-return valve and replace if necessary
	Note: All possible causes of defect, associated remedies and their interdependencies are too complex to go into here

8 Fault category: Gloss

Frosting

Description: Rough, matt part surfaces of the edges

Causes:	Remedial actions:
Injection speed too low	Raise injection speed
Mold temperature too low	Raise the temperature of the mold. Fit thermal insulation round mold. Use a more efficient temperature control unit
	Note: Only affects glass-fiber-reinforced thermoplastics. Very evident on amorphous thermoplastics, less so on semi-crystalline thermoplastics

Poor gloss with polished surfaces

Description: Part does not meet gloss requirements (either over the whole surface or in a certain area)

Causes:	Remedial actions:
Mold worn or not properly polished	Polish mold thoroughly
Injection speed too low, possibly due to poor venting	Increase injection speed, if necessary by improved venting
Fluctuations in mold temperature caused by inadequate cooling	Check consistency of mold temperature
Material not properly dried	Check drying process
Holding pressure ineffective	Improve effectiveness of holding pressure by increasing holding pressure, extending holding pressure time and if necessary increasing gate size

Variations in gloss on the surface of the molded article

Description: Variations in gloss over all or part of the surface of the article

Causes:	Remedial actions:
Injection speed too low	Raise injection speed
Cavity surface worn or corroded	Re-machine mold surface
Fluctuations in mold temperature. Problems in the temperature control circuit, e.g. leakage, blocked cooling channel, temperature control unit defective	Service the temperature control system and eliminate any leaks. Improve temperature control by adding more heating-cooling channels, increasing the throughput of the temperature control medium or changing the medium (e.g. use water instead of oil)
Springy mold elements, such as cores or ejectors	Increase mold rigidity

Localized, glossy, finger-shaped depressions

Description: Glossy depressions, often near the sprue, at cores or in the vicinity of hot runner units

Causes:	Remedial actions:
Premature demold	Extend cycle time
Holding pressure too low and holding pressure time too short	Increase holding pressure, increase holding pressure time, check melt cushion, check, and if necessary increase nozzle aperture and gate cross section
Switch from injection to holding pressure made too soon	Switch to holding pressure at a later stage
Mold temperature too high in places	Reduce mold temperature locally by means of additional cooling channels or separate temperature control
	Note: See also: Matt surface defects

Dull spots, matt patches

Description: Uniform, clearly defined velvety areas on surface

Causes:	Remedial actions:
Flow fronts with different velocities (with several gating points)	Even out differences in flow front velocities by improving the balance of the gating system (where several feed points are involved)
Tearing of already solidified outer skin at sharp bends and abrupt changes in wall thickness	Round off or polish transition zones and abrupt changes in wall thickness in the runner and mold; balance flow front velocities
	Note: See also: Flaking

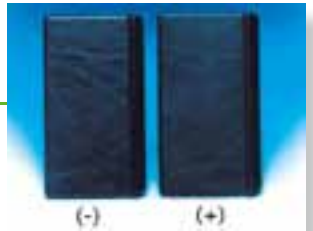
Matt surface defects near hot runner units

Description: Matt surface defects near hot runner units

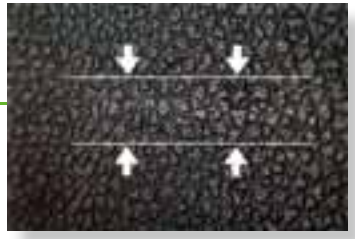
Causes:	Remedial actions:
Premature demold	Increase cooling time
Mold temperature at hot runner too high	Improve thermal isolation of hot runners, reduce mold temperature
Core temperature too high	Make sure core is adequately cooled

Poor matt effect on textured surfaces

Description: Part surface does not meet mattness requirements



Causes:	Remedial actions:
Injection speed and mold temperature too low	Increase injection speed and mold temperature
Holding pressure ineffective	Switch to holding pressure at a later stage and increase its level
Surface texture of mold cavity poor or worn	Re-machine mold surface



Damaged grain on the molded article

Description: Rough, torn surface with grooves in the direction of demolding, mostly at the same place

Causes:	Remedial actions:
Draft angles too small	Increase draft angles
Mold surface damaged	Re-machine mold surface
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure. Optimize injection rate. Increase melt temperature within acceptable limits
Inadequate mold rigidity	Strengthen mold
	Note: Scoring can often only be identified using optical aids

9 Fault category: Mechanical properties

Inadequate weld line strength

Description: Failure of part near weld line

Causes:	Remedial actions:
Insufficient mold venting	Improve mold venting
Inadequate flow properties of the resin. Injection speed too low. Walls too thin or flow paths too long	Improve flow properties. Increase injection speed. Raise melt and mold temperature. Increase wall thickness or relocate gates so as to shorten flow paths

Mechanically defective part

Description: Part unable to withstand mechanical stress

Causes:	Remedial actions:
Mechanical stress too high	Check design against mechanical requirements. (internal stress, resistance of the resin to various media)
Degradation of the material caused by faulty drying or thermal overloading	Monitor melt temperature, residence time and drying process
Unsuitable position of weld line	Locate weld lines away from main areas of stress
Poor ejection characteristics at screw bosses etc.	Prevent part from being damaged during demold, improve ejection characteristics

10 Fault category: Streaking

Cold flow marks, flaking

Description: Surface appears flaky with alternating glossy and matt areas, mostly near the sprue

Causes:	Remedial actions:
Displacement of material which has already cooled	Inject material in stages, starting slowly and gradually increasing speed. Reduce mold temperature. Design gates with radii and polish them

Jetting

Description: Generally serpentine strand of the melt first injected into the mold, found near the sprue or at constricted sections, and visible on the part surface

Causes:	Remedial actions:
Unsuitable design of gate or narrow sections preventing laminar flow. Gate position with no opposing wall. Gate cross section or narrow section too small	Redesign gate. Position gate opposite a wall. Enlarge gate cross section. Redesign changes in cross section
Injection speed too high	Inject material slowly at first, then switch to a faster speed

Large-area silver streaks

Description: Brush-shaped, elongated streaks spread over a large area

Causes:	Remedial actions:
Metering stroke of the plasticizing unit too long	Use a larger plasticizing unit to reduce the length of the metering stroke (⟡3D). If plasticizing unit cannot be changed: Increase temperature of feed section, reduce screw speed, increase cycle time and, as an additional, optional measure, increase the melt cushion by 1–2 D if possible
Air entrainment during metering	Optimize plasticizing conditions. Increase back pressure (within acceptable limits). Reduce screw retraction. Position injection nozzle tight up against hot runner mold
	Note: Sometimes occurs in association with blistering

Knuckle line

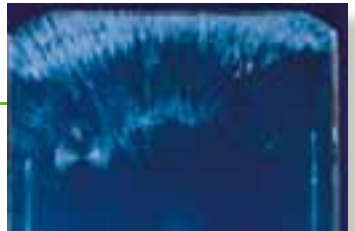
Description: When light falls on the part from a certain angle, a line or shimmer can clearly be seen on its surface, frequently at weld lines, ribs, abrupt changes in section thickness or splits

Causes:	Remedial actions:
Elastic deformation of sliding cores	Improve slide supports or increase mold rigidity
Glass fibers perpendicular to flow direction at weld lines	Alter position of weld lines, if necessary by changing location or number of gates
Abrupt changes in stiffness at ribs or where section thickness changes	Avoid abrupt changes in wall thickness in favor of gradual transitions

Surface marred by linear grooves, scratches

Description: Grooves and scratches running in the demolding direction, also visible as matt streaks on high-gloss surfaces

Causes:	Remedial actions:
Cavity surface damaged	Check cavity surface and re-machine if necessary, polish in demolding direction
Elastic deformation of sliding cores	Optimize sliding cores
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure. Optimize injection rate. Increase melt temperature within acceptable limits
Inadequate mold rigidity	Strengthen mold
	Note: See also: Mold opening noise



U-shaped streaks, moisture streaks

Description: Elongated, pencil-like streaks, open towards the flow direction: in mild cases may be single streaks

Causes:	Remedial actions:
Residual moisture content of pellets too high	Check drying process (temperature, time and hourly throughput). Examine dryer filter for contamination. Check direction of rotation of drive motor

Overheating streaks, silver streaks

Description: Elongated silver streaks

Causes:	Remedial actions:
Excessive thermal load on the melt: melt temperature too high	Reduce the thermal load on the melt, Reduce melt temperature
Excessive thermal load on the melt: melt residence time too long	Reduce the thermal load on the melt, use a smaller screw diameter
Excessive thermal load on the melt: screw speed too high	Reduce the thermal load on the melt, reduce screw speed
Excessive thermal load on the melt: nozzle and flow channel cross sections too small	Reduce the thermal load on the melt, widen nozzle and runner diameter
Excessive thermal load on the melt: failure to reduce temperature during a break in production	Reduce the thermal load on the melt, see notes on production stoppages
	Note: Often appears similar to moisture streaks

Large bubbles

Description: Air-filled bubbles in the walls

Causes:	Remedial actions:
Air entrainment during metering	Check granule feed for air entrainment. Increase holding pressure (within acceptable limits). Reduce screw retraction (suck back)
Capacity of plasticizing unit exceeded	Use a plasticizing unit one size larger if the screw stroke is greater than 3D

Cold slug, cold flow marking, irregular matt area

Description: Cold material trapped at the molded-part surface

Causes:	Remedial actions:
Cold slug well in cold runner absent or too small	Incorporate or improve cold slug well
Escape of material from injection nozzle or hot runner	Speed up screw retraction, improve thermal isolation in hot runner
Nozzle aperture too small, nozzle temperature too low	Increase size of nozzle aperture, install a more powerful heater band, check thermocouple and regulator

Small bubbles

Description: Entrapped air similar to voids, but very much smaller diameter and more numerous

Causes:	Remedial actions:
Excessive moisture in material	Check drying process
Unsuitable venting unit	Select a suitable vented screw or substitute a conventional screw for the vented screw and pre-dry the material
	Note: Often occurs in conjunction with extensive silver streaks

Tear drops

Description: Tear drop-shaped irregularities caused by entrapped air

Causes:	Remedial actions:
Air trapped in the mold, e.g. in engraved areas, grooves or depressions	Reduce injection speed in the critical area. Improve mold venting at weld lines and depressions, ribs and engraved areas. Apply a vacuum to the mold

Craters, pinholes, dimples

Description: Depressions as small as a pinhead

Causes:	Remedial actions:
Material degradation	Reduce melt temperature and residence time
Faulty pigmentation (using incompatible pigments in in-plant coloring, e.g. the wrong type of carbon black)	Use compatible pigments or a different type of carbon black
Too much carbon black	Reduce carbon black content
Mold temperature too low	Raise mold temperature significantly

Grey specks, metallic specks

Description: Grey foreign particles which appear shiny when lit from certain angle.

Causes:	Remedial actions:
Plasticizing unit worn	Check for wear on screw, cylinder and non-return valve
Foreign particles produced by abrasion of feed pipes, containers and hoppers	Check feed pipes, containers and hoppers for abrasion. Use stainless steel for feed pipes, containers and hoppers, aluminum and tinplate are unsuitable. Avoid corners as far as possible. If not, design them with large radii
Granulator for regrind worn	Carry out regular maintenance on granulators and check for abrasion and damage

Microscopic cracks, micro-cracks

Description: Microscopic cracks in the part, often occuring only at the surface where outer fibres are under tensile stress

Causes:	Remedial actions:
Excessive stress in the part	Optimize processing parameters with a view to reducing stress. Increase temperature of mold and melt. Re-design part so as to reduce long-term outer fiber strain
Contact with unsuitable media	Check compatibility with various media. Check stress-crack-inducing effect of release and anti-corrosive agents. Test part for chemical resistance to cleaning fluids and degreasing agents. Check part's resistance to media encountered in practical use and reduce mechanical load if necessary

Voids, bubbles, vacuoles

Description: Round or elongated bubbles generally only visible in transparent and translucent parts

Causes:	Remedial actions:
No compensation for volume contraction during the cooling phase. Holding pressure ineffective	Increase holding pressure, increase holding pressure time, check melt cushion, check, and if necessary increase nozzle aperture and gate cross section
No compensation for volume contraction during the cooling phase. Injection point poorly positioned, or part badly designed	Locate gate in a thick wall section. Revise part design so as to avoid abrupt changes in wall thickness
	Note: Comply with design guidelines for injection-molded parts

Stringing

Description: Long, thin threads emerge from the machine or hot runner nozzle

Causes:	Remedial actions:
Nozzle aperture too large	Select a smaller nozzle aperture, but remember critical shear
Poor thermal isolation at the nozzle point. Temperature of the nozzle point where it meets the hot runner too high. Insufficient suck-back	Optimize thermal isolation at the nozzle point. Reduce nozzle temperature. Activate suck-back or increase retraction distance (after metering in the case of machine nozzles, before metering in the case of hot runner nozzles)
Nozzle temperature too high at breaking point	Reduce nozzle temperature
Insufficient screw retraction	Activate screw retraction or increase retraction distance

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Bayer MaterialScience

Bayer MaterialScience AG
51368 Leverkusen
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www.plastics.bayer.com