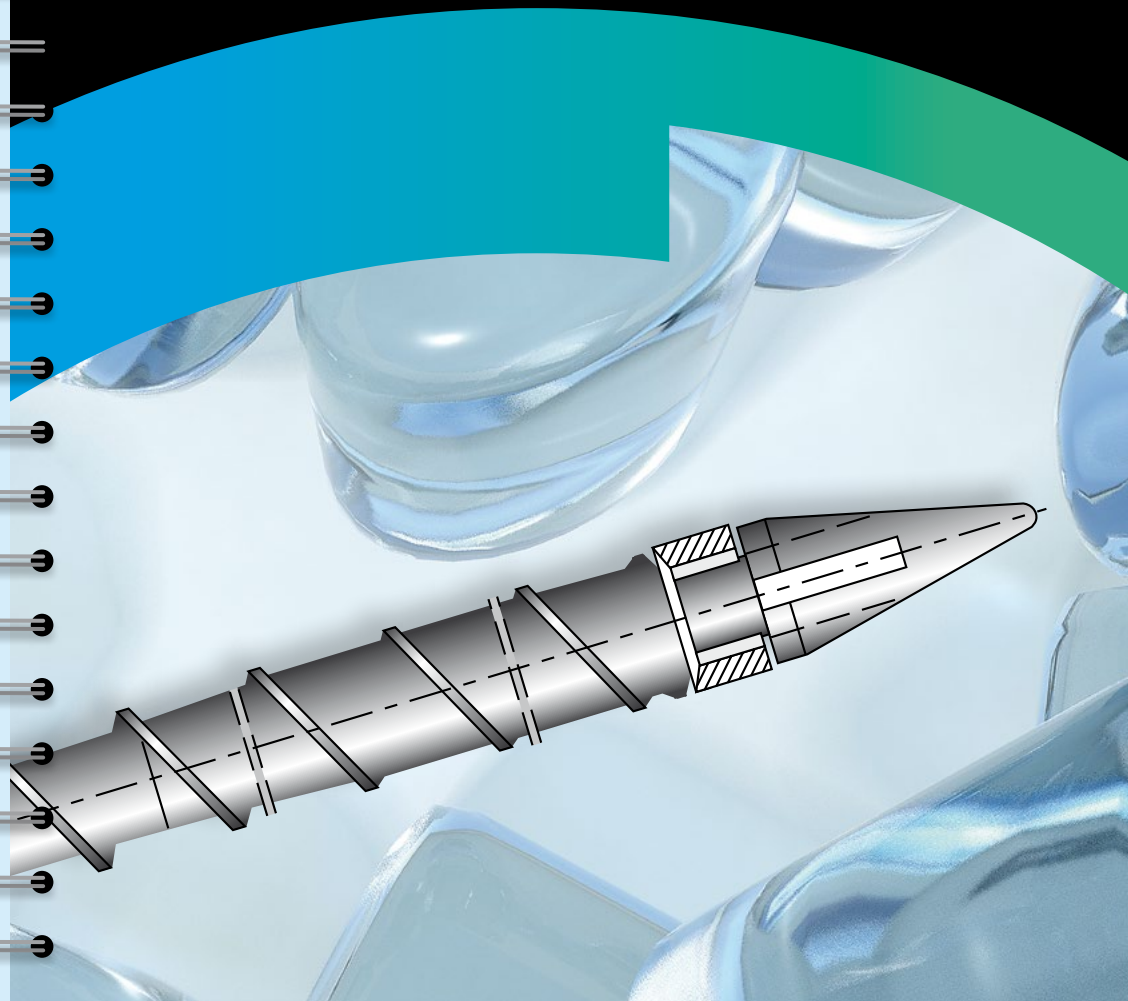
Tips for Defect-Free Injection Molding of TPU



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1. Tips for defect-free injection molding of TPU

Various problems can arise when injection molding thermoplastics – and that goes for TPU, too. 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 warpage" and "Defects caused by specks and dots". 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 catalogue of defects more complete.

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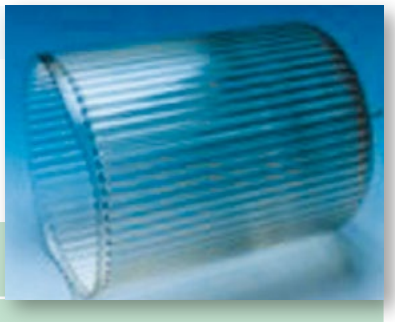
1.1 Defects in dimensions

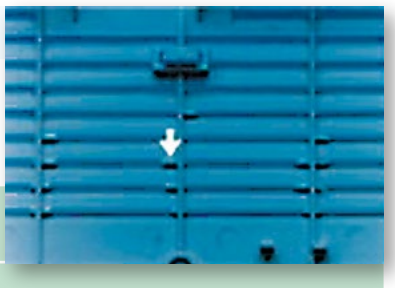
Short molding



Description: Molding not completely filled, mostly at end of flow path or thin-walled locations

Causes:	Remedies:
Unsuitable processing parameters	Optimize processing parameters. Increase melt and mold temperatures. Increase injection speed. Switch to holding pressure at a later point in time
Pressure losses too high in gating system, including hot runner. Sprue, gate and runner cross-sections too small. Pressure loss in hot runner too high. Pressure loss in shut-off nozzle system too high	Reduce pressure losses in gating system. Increase sprue, gate and runner cross-sections. Check hot runner cross-sections, optimize nozzle point torpedo. Work with machine nozzle open
Wall thickness inadequate	Increase wall thickness

Flash



Description: Mold gap results in polymer melt penetration on molding

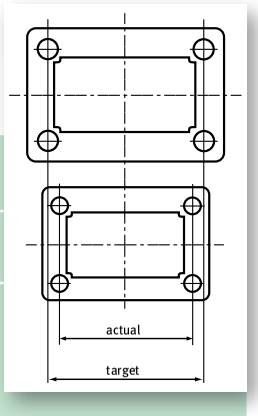
Causes:	Remedies:
Permitted gap width exceeded. Locking force inadequate. Mold rigidity inadequate. Wear of sealing faces	Check gap widths. Increase locking force. Increase mold rigidity. Rework sealing faces
Processing parameters not optimized	Optimize processing parameters. Reduce injection speed or melt temperature. Switch to holding pressure earlier or reduce holding pressure

Weight variation

Description: Significant fluctuations in molded part weight and mass

Causes:	Remedies:
Wear in plasticating unit	Check plasticating unit – in particular non-return valve – for wear
Mold and melt temperature fluctuations	Check plasticating unit's temperature control units and heating circuits
Drying inadequate	Check drying process
Metering stroke or melt cushion fluctuates	Check injection molding machine's injection and metering stroke
Locking force inadequate	Increase set locking force or select machine with higher locking force

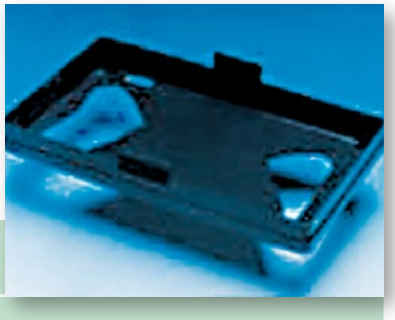
Variations in size



Description: Required dimensions of part not achieved

Causes:	Remedies:
Material too moist	Check material's dryness
Predicted shrinkage incorrect	Check shrinkage calculation using details from raw material manufacturer or comparable molds
Warpage due to unsuitable design of part or gate position	Check molding for warpage and switch to low-warpage design. Change gate position to obtain uniform orientation
Machine and mold not in thermal equilibrium	Check temperature profile of machine and mold for thermal fluctuations

Variations in wall thickness (deviation between nominal and actual values)



Description: Thickness of molded part does not correspond to nominal value or varies greatly and is not within tolerance range

Causes:	Remedies:
Mold rigidity inadequate	Check mold rigidity and reinforce mold if necessary
Shrinkage allowance inaccurate, mold dimensions incorrect	Check mold dimensions, compare with raw material manufacturer's shrinkage data
Cavity pressure too high or locking force too low	Reduce cavity pressure by switching to holding pressure earlier or using a lower holding pressure and increase locking force
Mold centering device defective or worn	Check mold centering device and replace if necessary

1.2 Demolding defects

Sprue remains attached

Description: Sprue contracts and / or remains attached to sprue bush or cold runner

Causes:	Remedies:
Unsuitable processing parameters (point at which switch is made from injection to holding pressure, level of holding pressure)	Optimize processing parameters. Reduce cavity pressure by switching to holding pressure earlier and using a lower holding pressure. Check cooling time and increase if necessary
Nozzle radius or aperture too large	Reduce nozzle radius or aperture
Drafts and polishing inadequate	Check components such as machine nozzle, cold runner and gate for undercuts and polishing and rework in the direction of removal (demolding) if necessary. Optimize drafts and polish if necessary

Ejector marks

Description: Distinct ejector marks on molding

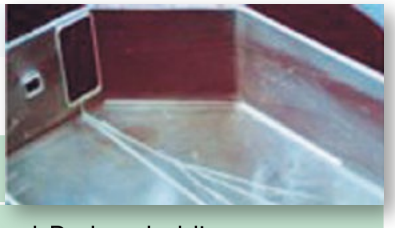
Causes:	Remedies:
Cavity pressure too high	Optimize injection speed. Reduce holding pressure. Switch to holding pressure earlier
Mold rigidity inadequate	Improve mold rigidity
Inadequate cooling time or mold temperature locally too high	Optimize cooling / mold temperature control
Unsuitable mold design. Excessive undercuts, inadequate draft	Optimize mold design. Reduce undercuts, optimize drafts
Inadequate mold (cavity) polishing. Ejector position unsuitable or ejector area too small	Improve mold (cavity) polishing. Optimize ejector position or enlarge ejector area

Noises as mold opens

Description: Opening the mold generates a considerable amount of noise

Causes:	Remedies:
Drafts inadequate	Check mold polishing and drafts, rework if necessary. Use an appropriate mold release agent
Mold centering device unsuitable or worn	Improve mold centering
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure
Mold rigidity inadequate	Increase mold rigidity
Insufficient release agent	Use release agent batch

Part fractures during removal



Description: Part damaged during removal

Causes:	Remedies:
Cavity pressure too high	Optimize injection speed. Reduce holding pressure. Switch to holding pressure earlier
Mold rigidity inadequate	Improve mold rigidity
Inadequate cooling time or mold temperature locally too high	Optimize cooling / mold temperature control
Unsuitable mold design. Excessive undercuts, inadequate draft	Optimize mold design. Reduce undercuts, optimize drafts
Inadequate mold (cavity) polishing. Ejector position unsuitable or ejector area too small	Polish mold surface in direction of removal (demolding), select appropriate coating or roughness height. Improve position and size of ejectors (in particular, locate near corners or under ribs / domes)
Inadequate material drying, residence time too long	Check material drying, residence time and melt temperature

Mold fails to open

Description: Even when applying maximum permitted opening force, injection molding machine fails to pull two halves of mold apart

Causes:	Remedies:
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure. Increase melt temperature within permitted limits
Mold rigidity inadequate	Increase mold rigidity
Slide valve control failure	Check slide valve is in correct position **Tips for opening 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

Molded part remains in cavity

Description: Molded part jams, cores / ejectors deform or penetrate part

Causes:	Remedies:
Mold overloaded	Reduce injection speed and holding pressure and switch to holding pressure earlier
Excessive undercuts, inadequate drafts	Reduce undercuts, improve drafts
Inadequate mold polishing on flanges, ribs or studs	Polish mold surface in direction of removal (demolding)
Vacuum between mold surface and molding	Optimize mold venting
Premature ejection, molded part sticks or still too soft	Increase cooling time, reduce mold temperature
Ejector pins too few in number or poorly positioned	Increase number of ejector pins or optimize their position

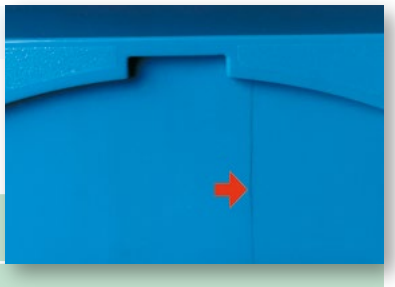
Part deformed during removal

Description: Part deformed during removal

Causes:	Remedies:
Cavity pressure too high	Optimize injection speed. Reduce holding pressure. Switch to holding pressure earlier
Mold rigidity inadequate	Improve mold rigidity
Inadequate cooling time or mold temperature too high locally	Optimize cooling / mold temperature control
Unsuitable mold design. Excessive undercuts, inadequate draft	Optimize mold design. Reduce undercuts, optimize drafts
Inadequate mold (cavity) polishing. Ejector position unsuitable or ejector area too small	Polish mold surface in direction of removal (demolding), select appropriate coating or roughness height. Improve position and size of ejectors (in particular, locate near corners or under ribs / domes)

1.3 Color defects

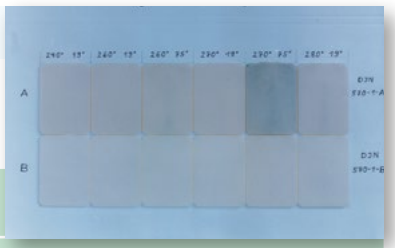
Darker color at weld lines



Description: Colored stripe. Darker color occurs at weld lines or near leading / lagging flow fronts fed from neighboring melt streams

Causes:	Remedies:
Pigment separation or refractive effect due to unsuitable flow at weld lines	Vary flow front speed
Overheating of melt, resulting in color changes at weld lines	Reduce thermal melt load
Oxidation due to inadequate venting	Improve venting, if necessary by relocating weld line **N.B.:** Fault tends to occur on light, bright colors such as white, blue, green and orange.

Homogeneous discoloration



Description: Uniform deviation from basic color, especially with light colors

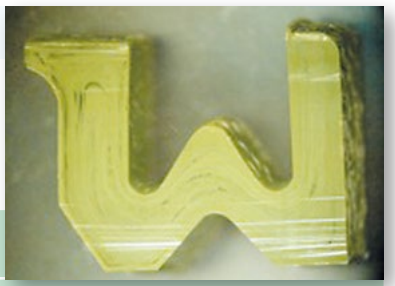
Causes:	Remedies:
Melt temperature too high	Check melt temperature and reduce if necessary
Inadequate utilization of plasticating unit capacity, resulting in excessive residence time	Use smaller plasticating unit
Master batch unsuitable	Use suitable master batch
Production stoppage without reduction in temperature	Comply with instructions for production stoppage

Partial color change

Description: Partial change in color

Causes:	Remedies:
Material not adequately homogenized	Increase back pressure, reduce screw speed
Injection and screw speeds too high	Reduce injection and screw speeds
Gate too narrow	Widen gate
Residence time too long	Shorten residence time by selecting smaller plasticating unit

Rings



Description: Rings, bloom effect, matte rings running concentrically to gate

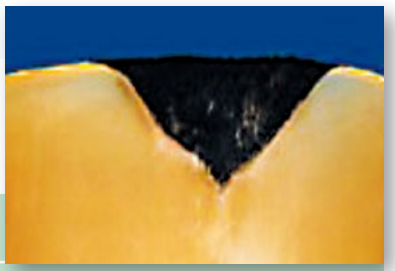
Causes:	Remedies:
Melt flow stagnates in mold, melt temperature too low	Try to achieve even melt flow, increase melt temperature
Mold temperature too low	Increase mold temperature
Inadequate injection speed	Increase injection speed

Black (overheating) marks

Description: Streaks and stains from burning, periodic discoloration, dark spots. Brown to black discoloration of molding, at different locations and irregular distances

Causes:	Remedies:
Entrapped, compressed air in injection mold, resulting in burns	Optimize mold venting, in particular near flow lines and at end of flow path. Correct flow front (wall thickness, gate position or flow promoters). Check venting channels. Reduce clamping force. Evacuate mold

Black discoloration



Description: Diesel effect. Concentrated black coloring at points where flows merge, e.g. on flanges or studs or in corners at end of flow paths

Causes:	Remedies:
Unfavorable cross-section changes / bends or defective sealing faces, resulting in dead spots where material burns. Dead spots at sealing faces, cross-section changes or bends in hot runne	Check / rework parts and sealing faces affected. Eliminate dead spots. Check weep holes for needle valve system. Check sealing faces. Check direction changes and transition cone
Screw, non-return valve or cylinder wear	Check screw, non-return valve and cylinder for wear **N.B.:** In addition to optical degradation of the molded part, this fault can also damage the mold through corrosion.

Stress-whitening

Description: Lighter color in places, with velvety molding surface

Causes:	Remedies:
Overstretching of polymer matrix. Demolding causes excessive mechanical stress. Ejector pins poorly positioned and drafts inadequate	Reduce mechanical stress during demolding. Position ejector pins near corners, domes and ribs (in general at stress-whitened lines)
Excessive service load	Adapt service loads to material values
Cavity pressure too high. Mold rigidity inadequate	Reduce cavity pressure. Increase mold rigidity **N.B.:** Fault mostly occurs with thermoplastics containing rubber.

Cloudy appearance

Description: Gray streaks. Molding surface has dark, cloudy appearance

Causes:	Remedies:
Plasticating unit dirty	Clean plasticating unit. Reduce screw speed
Wear effects on plasticating unit	Replace entire unit or individual (worn) components. Use a plasticating unit with an abrasion- and corrosion-resistant coating

1.4 Defects in the form of specks and dots

Black or brown dots

Description: Specks, either spherical with irregular contours or flaky with sharp, linear contours, occurring sporadically

Causes:	Remedies:
Boundary layers that have formed on screw / cylinder surface damaged / flaking off	Clean plasticating unit mechanically. Comply with procedures for production stoppages. Check plasticating unit for wear
Soiling of granules or regranulated scrap	Check cleanness of granules. Store granules in a dust-free location. Clean soiled moldings prior to regranulation. Do not regranulate moist or thermally damaged moldings. Check drying and conveyor system for soiling

1.5 Unevenness defects

Pockets

Description: Highly localized round or elongated solid swellings – horizontal or vertical – on molded part, not necessarily discernible on both sides

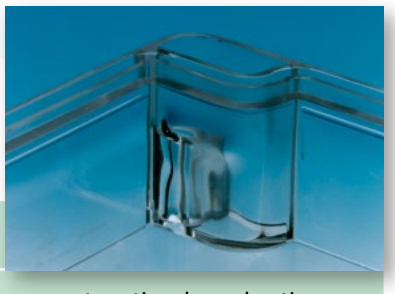
Causes:	Remedies:
Unmelted material or air intake during metering, screw cut too deeply	Use appropriate screw
Unmelted material or air intake during metering, metering stroke greater than 3D (D = diameter)	Select metering stroke between 1 and 3 D
Unmelted material or air intake during metering, back pressure inadequate	Increase back pressure
Unmelted material or air intake during metering, melt temperature too low	Increase melt temperature
Unmelted material or air intake during metering, screw speed too high	Reduce screw speed

Delamination

Description: Delamination. Surface layer detaches or flakes off. Can occur over extensive areas of molding or just near sprues

Causes:	Remedies:
Excessive shear stress. Gate too narrow. Injection speed too high	Reduce shear stress. Widen gates. Reduce injection speed
Contamination by incompatible resins	Clean plasticating unit. Check material in hopper and material supply system for contamination by other materials
Color batch unsuitable	Use appropriate color batch

Sink marks, localized

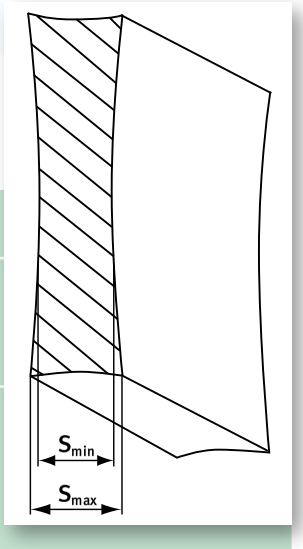


Description: Localized, pronounced depression in surface, mostly opposite ribs, at thick-walled locations, cores, weld lines, throats, hot runner nozzles or end of flow paths

Causes:	Remedies:
No compensation for volume contraction during cooling phase	Compensate for volume contraction by adapting wall thickness-rib ratio to material, increasing holding pressure and holding pressure time, and making nozzle aperture and sprue cross-section larger. Reduce melt and mold temperatures (may result in formation of voids). Check melt cushion. If necessary, laminate sink marks

Dog's bone effect, extensive sink marks

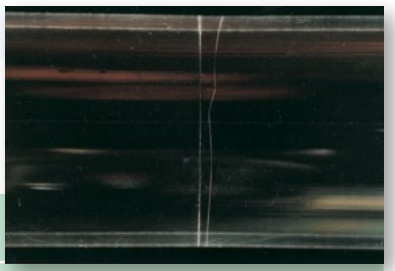
Description: Extensive contraction of molding away from mold surface except at edges



Causes:	Remedies:
Glass fibers standing up at end of flow path or at weld lines	Change flow front or move weld line to non-critical area
Holding pressure not sufficiently effective	Switch from injection to holding pressure later and increase both holding pressure and holding pressure time

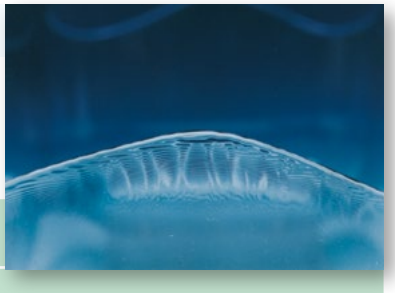
Notches along weld line

Description: Pronounced weld line, notch along weld line which can be seen or felt



Causes:	Remedies:
Inadequate mold venting	Improve mold venting, especially at end of flow path
Inadequate plastic flow properties. Insufficient injection speed. Wall thickness inadequate / flow paths too long	Improve flow properties by increasing melt and mold temperatures. Increase injection speed. Increase wall thickness or, if necessary, move gates to shorten flow paths **N.B.:** Fault mostly occurs with high-viscosity or quick-setting thermoplastics. For thermoplastics with a low pro-cessing temperature (e. g. PS), weld line can be laminated using the Promold® process.

Grooves



Description: Record grooves, stick-slip effect.
In sprue area: Fine, concentric grooves around gate.
In thin-walled areas: Grooves parallel to flow front

Causes:	Remedies:
Melt flow in mold pulsates due to excessive cooling of melt front.	Try to obtain quick, uniform melt flow
Injection speed too low	Increase injection speed
Melt temperature too low	Increase melt temperature
Mold temperature too low	Increase mold temperature
Wall thickness too low	Increase wall thickness

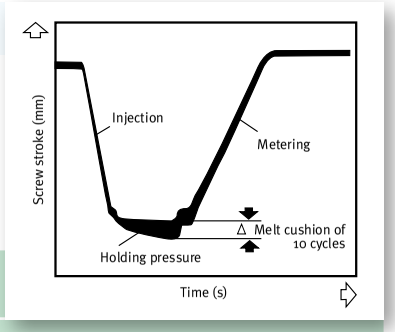
1.6 Processing defects

Unusual odor

Description: Pronounced odors, either typical or atypical of material

Causes:	Remedies:
Thermal damage to material. Excessive residence time in cylinder or hot runner. Melt temperature too high	Reduce melt's exposure to heat. Reduce residence time in cylinder or hot runner. Lower melt temperature

Melt cushion fluctuates



Description: Melt cushion varies greatly, sometimes approaching zero

Causes:	Remedies:
Non-return valve defective or worn	Check non-return valve and replace with a new one if necessary
Hydraulics faulty	Check hydraulics are working properly
Uneven metering	Check cylinder barrel for wear and if necessary fit bush or use new plasticating unit

Cycle too long

Description: Actual cycle time exceeds scheduled cycle time

Causes:	Remedies:
Metering time too long	Cut metering time. Increase screw speed to maximum peripheral velocity of 0.25 m / s. Use larger plasticating unit. Check plasticating unit for wear. Use more efficient screw
Cooling time too long	Cut cooling time. Reduce mold temperature within permitted limits. Improve cooling, targeting critical areas
Handling time too long	Improve handling system

1.7 Warpage defects

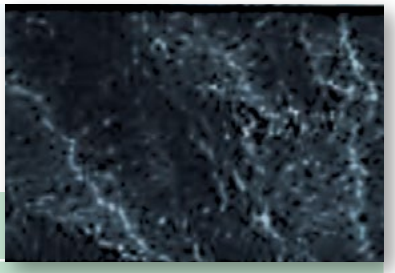
Warpage, general

Description: Moldings not as shown in drawing, distorted or do not fit together accurately

Causes:	Remedies:
Unsuitable design of part. Unsuitable glass fiber orientation. Unsuitable wall thickness distribution	Optimize design of molding. Improve glass fiber orientation by optimizing gate. Optimize wall thickness distribution
Holding pressure not sufficiently effective. Non-return valve worn	Switch from injection pressure to holding pressure later and increase holding pressure. Check non-return valve and replace if necessary **N.B.:** Possible causes of defect, associated remedies and their interdependencies are too complex to go into here.

1.8 Gloss defects

Frosting



Description: Rough, matt part surface

Causes:	Remedies:
Injection speed inadequate	Increase injection speed
Mold temperature too low	Increase mold temperature. Equip mold with thermal insulation. Use more efficient temperature-control unit **N.B.:** Only affects glass-fiber-reinforced thermoplastics. Very evident on amorphous thermoplastics, less so on semi-crystalline thermoplastics

Gloss level not achieved on polished surface

Description: Molding fails to achieve required gloss level either over entire surface or in a specific area

Causes:	Remedies:
Mold polishing inadequate or worn	Improve mold polishing
Inadequate injection speed, possibly due to poor venting	Increase injection speed, if necessary by improving venting
Fluctuating mold temperature due to insufficient cooling	Check mold for uniform temperature
Inadequate material drying	Check drying process
Holding pressure not sufficiently effective	Increase holding pressure and holding pressure time. If necessary, widen gates

Gloss differential on molded part surface

Description: Different gloss levels, either over entire molded part or at various locations

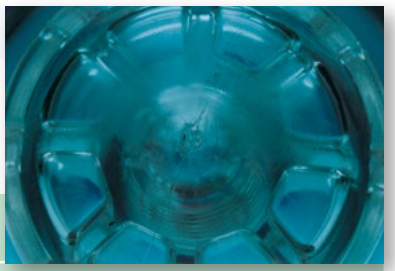
Causes:	Remedies:
Inadequate injection speed	Increase injection speed
Mold surface worn or corroded	Rework mold surface
Fluctuating mold temperatures. Fault in heating / cooling circuit, e.g. leak, heating / cooling channel blocked, temperature control unit not working	Service temperature control system and repair leak if necessary. Improve temperature control with additional heating / cooling channels, by increasing heating / cooling medium throughput or by changing this medium (water instead of oil)

Localized, shiny, finger-like hollows

Description: Shiny hollows, often near sprues, at cores or close to hot runner elements, often assumed to be bonding spots

Causes:	Remedies:
Premature ejection	Extend cycle time
Inadequate holding pressure and holding pressure time	Increase holding pressure, extend holding pressure time, check melt cushion. Check nozzle aperture, sprue cross-section and gate cross-section and widen if necessary
Premature switch to holding pressure	Switch to holding pressure later
Localized excessive mold temperature	Lower mold temperature on a localized basis using additional cooling channels or separate temperature control **N.B.:** See also “Matt surface defects”

Dull spots



Description: Matt halo, dull spot. Uniform, well-defined velvety area

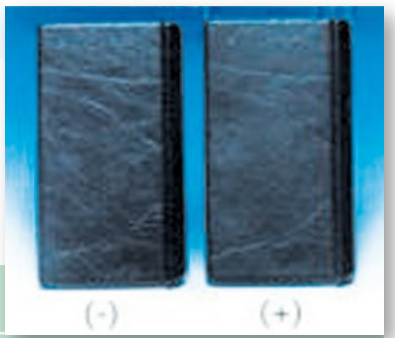
Causes:	Remedies:
Speed differences between flow fronts (if several injection points)	Even out speed differences by balancing gating system (if several injection points)
Tearing of already solidified outer skin at sharp bends or sudden changes in wall thickness	Round off or polish changes in wall thickness and transitions in gate / mold or adjust flow front speed **N.B.:** See also “Flaking”

Matt surface defects at hot runner elements

Description: Rough, cracked surface, creating a matt effect close to hot runner elements or at hot cores

Causes:	Remedies:
Premature ejection	Extend cooling time
Mold temperature too high at hot runner	Improve thermal separation of hot runner, reduce mold temperature
Core temperature too high	Ensure adequate cooling of core

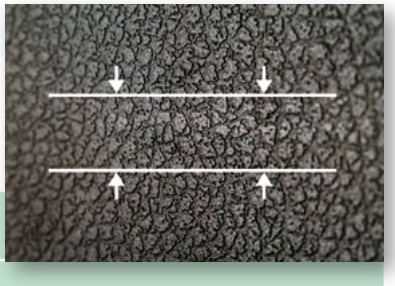
Matt appearance not achieved on textured surface



Description: Required matt appearance not achieved on surface of molding

Causes:	Remedies:
Injection speed and mold temperature too low	Increase injection speed and mold temperature
Holding pressure not sufficiently effective	Switch to holding pressure later and increase holding pressure
Surface texture inadequate or worn	Rework mold surface

Damage to grain on molded part



Description: Cracked, rough surface with scoring in direction of removal (demolding), mostly at same location

Causes:	Remedies:
Inadequate drafts	Make drafts larger
Mold surface damaged	Rework mold surface
Cavity pressure too high	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure. Optimize injection speed. Increase melt temperature within permitted limits
Inadequate mold rigidity	Increase mold rigidity **N.B.:** Scoring can often only be identified using optical aids.

White patches

Description: Whitish, rough, flaky patches or whitish round or oval patches resembling mildew

Causes:	Remedies:
Material too moist	Check dryer / drying process
Melt temperature too high, residence time in cylinder and hot runner too long	Check melt temperature, melt residence time and screw speed and reduce if necessary

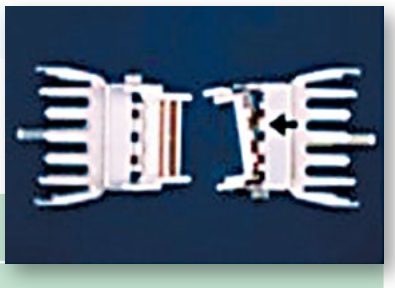
1.9 Defects in mechanical properties

Weld line strength insufficient

Description: Part failure near weld line

Causes:	Remedies:
Insufficient mold venting	Improve mold venting
Inadequate plastic flow properties. Injection speed too low. Wall thickness inadequate / flow paths too long	Improve flow properties. Increase injection speed. Increase melt and mold temperatures. Increase wall thickness or relocate gates if necessary to shorten flow paths

Defective integral hinges



Description: Integral hinges tear or break under stress

Causes:	Remedies:
Incorrect material selection, e.g. amorphous thermoplastics	Use a suitable semi-crystalline thermoplastic
Weld line in unsuitable position in integral hinge	Change weld line and comply with design guidelines for integral hinges

Mechanical problems with part

Description: Molding not up to mechanical requirements

Causes:	Remedies:
Excessive mechanical stress	Check dimensioning meets mechanical requirements. Check molded parts' internal stress levels (if necessary, increase mold and melt temperatures, reduce cavity pressure). Check plastics' resistance to media
Material degradation due to incorrect drying or overexposure to heat	Check melt temperature, residence time and drying process
Weld line in unsuitable position	Locate weld line outside area where main stress occurs
Poor demolding behavior at domes and screw connections	Avoid damaging part during removal (demolding), improve removal behavior by polishing mold

1.10 Surface defects

Flaking

Description: Cold displacement. Surface looks flaky with alternating shiny and matt areas, mostly near sprues

Causes:	Remedies:
Displacement of already cooled material	Inject in stages – slow to fast. Reduce mold temperature. Provide gates with radii and polish

Jetting

Description: Jetting. Melt which has entered cavity first is visible on part surface (mostly S-shaped). Fault occurs near sprues or at throats

Causes:	Remedies:
Unsuitable gate or throat with result that no frontal flow is produced. Gate position has no deflector surface. Gate cross-section or throat too small	Change gate. Select gate position with deflector surfaces. Make gate cross-section larger. Improve design of changes in diameter
Injection speed too high	Give preference to injection in stages – slow to fast.

Extensive silver streaks

Description: Extensive elongated penicillate streaks

Causes:	Remedies:
Plasticating unit's metering stroke too high	Use larger plasticating unit to reduce metering stroke (‹3D). If plasticating unit cannot be changed, increase feed section temperature, reduce screw speed, increase cycle time and if necessary increase size of melt cushion, if possible by 1-2 D, as an additional remedial measure
Air intake during metering	Optimize plasticating conditions. Increase back pressure within permitted limits. Shorten screw retraction. Let machine nozzle contact hot runner mold **N.B.:** Fault sometimes occurs in association with blistering.

Buckling line

Description: Depending on angle of light, clearly discernible line or shimmering area on part, often at weld lines, ribs, sudden changes in wall thickness or slide valves

Causes:	Remedies:
Spring-loaded gate valves	Improve gate valve support / mold rigidity
Glass fibers standing up at weld lines	Change position of weld line, if necessary also using sprue position and number of gates
Sudden changes in rigidity at ribs or sudden changes in wall thickness	Avoid sudden changes in wall thickness and provide gradual transitions

Large bubbles

Description: Hollow bubbles filled with air in wall

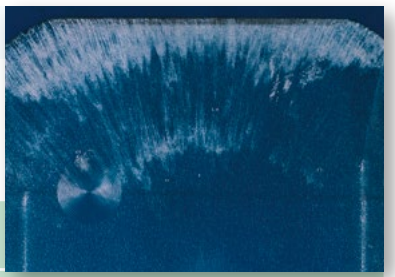
Causes:	Remedies:
Air intake during metering	Check granule conveying system for air intake. Increase back pressure within permitted limits. Shorten screw retraction
Capacity utilization of plasticating unit too high	If screw stroke exceeds 3D, use plasticating unit one size larger

Linear surface damage

Description: Scoring, scratches. Scoring or scratches on part surface running in direction of removal (demolding), also visible as matt stripes on high-gloss surface

Causes:	Remedies:
Mold's surface texture damaged	Check mold's surface texture and rework if necessary, polish in direction of removal
Spring-loaded gate valves	Optimize slide valves
Excessive cavity pressure	Reduce cavity pressure. Switch from injection to holding pressure earlier. Reduce holding pressure. Optimize injection speed. Increase melt temperature within permitted limits
Inadequate mold rigidity	Reinforce mold **N.B.:** See also "Noises as mold opens"

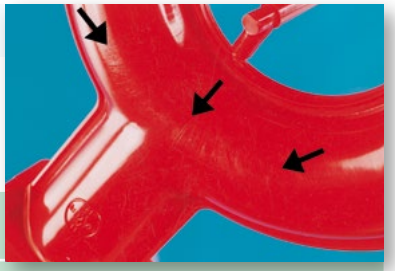
Streaks open towards flow direction



Description: Moisture streaks. U-shaped, elongated, tufted streaks, open towards flow direction; in a less pronounced version in the form of small lines

Causes:	Remedies:
Residual moisture content of pellets too high	Check drying process (drying temperature and time and hourly throughput). Check dryer for soiled filters. Check drive motor's direction of rotation

Streaks due to overheating, needle-like streaks



Description: Silver streaks. Elongated silvery streaks

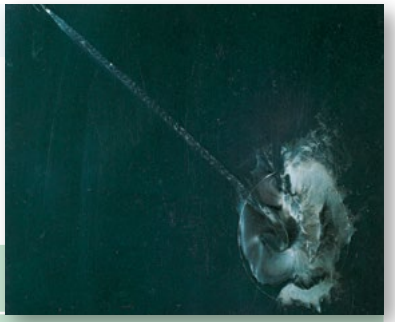
Causes:	Remedies:
Overheating of melt, melt temperature too high	Reduce thermal stress on melt, lower melt temperature
Overheating of melt, melt residence time too long	Reduce thermal stress on melt, select smaller screw diameter
Overheating of melt, screw speed too high	Reduce thermal stress on melt, lower screw speed
Overheating of melt, nozzle and runners too narrow	Reduce thermal stress on melt, widen nozzle and runners
Overheating of melt, production stoppage without reduction in temperature	Reduce thermal stress on melt, comply with instructions for production stoppage **N.B.:** Fault often similar to moisture streaks.

Tear drops

Description: Air-filled hook. Lines in shape of hook / tear drop caused by trapped air

Causes:	Remedies:
Air rolled over and trapped in injection mold, e.g. from engravings, grooves or depressions	Reduce injection speed in critical area. Improve mold venting close to flow lines and near depressions, flanges or engravings. Evacuate mold

Cold slug



Description: Cold-flow mark. Well-defined, irregular matte area. Cold melt particles entrapped in surface of molding

Causes:	Remedies:
Ejector claw on cold runner rod missing or too small to absorb cold slug	Provide or optimize ejector claw so that cold slug is absorbed
Melt leaking from machine nozzle or hot runner	Increase screw retraction, optimize thermal separation in hot runner
Nozzle aperture and heating inadequate	Make nozzle aperture larger, install band heater with higher capacity, check thermocouple and controller

Small bubbles

Description: Entrapped air similar to voids but greater in number and with much smaller diameters

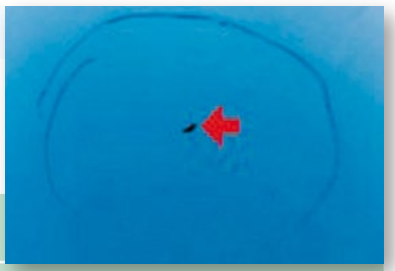
Causes:	Remedies:
Material too moist	Check drying process
Unsuitable vented screw	Select appropriate vented screw or replace vented screw with normal one and pre-dry material **N.B.:** Fault often coincides with silver streaks.

Craters

Description: Pinholes, pimples. Depressions the size of pinpricks

Causes:	Remedies:
Material degradation	Reduce melt temperature and residence time
Pigment has detrimental effect (use of incompatible pigments for in-plant coloring, often wrong type of carbon black)	Use compatible pigments or different type of carbon black
Proportion of carbon black too high	Reduce proportion of carbon black

Gray dots



Description: Metal specks. Gray foreign particles which may appear shiny, depending on angle of light

Causes:	Remedies:
Plasticating unit worn	Check plasticating unit for screw, cylinder or non-return valve wear
Foreign bodies due to feed pipe, container and feed hopper abrasion	Check pipes, containers and feed hoppers for abrasion. Make such pipes, containers and hoppers from stainless steel – aluminum and tinplate are unsuitable. Avoid bends as far as possible, otherwise design with large radii
Granulator for producing reclaim worn	Check granulators regularly for abrasion / damage and repair when necessary

Microscopic cracks

Description: Fine, microscopic cracks in molded part, often just on surface of outer fibers under tensile stress

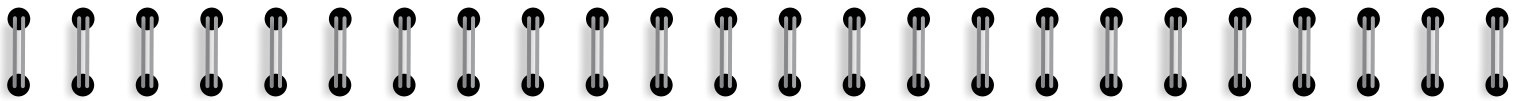
Causes:	Remedies:
Stress levels too high in molded part	Optimize processing parameters with regard to stress levels. Increase mold and melt temperatures. Design molding to reduce long-term outer fiber strain
Contact with inappropriate media	Check media compatibility. Check release and anti-corrosion agents to see if they cause stress cracking. Check molded parts for chemical resistance to cleaning / degreasing agents. Check resistance to media used and reduce load if necessary

Voids

Description: Vacuole, bubble. Round or elongated bubbles (hollow vacuums), generally only discernible on transparent or translucent parts

Causes:	Remedies:
No compensation for volume contraction during cooling phase. Holding pressure not sufficiently effective	Increase holding pressure, extend holding pressure time, check melt cushion. Check nozzle aperture, sprue cross-section and gate cross-section and make larger if necessary
No compensation for volume contraction during cooling phase. Unsuitable injection position or part design	Inject in thick-walled area. Revise wall thicknesses to avoid excessive changes in thickness **N.B.:** Comply with design guidelines for injection molded parts

Notes



Notes