NETWORK POLYMERS, INC.

Softflex® TPE
Part and Tooling Design Guide

Softflex® brand Thermoplastic Elastomers from Network Polymers, Inc. are formulated for demanding overmold applications that require enhanced dry gripping, drop impact energy absorption, soft tactile feel and pleasing cosmetic appearance.

Softflex® TPE materials are formulated in two main chemistry groups ~ Softflex® TPE materials for overmolding onto engineered substrates and Softflex® TPE materials for overmolding onto polypropylene substrates and/or stand alone applications.

Overmolding Applications:
Softflex® TPE's are formulated for overmolding and stand alone applications. This guide primarily covers overmolding applications.

Softflex® overmolding applications can be processed as a two shot process where the rigid first shot substrate is molded in a separate tool and then inserted manually into the second shot overmolding tool where the overmold TPE is applied, or in a true two shot - multi-shot / barrel injection molding machine where the substrate and overmolding processes are conducted within the molded part cycle time. The content of this guide is specifically designed for insert overmolding applications, though the recommendations could also be applied to true multi-shot applications.

Tool Steel:
Standard industry practices apply. Softflex® TPE materials are basically non-corrosive when processed properly. H13 is generally used as the steel of choice due to its hardness and ability to stand up against the repeated pre-load against the first shot plastic substrate. P 20 is sometimes used but tends to "wash out" easily against repeated pre-load conditions.

Plastic First Shot Pre-load:
To keep the part from flashing with Softflex® TPE materials the overmolded areas should be pre-loaded with .005" - .010" of "crush" against the first shot plastic base substrate part. Designers generally incorporate a style grove as a pre-load crush area on the plastic first shot substrate. The style grove can be designed for aesthetic appearance and pre-load crush location. Style groves are generally designed without texture and .040" - .060" wide.

Second Shot Tooling Support:
Weather the first shot substrate part is hand loaded, robotically shuffled or is a true two shot rotation mold, the area on the first shot part where the overmold material is to be applied must be completely backed up by tool steel. Softflex® TPE materials are processed in the temperature range of 380º - 400ºF, well above the vicat softening temperature of most first shot plastic substrate parts. If the area under the overmolded Softflex® TPE is not supported by tool steel the substrate part at that location may distort or "blow through" causing fit & function related issues.

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Water lines:
Standard industry practices apply. Water temperature on the non-overmolded side (core side) is not critical. Water temperature on the overmold side (cavity side) is critical. The water temperature on the overmolded side is generally recommended to be maintained between 80º – 130º F with a close tolerance delta T.

Ejection:
Standard industry practices apply. Standard core ejection tooling should be designed to eject on the inside of the substrate insert. Non standard tooling (cavity ejection etc.) should not be designed to eject on the overmold surface. Ejector pins / bars employed on the overmold surface generally result in uncontrollable flash down the ejector pin / bar. If ejection is designed to push on the cosmetic surface of the first shot plastic substrate, nylon bumper pads can be utilized to minimize surface marring.

First Shot Surface Preparation for Overmolding:
The first shot overmold tool surface should be rough (slight texture, EDM finish, vapor honed surface) not polished. The first shot substrate parts should be free of any surface contamination (silicone spray, grease, dirt, pigment-leaching etc.). We recommend you handle the first shot substrate parts with thin cotton gloves, do not use silicon release sprays and keep non overmolded first shot substrate parts stored and covered in a clean dry location to minimize potential surface contamination that can cause overmold bonding issues.

Mold Surface Treatments:
Generally bead blasted and/or textured surfaces work well with Softflex® TPE overmold designs for part ejection / part removal from the tool. Bead blasted and/or textured tool surfaces can be re-bead blasted as required and as a set PM tool program for removal of built up gas that can cause part surface / appearance issues. There may be times depending on the design and part geometry where the use of an impregnated coating maybe required to facilitate core side part removal. Teflon impregnated coatings have been successfully utilized to aid part removal.

Draft:
Standard industry design rules apply. Deep draw parts are recommended to maintain a minimum of 1° draft per side. Additional draft maybe required depending on the draw length.

Texture:
Standard industry practices for texture depth and draft relief applies. As a general rule textured surfaces on the outside of the overmold help release the overmolded part from the tool, and enhance the parts appearance. Matched textured surfaces between Softflex® TPE materials and rigid thermoplastic substrates are difficult to exactly match. If a specified texture is on a mold print for use with a Softflex® TPE, you will generally have to increase the texture design one level to closely replicate the specified texture (ex. MT 11020 is specified you will probably have to use MT 11030 to closely replicate MT 11020). The reason for the increased texture design is the shrinkage rate of Softflex® TPE materials.

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Venting:

Runners ~

Runner venting is recommended. Vent depth is generally .001" - .0015".

Tool Venting – Parting Line Vents ~

Standard industry practices apply to the secondary vents (gas paths to atmosphere); however, primary vents (small land length vents at the parting line of the mold) should not be installed other then at the end of fill location. Natural venting paths generally work well with Softflex® TPE materials. If additional vents are required after mold sampling; the use of vent pins, primary vents, flattened ejector pins and /or sintered metal inserts can be added. Retractable or stationary vent pins generally are designed in the size range of .0625" to .0125" at the location of non-parting line venting related issues / trapped gas. Primary vents can be added as required at parting line locations ~ depth of .0008" - .001" with a short land length of .030" - .040" and a width of .250" – 1.00". Flattened ejector pins can be used for venting of Softflex® TPE materials – ejector pins should be ground about .002" for both sides. Flattened ejector pins used for venting purposes will be self cleaning upon ejection; however, some pin flash may occur. Sintered metal inserts can be added to non-parting line locations to aid in the evacuation of trapped gas. Sintered metal inserts should be self cleaning by incorporation of an air blast during the ejection phase of the molding cycle.

Shrinkage:

Softflex® TPE materials generally do not list shrinkage values on data sheets provided. Shrinkage values are not required in overmolding applications – shrinkage is controlled by the bonding to the plastic substrate base material – refer to the Overmold Thickness Ratio section of this design guide for additional information.

Runner Designs:

- Keep the runners system as short as possible, total runner length of less than 8" is recommended
- Runners should be vented to remove excessive melt gas – refer to venting section
- Cold Slug Wells should be incorporated into the runner design to remove the cold slug from the nozzle tip. Additional cold slug wells can be incorporated at the end of each runner section turn.
- Full round runners are suggested utilizing standard industry practices for runner size and runner venting. We recommend starting with as small a runner as possible – industry guidelines for calculations for runner sizing can be used for optimum runner sizing ~ volume sizing of each runner segment; calculated shear rate and shear stress; pressure drop for each runner segments
- Conventional runners and sprues should not be polished. A slight texture will aid in the release of the runner
- Sprue Extractors – tapered extractor and Z-pin extractors are recommended. Sucker pin style extractors are not recommended
- Heated sprues for direct gating into the runner system or part are recommended to eliminate the potential for the sprue to stick and elimination of sprue regrind
- Hot runner systems can be employed providing the runner system is designed for volume reduction and elimination of stagnation points

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Gate Designs:
Standard industry practices apply for gate designs, widths and depths. Softflex® TPE's have been successfully molded utilizing, edge gates, pin (submarine) gates, heated sprues, hot runner drops and hot runner valve gates. General rule is to keep the gates as small as possible, opening them up in small increments if required for part filling. As a general rule smaller gates cause higher shear rates and aid in the flow length of Softflex® TPE materials.

Gate Design Guidelines:
Gate Land length ~ .030" - .040"
Edge Gate Thickness ~ generally 50% of the nominal part wall thickness
Edge Gate Width ~ depends on the cavity volume – edge gate width should never be less then the gate thickness

Tonnage Requirements:
Designers should design between 5- 7 tons per square inch of clamping force to minimize flash on Softflex® TPE overmold applications.

Overmold Thickness Ratio:
Recommended Softflex® TPE material thickness to the first shot substrate material thickness is maximum .8:1 ratio with minimal wall thickness transitions. Commercial applications are employed where overmolded Softflex® TPE material is thicker than the substrate; however, for design simplicity you should stick to the maximum ratio of 0.8:1. Most overmolded parts generally fall into the range .040" - .080" overmold thickness. The thicker the Softflex® TPE overmold the more rigid the first shot substrate must be designed through the incorporation of first shot nominal wall thickness, ribs and gussets to help keep the substrate from distorting when overmolded.

Softflex® TPE Length of Travel:
Softflex® TPE's are designed for easy processibility with long flow lengths. Recommended maximum L/T (L= flow length / T= nominal wall thickness) figure is 175 – 200.

For additional design, processing, and material selection information on Network Polymers, Inc. Softflex® TPE materials, contact an application specialist at Network and Diamond Polymers
1-888-4 DPI NPI, 1-888-437-4674.