



ProFlex™ SEBS Thermoplastic Elastomer Processing Guide

Foster Corporation formulates and manufactures ProFlex™ medical grade styrenic thermoplastic elastomer copolymers (SBC's). ProFlex™ SEBS is available in a comprehensive range of pre-formulated "stock grades", as well as custom formulations manufactured to specific requirements, including hardness, flow and clarity.

ProFlex™ SEBS offers excellent elastomeric properties, with superior design flexibility and ease of processing via injection molding and extrusion. ProFlex® formulations have passed USP Class VI testing for biocompatibility and are suitable for a variety of medical applications.

Injection Molding of ProFlex™ SEBS

ProFlex™ SEBS can be processed by a variety of techniques including thermoplastic injection molding. ProFlex™ SEBS can be easily molded into shapes such as grips, gaskets, caps, as well as many other applications.

A summary of "best practices" regarding the injection molding of Foster ProFlex™ SEBS is outlined below.

Machine

ProFlex™ SEBS can typically be injection molded on reciprocating screw injection molding machines.

Screw Design

Like other styrenic based TPE copolymers, ProFlex™ SEBS does not have a steep melting curve. Melt behavior is highly dependent on screw configuration and screw speed. General purpose screws designed for polyolefins or PVC can be used effectively to injection mold ProFlex™ SEBS. These screws have shallow channels, sudden deep compression, and long metering zones. Recommended compression ratio is from 2:1 to 4:1 with a 60° tip angle and a reverse flow inhibitor.

Higher speed screws with mixing sections or mixing pins can also be used when blending color concentrates or other concentrate functionalization into the melt stream.

Recommended screw speeds are 25 – 75 rpm.

Nozzles, Sprues, Runners

Conventional nozzles, nozzles with reverse tapers or nozzles employing a means of positive shutoff are acceptable for molding ProFlex™ SEBS compounds. ProFlex™ can withstand short stationary periods of time in the nozzle without significant degradation.

Full round runners are preferred for carrying ProFlex™ melt to the mold cavity. Balanced flow is highly preferred. Abrupt transitions should be avoided. Insulated, heated runner, or hot tip systems can be used with ProFlex™ SEBS.

Standard sprues with draft angles of at least 3° are recommended. Because these materials are soft materials the type of sprue puller should be considered depending on the softness of the grade being molded.

Gates

Common gate types are acceptable for ProFlex™ SEBS with a draft angle of 2.5°. Thickness of the gate should be about 15% to 25% of the part thickness. Land length should be kept as short as possible. Multiple gates are acceptable as long as they are close enough to each other to avoid weld line issues.

Mold Design

Most conventional mold designs will work with ProFlex™ SEBS. The physical properties of ProFlex™ are affected depending on flow direction and shear as these materials are anisotropic and orientation can occur in the direction of flow. One can expect a mold shrinkage percentage between 0.0625 and 0.125; shrinkage is usually higher in the direction of flow.

The following mold design tips are recommended:

- *Avoid wide variations in material thickness*
- *Provide radii at all edges and tips*
- *Avoid thin cores*
- *Avoid highly polished mold surfaces (EDM textured surfaces hide part imperfections and allow for easier de-molding)*
- *Avoid pins or obstructions that cause weld lines*
- *Use judicious use of ribs and reinforcing sections in order to avoid sinks in the part*

Venting

Good venting practices are necessary with ProFlex™ SEBS. Vents can be taper ground or relived directly into air. Typical vents should be 0.0005" to 0.001" in thickness. Typical width is 1/8" to 1/4" ...both dependent on the size of the part. Vents should be located opposite the gate.

Part Ejection

ProFlex™ SEBS can be very soft and flexible. Soft materials can be difficult to eject or de-mold. Ejector pins should be as large as possible and air assists ejection can be preferable.

Draft angles of 3° to 5° should be adequate for part ejection. Undercuts are possible with ProFlex™ SEBS and should have room to flex during ejection.

Mold Temperature

Molds should have ample cooling built in. Typical mold temperatures are 75° F to 125° F.

Typical injection molding processing temperatures of ProFlex™ SEBS are as follows:

IM Zone	35A/45A/55A	65A/75A	85A	90A & Above
Rear	320 – 340 °F	330 - 360 °F	340 - 380 °F	340 – 380 °F
Middle	340 – 360 °F	350 – 380 °F	360 – 400 °F	360 – 400 °F
Front	370 – 390 °F	380 – 420 °F	400 – 440 °F	400 – 440 °F
Nozzle	370 - 380 °F	370 - 400 °F	380 - 410 °F	380 - 410 °F

Miscellaneous

ProFlex™ SEBS can be over-molded with other like materials, including PP and PE. ProFlex™ grades are non-hygroscopic, in other words hydrophobic, and do not have to be dried. Softer durometers (35A-65A) are manufactured using an underwater pelletizer and are shipped in a consistent round/oval configuration for easy feeding from the hopper into the injection molding machine. Grades above 65 Shore A will be strand cut, unless otherwise requested by the customer.

ProFlex™ SEBS can be custom formulated for targeted hardness' ranging from "0" durometer up to well over 90A. Foster also offers a comprehensive range of pre-formulated "stock grades" available in 35A, 45A, 55A, 65A, 75A and 85A formulations. Depending on the formulation, lower durometer materials may be "tacky" and may not be difficult to de-mold.

Softer durometer TPE's (35A-65A) should not be kept for extended period of time in extreme high temperature environments as the material may "clump" in the box, making feeding more difficult.

ProFlex™ SEBS is easily colorable using pre-color compounding techniques or by masterbatch. For masterbatch processing, it is recommended that either an SEBS specific carrier or Foster's universal medical grade carrier is used. Letdown ratios range from 1% to 5%.

Regrind SEBS polymers can be presented in a melt. Recommended levels should not exceed 20% with residence times in the barrel as low as possible.

Extrusion of ProFlex™ SEBS

Foster ProFlex™ SEBS can be processed by a variety of techniques including thermoplastic extrusion. ProFlex™ SEBS is easily extruded into shapes including single lumen tubing, multi-lumen profiles, wire & cable, and film/sheet, however proper equipment and processing parameters are required for optimum results.

A summary of "best practices" regarding the extrusion of Foster ProFlex™ SEBS is outlined below.

Machine

ProFlex™ SEBS can be extruded on the same machines that are used for the extrusion of polyolefins (PP, PE). Minimum L/D ratio is 20/1 with 24/1 preferred.

Screw Design

Like other styrenic based TPE copolymers, ProFlex™ SEBS does not have a steep melting curve. Melt behavior is highly dependent on screw configuration and screw speed. General purpose screws designed for polyolefins or PVC can be used effectively to extrude ProFlex™ SEBS. These screws have shallow channels, sudden deep compression, and long metering zones. Recommended compression ratio is from 2.5:1 to 4.0:1.

Higher speed screws with mixing sections or mixing pins can also be used when blending color concentrates or other concentrate functionalization into the melt stream.

Recommended screw speeds are 50 – 100 rpm.

Die

As noted above, ProFlex™ SEBS can be extruded into any number of configurations. Screws should have flow paths. Long die adapters should be avoided. Die land lengths should be less than 0.5” depending on the surface finish and profile needed.

Output

ProFlex™ SEBS production output rates are comparable to those of other thermoplastic materials. Lower durometer SEBS (35A-65A) production rates show a decrease of output and an increase in back pressure compared to harder SEBS materials.

Material

For best results, typical extrusion grades of ProFlex™ SEBS have an apparent viscosity of 11 (10,994 (1/sec) @ 210C, Pa- sec) and above.

Typical extrusion processing temperatures of ProFlex™ SEBS are as follows:

Extruder	35A/45A/55A	65A/75A	85A	90A & Above
Rear	320 - 340 °F	330 - 360 °F	340 - 380 °F	340 – 380 °F
Middle	340 – 360 °F	350 – 380 °F	360 – 400 °F	360 – 400 °F
Front	370 – 390 °F	380 – 420 °F	400 – 440 °F	400 – 440 °F
Die	370 - 380 °F	370 - 400 °F	380 - 410 °F	380 - 410 °F

Miscellaneous

ProFlex™ SEBS can be custom formulated for targeted hardness’ ranging from “0” durometer up to well over 90A. Foster also offers a comprehensive range of pre-formulated “stock grades” available in 35A, 45A, 55A, 65A, 75A and 85A formulations. Softer durometer TPE’s (35A-65A), should not be kept for extended period of time in extreme high temperature environments as the material may “clump” in the box, making feeding more difficult.

Foster ProFlex™ SEBS is easily colorable using pre-color compounding techniques or by masterbatch. For masterbatch processing, it is recommended that either an SEBS specific carrier or Foster’s universal medical grade carrier is used. Letdown ratios range from 1% to 5%.

ProFlex™ SEBS can be coextruded with other like materials including other SEBS TPE’s, PP, and PE. Foster also has a unique enhancement technology that allows coextrusion with other amorphous and polar materials.

Softer durometers of ProFlex™ SEBS (35A-65A) are manufactured using an underwater pelletizer and are shipped in a consistent round/oval configuration for easy feeding from the hopper into the injection molding machine. Grades above 65 Shore A will be strand cut, unless otherwise requested.

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