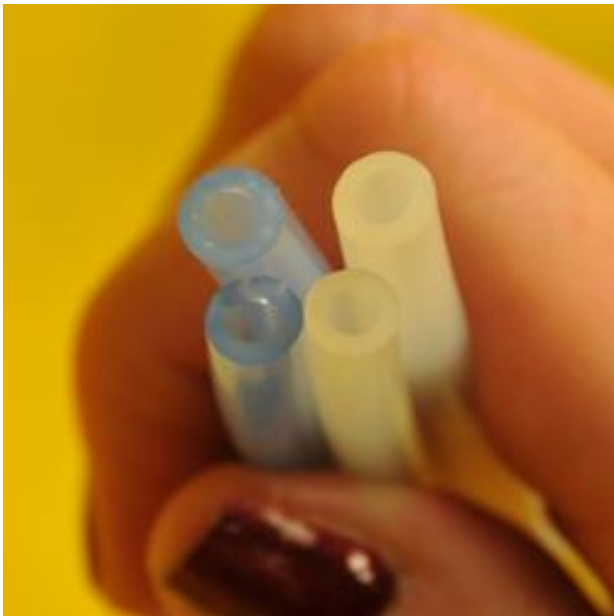


How Silicone Swelling Improves Design and Your Bottom Line

Jay Tourigny

Silicone based thermo polymers have a long history of being some of the most commonly used materials in healthcare. Silicone biocompatibility, flexibility, and resilience make it ideal for use in many medical device applications, but its physical properties can create challenges for design engineers.



This photo illustrates the difference between untreated tube (bottom) and treated tube (top) after 5 minutes exposure to the VMS silicone swelling fluid. Note that the dimensional change is an approximate 30% increased, that will quickly recover back to original dimensions when removed from the swelling agent.

Silicone's inability to expand or stretch without mechanical or chemical assistance coupled with its tacky surface makes assembly with rigid parts difficult. Connecting flexible silicone tubing to barbed fittings or mating molded silicone parts with complex geometries can be frustrating, messy, and time-consuming. As the use of silicone in the medical device industry continues to grow, so does the need for innovative methods that allow design engineers to design the most effective medical devices in the most efficient way possible. That solution is treating the

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silicone part with a specially formulated swelling agent, such as the [MicroCare Medical](#) [1] Swellex silicone swelling agent.

An Efficient Process

Swelling silicone rubber parts allows manufacturers the option of connecting the same size diameter tubing to different fittings with multiple diameters. Selection of a proper swelling agent will provide design flexibility and an effective, efficient, and environmentally superior way to join silicone tubing or molded parts to an assembly. The process of attaching a silicone part or tube to a barbed fitting is as easy as 1-2-3:



Photo of two silicone tube ends being treated in a small vial of the VMS swelling agent. This high purity fluid is water white with minimal odor, and it quickly dries off the surface of a treated part in only a few moments without leaving any residue. Amount of swell in the tubing is determined by exposure times, which are defined by wall thickness and durometer of the part.

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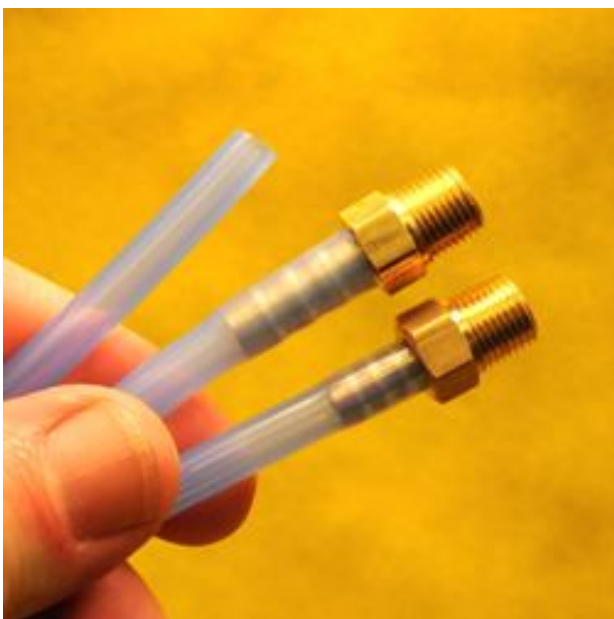
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1. The end of the silicone tube that is to be connected to a barbed fitting is dipped into a vessel of the liquid swelling agent.
2. The swelling of the submerged tube-end will begin almost immediately. The amount of time that the tubing is in the solution will determine how much it swells, so it can be mated with a variety of diameters or irregular geometries. Length of exposure can also be timed accurately in high-volume operations to ensure that efficiency is maximized.
3. Once the treated part is removed from the fluid, the swelling agent will immediately begin to evaporate. As it evaporates, the treated silicone part will return to its original state without any lingering residue. What remains is the silicone rubber component attached to another part with a secure fit.

Experience the Difference

While there are similar methods for connecting molded silicone to fittings or other rigid parts, they are not likely to be as efficient, versatile, or environmentally friendly as an agent formulated for that specific task. Frequently, assembly engineers will resort to lubrication methods to connect silicone tubing with barbed fittings. Isopropyl alcohol (IPA) and silicone oil are two commonly used lubrication methods, both of which are well known to engineers. IPA is used usually as an item of convenience because it is relatively inexpensive and dries without leaving a residue, but is not very effective as a lubricant resulting in unnecessary effort during assembly. On the other hand, silicone oils are good lubricants, but will require a secondary operation to clean the assembly. Silicone oils will also migrate during use and require significant engineering controls to avoid an excessive cleanup at assembly workstations and throughout the facility. These significant drawbacks limit design options and slow down production, especially in a high-assembly environment, costing the manufacturer valuable time and money.

Swelling silicone using hexane-based solvents is another popular method in the industry; however, the odorous and highly aggressive hexane solvents are regulated as a volatile organic compound by the EPA, and they can affect the physical properties of the silicone component or other mating plastic components.



This photo illustrates a 1/8" x 1/4" translucent blue tube unmounted, and also mounted on a 1/8" barb fitting as well as a 1/4" barb fitting. This tube was subjected to a five minute bath in the VMS swelling agent to expand the diameter sufficiently to easily mount to either fitting. Note that the tube is easily mounted on even the bigger size barb, and has recovered without any detrimental impact on strength, color, or cosmetic integrity of the tube.

Use of a swelling agent specifically engineered for the task ensures the material is chemically compatible to silicone polymers, which means the agent not only more effectively swells silicone, but also ensure that the physical properties of the silicone polymer remain intact without changing important elastomeric properties such as tear strength, compression, or color. Unlike hexane solvents, a properly formulated swelling agent will provide enhanced safety in terms of operator exposure and also will not be regulated as a smog producing volatile organic compound.

Additionally, use of a well formulated swelling agent enables the parts to be later separated for repairs or reuse—without damage to either part. It is important to specify a swelling agent with excellent materials compatibility so it does not chemically soften or change the cosmetic or chemical properties of commonly used mating plastic components, such as polycarbonate. Many solvent-based swelling agents may actually attack or soften polycarbonate-based plastics, resulting in either structural embrittlement, or chemically melting the plastic surface to cause it to physically bond to the silicone, so that replacing either part or trying to detach one from the other is infeasible.

Improve Your Bottom Line

A well-engineered silicone swelling agent offers greater ease and more efficient methods of assembling molded silicone parts than previously available, especially in high-speed, high-assembly situations. Eliminating the extra housekeeping or increased drying time that is necessary with other methods saves companies time and money. For designers, the removal of geometry and design limitations typically associated with mating molded silicone polymer parts means that they are free to design with fewer restrictions and have more flexibility in their specifications. The result is a better-designed, lower cost medical device for the healthcare industry.

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[1] <http://www.microcaremedical.com/>

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