MASTERFLEX® Pump Tubing Formulation Descriptions

Silicone Tubing

While our silicone tubing formulations share many characteristics, there are some basic differences.

Platinum-Cured Silicone Tubing

- Slightly greater clarity
- Smooth surface; lower protein binding levels
- Fewer potential leachables
- Ideal for pharmaceutical and biotechnology use

Peroxide-Cured Silicone Tubing

- Greater physical compression capability
- Economical, longer tubing life
- Potential outgassing of peroxide products

BioPharm Silicone Tubing (platinum-cured)

- Ultra-smooth inner surface minimizes particle entrapment
- Very low extractables, with documented biocompatibility for sensitive applications
- Ideal for lab, biotech, and pharmaceutical applications

BioPharm Plus Silicone Tubing (platinum-cured)

- All of the benefits of BioPharm silicone tubing (at left), plus:
- Longest tubing life of any silicone pump tubing
- Lower spallation than regular silicone
- Enhanced pressure capability

C-FLEX® Tubing

- Combines the biocompatibility of silicone with chemical resistance similar to Tygon®
- Very low protein binding
- Heat sealable and weldable
- Economical

To sterilize all silicone tubing:

High-speed instrument (flash) autoclave: Place tubing on nonlinting cloth or sterilizing paper in a clean, open tray for 10 minutes at 132°C (270°F) at 2 kg/cm² (30 psi).

Standard gravity autoclave: Wrap tubing in nonlinting cloth or sterilizing paper and place in a clean, open tray for 30 minutes at 121°C (250°F) at 1 kg/cm² (15 psi).

Pre-vacuum high-temperature autoclave: Wrap tubing in nonlinting cloth or sterilizing paper and place in a clean, open tray for normal cycle of 30 to 35 minutes at 121°C (250°F).

Gamma radiation: 2.5 Mrad.

Pump tubing formulation	Silicone (platinum-cured)	Silicone (peroxide-cured)	BioPharm Silicone (platinum-cured)	BioPharm Plus Silicone (platinum-cured)	C-FLEX (50 A)
Series number	**96410**	**96400**	**96420**	**96440**	**06424**
					
Advantages	Excellent biocompatibility. No leachable additives, DOP, or plasticizers; phthalate and latex-free; odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Extremely good over a wide temperature range. Weather, ozone, corona, and radiation resistant. Minimal tendency to take a set.	Excellent biocompatibility. No additives, plasticizers or DOP; odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Extremely good at low temperatures. Weather, ozone, corona, and radiation resistant. Minimal tendency to take a set.	Ultra-smooth inner surface minimizes particle entrapment. Lower absorption; excellent biocompatibility; no leachable additive, DOP, or plasticizers. Very low extractables. Odorless and nontoxic, fungus-resistant. No taste imparted to transported fluids. Weather, ozone, corona, and radiation resistant.	Similar to BioPharm Silicone, plus: Longest life of any silicone pump tubing. Lower spallation than regular silicone. Enhanced pressure capability. Fungus-resistant. Nontoxic, no leachable plasticizers. Lower gas permeability than other silicones. Use with many acids and alkalies.	Physical properties similar to silicone with chemical compatibility of Tygon. Very low protein binding. Inexpensive. Biocompatible. Heat sealable and weldable.
Limitations	Do not use with concentrated acids and bases, organic solvents, or oils. Relatively high gas permeability.	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.	Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.	Not recommended for use with oils. Moderate pumping life.
Application suitability:					
Acids	Not recommended	Not recommended	Not recommended	Not recommended	Good
Alkalies	Not recommended	Not recommended	Not recommended	Not recommended	Good
Organic solvents	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended
Pressure	Fair	Fair	Fair	Fair	Fair
Vacuum	Good	Good	Good	Good	Good
Viscous fluids	Fair	Fair	Fair	Fair	Fair
Sterile fluids	Excellent	Excellent	Excellent	Excellent	Excellent
Physical characteristics and composition	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material; flexible. Translucent, clear to light amber.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material. Translucent, clear to light amber.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material. Translucent, clear to light amber.	Thermal set rubber. Siloxane polymers and amorphous silica. Excellent compression strength. Soft material.Translucent, clear to light amber.	Thermoplastic elastomer. Styrene-ethylene-butylene modified block copolymer with silicone oil. Excellent tensile and tear strength
Temperature range	–50 to 230°C (–58 to 446°F)	–50 to 230°C (–58 to 446°F)	–60 to 232°C (–75 to 450°F)	–60 to 232°C (–75 to 450°F)	–73 to 135°C (–100 to 275°F)
Meets classifications	USP Class V Extractables; exceeds Class VI Implant; FDA 21 CFR 177.2600; Exceeds 3A Sanitary cGMPs (FDA 21 CFR 210 and 211). European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 criteria European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 Exceeds 3A sanitary standards European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR Part 177.2600 Exceeds 3A sanitary standards European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.1810
Gas permeability $\frac{\text{cc x mm}}{(\text{cm}^2 \text{ x sec x cm Hg}) \text{ x } 10^{-10}}$	CO_2: 20,132 H_2: 6579 O_2: 7961 N_2: 2763	CO_2: 20,132 H_2: 6579 O_2: 7961 N_2: 2763	CO_2: 25,147 H_2: — O_2: 4715 N_2: 2284	CO_2: 25,147 H_2: — O_2: 4715 N_2: 2284	CO_2: — H_2: — O_2: 150 N_2: —
Cleaning/sterilization	Clean with hot water/soap solution; use a non-oily soap such as Ivory®, not synthetic detergent or oil-based soap as they may be absorbed by the tubing and into the fluid. Rinse well with distilled water. Ethylene oxide (ETO) sterilization is not recommended—sufficient data is not available about complete outgassing of residual ETO and other ETO products.	Clean with isopropyl alcohol or hot water/soap solution; use a non-oily soap such as Ivory, not synthetic detergent or oil-based soap as they may be absorbed by the tubing and into the fluid. Rinse thoroughly with distilled water. May use ETO. Autoclavable.	Sterilize by ETO, autoclave, or gamma radiation up to 2.5 Mrad. To autoclave: coil loosely in nonlinting cloth or paper; autoclave at 121°C (250°F), 1 bar (15 psi) for 30 minutes.	Sterilize by ETO, autoclave, or gamma irradiation up to 2.5 Mrad. To autoclave: coil loosely innonlinting cloth or paper; autoclave at 121°C (250°F),1 bar (15 psi) for 30 minutes.	Sterilize by ETO, autoclave, or gamma radiation.

Other Biopharmaceutical Tubing

In addition to silicone, we also carry other pump tubing formulations that are biocompatible and well-suited to biotech and pharmaceutical laboratory or production applications.

PharMed® BPT Tubing

- Over 10,000 hours of tubing life
- Resists ozone and UV radiation
- Noncytotoxic and nonhemolytic
- Ideal for tissue and cell culture work
- Heat sealable and bondable

PharmaPure® Tubing

- Biocompatibility similar to PharMed BPT
- Long life under continuous pressure up to 40 psi (2.7 bar)
- Very low spallation
- Low extractables

Style 100 RF Silicone Tubing

- Long life at continuous pressure up to 60 psi (4 bar)
- Excellent flow stability
- Spallation-free
- Low gas permeability

Style 500 RF FFKM Tubing

- Very similar to STA-PURE (at left), plus:
- Excellent chemical resistance
- Compatible with many inorganic and organic chemicals

Pump tubing formulation	PharMed BPT	PharmaPure	Gore™ Style 100 RF Silicone	Gore Style 500 RF FFKM
Series number	**06508**	**06435**	**96200**	**96210**
				
Advantages	Great for tissue and cell work—nontoxic and nonhemolytic. Long service life minimizes risk of fluid exposure; reduces tubing costs and pump downtime. Opaque to UV and visible light to protect light-sensitive fluids. Low gas permeability. High-pressure (100 psi) version available.	Nontoxic and nonhemolytic (similar to PharMed BPT); biocompatible. Long life even under pressure; up to 1000 hours at 40 psi (2.7 bar). Very low spallation—protects fluid purity. Low extractables. Low gas permeability.	Long life, even under pressures up to 60 psi (4 bar). Excellent flow stability; <1% change in flow rate as tubing wears, no break-in period required. Spallation-free. Excellent biocompatibility. Very low extractables.	Similar to Style 100 RF Silicone tubing but with enhanced chemical resistance. Resistant to many organic and inorganic fluids. Long life at pressure up to 60 psi (4 bar). Spallation-free Excellent biocompatibility. Low gas permeability.
Limitations	Potential leaching of USP mineral oil or blend material.	Potential leaching of USP mineral oil or blend material.	Sold as tube elements only; no continuous lengths available.	Sold as tube elements only; no continuous lengths available.
Application suitability:				
Acids	Good	Good	Not recommended	Excellent
Alkalies	Good	Good	Not recommended	Good
Organic solvents	Not recommended	Not recommended	Not recommended	Excellent
Pressure	Good	Good	Excellent	Excellent
Vacuum	Good	Good	Good	Good
Viscous fluids	Excellent	Excellent	Good	Good
Sterile fluids	Excellent	Good	Excellent	Excellent
Physical characteristics and composition	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, beige.	Thermoplastic elastomer. Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, off-white.	ePTFE (expanded PTFE) and platinum-cured silicone. Excellent tensile strength. Firm (stiff) material. Opaque, white.	ePTFE (expanded PTFE) and fluoroelastomer. Excellent tensile strength. Firm (stiff) material. Opaque, white.
Temperature range	–51 to 132°C (–60 to 270°F)	–67 to 135°C (–89 to 275°F)	–40 to 150°C (–40 to 302°F)	–80 to 200°C (–112 to 392°F)
Meets classifications	USP Class VI FDA 21 CFR 177.2600 NSF-listed (Standard 51). European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.2600 European Pharmacopoeia (EP)	USP Class VI FDA 21 CFR 177.1550
Gas permeability $\frac{\text{cc x mm}}{(\text{cm}^2 \text{ x sec x cm Hg}) \text{ x } 10^{-10}}$	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 20,132 H_2: 6579 O_2: 7961 N_2: 2763	CO_2: 76 to 79 H_2: — O_2: — N_2: 4.3
Cleaning/sterilization	Sterilize by ETO, autoclave, or gamma radiation up to 2.5 Mrad. Repeated autoclaving will not affect overall life.	Sterilize by ETO, autoclave or gamma radiation up to 2.5 Mrad. Repeated autoclaving will not affect overall life.	Sterilize by ETO, autoclave or SIP (steam in place). Repeated autoclaving will not affect overall life.	Sterilize by ETO, autoclave or SIP (steam in place). Repeated autoclaving will not affect overall life.

MASTERFLEX® Pump Tubing Formulation Descriptions

Tygon® Tubing

Our Tygon tubing comes in five separate formulations that share common characteristics but differ in tubing life and other specifications. See descriptions below for details about each formulation.

Tygon Lab Tubing

- Ideal for general transfer applications
- Economical
- Nontoxic, nonaging, and nonoxidizing

Tygon LFL Tubing

- Longest tubing life of all Tygon tubing formulations
- Broad chemical compatibility
- Low gas permeability

Tygon Food Tubing

- Meets various food and sanitary regulations
- Unaffected by all commercial sanitizers
- Nonwetting properties allow flush-cleaning and complete drainage
- Smooth inner surface

Tygon Fuel & Lubricant Tubing

- Ideal for transferring hydrocarbons, gasoline, kerosene, heating oils, cutting compounds, and glycol-based coolants
- Not for use with concentrated strong acids or alkalies

Tygon Chemical Tubing

- Best chemical resistance of Tygon formulations
- Compatible with some organics
- Plasticizer-free

Sterilization

Ethylene oxide (ETO): Coil tubing loosely in nonlinting cloth or sterilization paper. Follow the sterilization equipment manufacturer's directions as to gas type, concentration, times, and temperatures; maintain humidity within the prescribed limits, generally between 30 to 65%.

Standard gravity autoclave: Coil tubing loosely in nonlinting cloth or sterilizing paper, and place in a clean, open tray for 30 minutes at 121°C (250°F) at 1 kg/cm² (15 psi); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.

Gamma radiation: Cap ends of tubing if required. Radiation should be product specific and according to GMP guidelines.

Pump tubing formulation	Tygon Lab (R-3603)	Tygon LFL	Tygon Food (B-44-4X)	Tygon Fuel & Lubricant (F-4040-A)	Tygon Chemical (2001)
Series number	**06409**	**06429**	**06419**	**06401**	**06475**
					
Advantages	Inexpensive tubing for general laboratory applications. Clear for easy flow monitoring Handles virtually all inorganic chemicals. Nonaging, nonoxidizing. Low gas permeability. Good for viscous fluids. High dielectric constant.	Longest life of all Tygon peristaltic tubing (up to 1000 hrs). Clear for easy flow monitoring. Broad chemical resistance. Nonaging, nonoxidizing. Low gas permeability. Smooth bore. Good for viscous fluids. High dielectric constant.	Designed especially for handling food products. Bore is extremely smooth (better than most stainless steels) Nontoxic, will not affect taste or odor, and clear for CIP and flow verification. Excellent nonwetting properties permit flush cleaning and complete drainage. High dielectric constant.	Specially formulated to transport hydrocarbons, petroleum products, and distillates. Suitable for gasoline, kerosene, heating oils, cutting fluids, and glycol-based coolants. Minimum extractability. Low gas permeability. High dielectric constant.	Best chemical resistance of any Tygon formulation. Compatible with many polar solvents. Plasticizer-free. Clear for easy flow monitoring. Low extractability. Low gas permeability. High dielectric constant.
Limitations	Limited pumping life. Potential leaching of plasticizer.	Potential leaching of plasticizer.	Limited pumping life.	Don't use with strong acids and alkalies.	Limited pumping life. Some external spallation during use (does not affect tubing ID). Recommended for use with Easy-Load®, Easy-Load II, and Easy-Load 3 pump heads only.
Application suitability:					
Acids	Good	Good	Good	Good	Excellent
Alkalies	Good	Good	Good	Good	Excellent
Organic solvents	Not recommended	Not recommended	Not recommended	Not recommended	Good
Pressure	Good	Good	Good	Good	Good
Vacuum	Good	Good	Good	Good	Good
Viscous fluids	Excellent	Excellent	Excellent	Excellent	Excellent
Sterile fluids	Poor	Good	Good	Poor	Good
Physical characteristics and composition	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, clear.	Thermoplastic. PVC-based material with plasticizer. Firm (stiff) material. Transparent, yellow.	Thermoplastic elastomer. PVC- and plasticizer-free material. Firm (stiff) material. Transparent, clear.
Temperature range	–50 to 74°C (–58 to 165°F)	–50 to 74°C (–58 to 165°F)	–44 to 74°C (–47 to 165°F)	–37 to 74°C (–35 to 165°F)	–77 to 57°C (–108 to 135°F)
Meets classifications	FDA 21 CFR 175.300	USP Class VI FDA 21 CFR 175.300	FDA 21 CFR 175.300 NSF-listed (Standard 51)	None	USP Class VI FDA 21 CFR 177.2600
Gas permeability $\frac{\text{cc x mm}}{(\text{cm}^2 \text{ x sec x cm Hg}) \times 10^{-10}}$	CO_2: 360 H_2: 97 O_2: 80 N_2: 40	CO_2: 563 H_2: — O_2: 124 N_2: 67	CO_2: 270 H_2: 97 O_2: 60 N_2: 30	CO_2: 100 H_2: 97 O_2: 22 N_2: 12	CO_2: 114 H_2: — O_2: 19 N_2: 9
Cleaning/sterilization	Sterilize with ETO or autoclave. To autoclave: Coil tubing loosely in nonlinting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm² (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Sterilize with ETO or autoclave. To autoclave: Coil tubing loosely in nonlinting cloth or paper, autoclave at 121°C (250°F), 1 kg/cm² (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Unaffected by commercial sanitizers (with recommended procedures). Sterilize by ETO or autoclave. To autoclave: Coil tubing loosely in nonlinting cloth or paper; autoclave at 121°C (250°F), 1 kg/cm² (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.	Sterilization is not recommended.	Sterilize by ETO, autoclave, or gamma radiation. To autoclave: Coil tubing loosely in nonlinting cloth or paper; autoclave at 121°C (250°F), 1 kg/cm² (15 psi) for 30 minutes (tubing will appear milky); air dry at max 66°C (150°F) for 2 to 2½ hours until clear.

Other Industrial and Food-Grade Tubing

Norprene® Tubing

- Up to 10,000 hours of tubing life
- Best choice for pressure/vacuum applications
- Resists heat, ozone, acids, and alkalies
- Heat sealable and bondable
- Nonaging, nonoxidizing

Norprene Food Tubing

- Ideal for high-temperature food and beverage applications
- Similar characteristics as Norprene tubing
- Meets FDA and NSF standards

Viton® Tubing

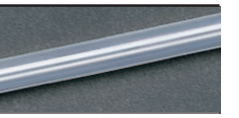
- Excellent chemical resistance
- Resists corrosives, solvents, and oils at elevated temperatures

FDA Viton Tubing

- Similar to Viton (above), but with FDA approval
- Excellent chemical resistance

PTFE Tubing

- Chemically inert; best chemical resistance of any pump tubing
- Sold in molded pump tubing elements
- Use with PTFE tubing pump head

Pump tubing formulation	Norprene (A 60 G)	Norprene Food (A 60 F)	Viton	FDA Viton	PTFE
Series number	**06404**	**06402**	**06412**	**96412**	**77390**
					
Advantages	Best choice for vacuum/ pressure applications. Offers longest pump tubing life. Heat and ambient ozone resistant. Good resistance to acids/alkalies. Black color hides dirt and dust. Heat sealable, nonaging, and nonoxidizing. High dielectric constant. High-pressure version available.	Similar to Norprene (06404) but with FDA approval. Excellent for food/dairy applications. Longest life, good flow consistency. Heat and ozone resistant. Good resistance to acids/alkalies. Heat sealable, nonaging, and nonoxidizing. High dielectric constant.	Excellent chemical resistance. Resistant to corrosives, solvents, and oils at elevated temperatures. Low gas permeability.	Similar to Viton (06412) but with FDA approval. Perfect for food and lab applications where FDA compliance is required. Excellent chemical resistance. Resistant to corrosives, solvents, and oils at elevated temperatures. Low gas permeability.	Chemically inert. Excellent chemical resistance. Will not leach into or absorb out of fluid being pumped. Extremely low gas permeability. Nontoxic. Virtually nonporous. Low coefficient of friction.
Limitations	Potential leaching of USP mineral oil or blend material.	Potential leaching of USP mineral oil or blend material.	Limited pumping life.	Limited pumping life.	Limited pumping life.
Application suitability:					
Acids	Good	Good	Excellent	Excellent	Excellent
Alkalies	Good	Good	Excellent	Excellent	Excellent
Organic solvents	Not recommended	Not recommended	Variable—test before using	Variable—test before using	Excellent
Pressure	Excellent	Excellent	Good	Good	Good
Vacuum	Excellent	Excellent	Good	Good	Good
Viscous fluids	Excellent	Excellent	Good	Good	Excellent
Sterile fluids	Not recommended	Good	Fair	Fair	Good
Physical characteristics and composition	Thermoplastic elastomer Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, black.	Thermoplastic elastomer Polypropylene-based material with USP mineral oil. Excellent tensile strength. Firm (stiff) material. Opaque, beige.	Thermal set rubber. Viton B (67% fluorine). Firm (stiff) material. Opaque, black.	Thermal set rubber. Viton B (67% fluorine). Firm (stiff) material. Opaque, black.	Polytetrafluoroethylene. Rigid material. Translucent, white.
Temperature range	–59 to 135°C (–60 to 270°F)	–59 to 135°C (–60 to 270°F)	–32 to 205°C (–25 to 400°F)	–32 to 205°C (–25 to 400°F)	–240 to 260°C (–400 to 500°F)
Meets classifications	None	FDA 21 CFR 177.2600 NSF-listed (Standard 51)	None	FDA 21 CFR 177.2600	USP Class VI FDA 21 CFR 177.1500
Gas permeability $\frac{\text{cc x mm}}{(\text{cm}^2 \text{ x sec x cm Hg}) \text{ x } 10^{-10}}$	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 1200 H_2: — O_2: 200 N_2: 80	CO_2: 76 to 79 H_2: — O_2: 13 to 15 N_2: 4.3	CO_2: 76 to 79 H_2: — O_2: 13 to 15 N_2: 4.3	CO_2: 6.8 H_2: — O_2: — N_2: 1.0
Cleaning/sterilization	Sterilize by autoclave. Repeated sterilization will not affect overall life.	Sterilize by autoclave. Repeated autoclaving will not affect overall life.	Sterilization is not recommended.	Sterilize by using a circulating hot air oven at 249°C (480°F) for 16 hours.	Sterilize by ETO, autoclave or dry heat.