### 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

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### Table: Pump Tubing Formulation Descriptions

<table>
<thead>
<tr>
<th>Pump tubing formulation</th>
<th>Silicone (platinum-cured)</th>
<th>Silicone (peroxide-cured)</th>
<th>BioPharm Silicone (platinum-cured)</th>
<th>BioPharm Plus Silicone (platinum-cured)</th>
<th>C-FLEX® (5A)</th>
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<tbody>
<tr>
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<td>96400</td>
<td>96429</td>
<td>96440</td>
<td>06424</td>
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<td><strong>Limitations</strong></td>
<td>Do not use with concentrated acids and bases, organic solvents, or oils. Relatively high gas permeability.</td>
<td>Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.</td>
<td>Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.</td>
<td>Do not use with concentrated solvents, oils, acids. Relatively high gas permeability.</td>
<td>Not recommended for use with oils. Moderate pumping life.</td>
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<tr>
<td><strong>Application suitability:</strong></td>
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<td>Not recommended</td>
<td>Not recommended</td>
<td>Good</td>
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<tr>
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<td>Not recommended</td>
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<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
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<td>Pressure</td>
<td>Fair</td>
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<td>Good</td>
<td>Good</td>
<td>Fair</td>
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<tr>
<td>Vacuum</td>
<td>Good</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Fair</td>
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<tr>
<td>Viscous fluids</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
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<tr>
<td>Sterile fluids</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Temperature range</strong></td>
<td>–50 to 230°C (1-58 to 468°F)</td>
<td>–50 to 230°C (1-58 to 468°F)</td>
<td>–60 to 232°C (–75 to 460°F)</td>
<td>–60 to 232°C (–75 to 460°F)</td>
<td>–73 to 130°C (–100 to 270°F)</td>
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<td><strong>Gas permeability</strong></td>
<td>CO₂: 20,132</td>
<td>CO₂: 20,132</td>
<td>CO₂: 25,147</td>
<td>CO₂: 25,147</td>
<td>CO₂: —</td>
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<tr>
<td>(cc/m² x sec x cm Hg) x 10⁻¹⁰</td>
<td>H₂: 6579</td>
<td>H₂: 6579</td>
<td>H₂: 4715</td>
<td>H₂: 4715</td>
<td>H₂: —</td>
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</table>

**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 isopropl 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.

**Sterilization by ETO, autoclave, or gamma radiation to 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.

- Sterilization by ETO, autoclave, or gamma irradiation 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.
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.

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

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

**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

<table>
<thead>
<tr>
<th>Pump tubing formulation</th>
<th>PharMed BPT</th>
<th>PharmaPure</th>
<th>Gore™ Style 100 RF Silicone</th>
<th>Gore Style 500 RF FFKM</th>
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<tbody>
<tr>
<td>Series number</td>
<td>06508</td>
<td>06435</td>
<td>96200</td>
<td>96210</td>
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</table>

### Advantages
- 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.

### Limitations
- Potential leaching of USP mineral oil or blend material.
- Potential leaching of USP mineral oil or blend material.

### Application suitability:
- **Acids**
  - Good
  - Good
  - Good
  - Not recommended
  - Good
  - Good
  - Good
  - Not recommended
- **Organic solvents**
  - Good
  - Good
  - Good
  - Not recommended
- **Pressure**
  - Good
  - Good
  - Good
  - Not recommended
- **Vacuum**
  - Good
  - Good
  - Good
  - Not recommended
- **Viscous fluids**
  - Good
  - Good
  - Good
  - Not recommended
- **Sterile fluids**
  - Excellent
  - Excellent
  - Excellent
  - Excellent

### Physical characteristics and composition
- **PharmPure**
  - Thermoplastic elastomer.
  - Polypropylene-based material with USP mineral oil.
  - Excellent tensile strength.
  - Firm (stiff) material.
  - Opaque, beige.
- **PharMed**
  - Thermoplastic elastomer.
  - Polypropylene-based material with USP mineral oil.
  - Excellent tensile strength.
  - Firm (stiff) material.
  - Opaque, off-white.
- **Gore**
  - ePTFE (expanded PTFE) and platinum-cured silicone.
  - Excellent tensile strength.
  - Firm (stiff) material.
  - Opaque, white.

### Temperature range
- –51 to 132°C
  - –67 to 139°C
  - –40 to 150°C
  - –80 to 200°C
- (+40 to 270°F)
  - (+40 to 275°F)
  - (+40 to 302°F)
  - (+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

<table>
<thead>
<tr>
<th>Gas permeability</th>
<th>CO₂ 1200</th>
<th>O₂ 200</th>
<th>H₂ 80</th>
<th>CO₂ 1200</th>
<th>O₂ 200</th>
<th>N₂ 80</th>
<th>CO₂ 30,132</th>
<th>H₂ 6579</th>
<th>O₂ 7961</th>
<th>N₂ 2763</th>
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<tbody>
<tr>
<td>cc x mm (cm² x sec x cm Hg) x 10⁻¹⁰</td>
<td>40 to 270°F</td>
<td>40 to 275°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
<td>40 to 302°F</td>
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</tbody>
</table>

### 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.
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

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<table>
<thead>
<tr>
<th>Pump tubing formulation</th>
<th>Tygon Lab (R-3603)</th>
<th>Tygon LFL</th>
<th>Tygon Food (B-64-4X)</th>
<th>Tygon Fuel &amp; Lubricant (F-6040-A)</th>
<th>Tygon Chemical (2001)</th>
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<tr>
<td>Series number</td>
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<td>06429</td>
<td>06419</td>
<td>06401</td>
<td>06475</td>
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</table>

### 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.

### Limitations
- Limited pumping life.
- Potential leaching of plasticizer.
- Limited pumping life.
- Don’t use with strong acids and alkalies.
- Limited pumping life.

### Application suitability:
- **Acids:**
  - Good
  - Good
  - Good
  - Good
  - Poor

- **Alkalis:**
  - Good
  - Good
  - Good
  - Good
  - Good

- **Organic solvents:**
  - Good
  - Not recommended
  - Good
  - Good
  - Excellent

- **Pressure:**
  - Good
  - Good
  - Good
  - Good
  - Excellent

- **Vacuum:**
  - Good
  - Good
  - Good
  - Good
  - Good

- **Viscous fluids:**
  - Good
  - Good
  - Good
  - Good
  - Good

- **Sterile fluids:**
  - Good
  - Good
  - Good
  - Good
  - Good

### Physical characteristics and composition
- **Thermoplastic.** PVC-based material with plasticizer.
  - 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 160°F)
- -37 to 74°C (-35 to 160°F)
- -7 to 57°C (-10 to 130°F)

### Meets classifications
- FDA 21 CFR 175.300
- USP Class VI
- FDA 21 CFR 175.300
- USP Class VI
- None

### Gas permeability
- CO₂: 360
- H₂: 97
- O₂: 80
- N₂: 40
- CO₂: 580
- H₂: —
- O₂: 124
- N₂: 67
- CO₂: 270
- H₂: 97
- O₂: 60
- N₂: 35
- CO₂: 100
- H₂: 97
- O₂: 22
- N₂: 12
- CO₂: 114
- H₂: —
- O₂: 19
- N₂: 9

### Cleaning/sterilization
- **Sterilize with ETO or autoclave.** To autoclave: Coil tubing loosely in nonlining 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 chemical sanitizers (with recommended procedures).** Sterilize by ETO or autoclave. To autoclave: Coil tubing loosely in nonlining 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.

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**Sterilization**

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

**Standard gravity autoclave:** Coil tubing loosely in nonlining cloth or sterilizing paper; 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.

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**TD-10**
### 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 alkalis
- 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

<table>
<thead>
<tr>
<th>Pump tubing formulation</th>
<th>Norprene (A 60 G)</th>
<th>Norprene Food (A 60 F)</th>
<th>Viton</th>
<th>FDA Viton</th>
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<td>Series number</td>
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<td>06402</td>
<td>06412</td>
<td>96412</td>
<td>77390</td>
</tr>
</tbody>
</table>

#### Advantages
- Best choice for vacuum/pump applications.
- Offers longest pump tubing life.
- Heat and ambient ozone resistant.
- Good resistance to acids/alkalis.
- Black color hides dirt and dust.
- Heat sealable, nonaging, and nonoxidizing.
- High dielectric constant.
- High pressure version available.

#### Limitations
- Potential leaching of USP mineral oil or blend material.
- Limited pumping life.

#### Application suitability:
- **Acids**
  - Good
  - Not recommended
- **Alkalis**
  - Good
  - Not recommended
- **Organic solvents**
  - Good
  - Not recommended
- **Pressure**
  - Good
  - Not recommended
- **Vacuum**
  - Good
  - Not recommended
- **Viscous fluids**
  - Good
  - Not recommended
- **Sterile fluids**
  - Good
  - Not recommended

#### Physical characteristics and composition
- Thermostable elastomer.
- Polypropylene-based material with USP mineral oil.
- Excellent tensile strength.
- Firm (stiff) material.
- Opaque, black.

#### Temperature range
- –59 to 135°C
- (–60 to 270°F)

#### Meets classifications
- None
- FDA 21 CFR 177.2600
- NSF-listed (Standard 51)

#### Gas permeability
- CO₂: 1200
- H₂: —
- O₂: 200
- N₂: 60

#### Cleaning/sterilization
- Sterile by autoclave.
- Repeated sterilization will not affect overall life.

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### Norprene® Tubing Formulations

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<th>Series Number</th>
<th>Description</th>
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<tr>
<td>A 60 F</td>
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<td>Norprene Food</td>
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### Norprene® Food Tubing Formulations

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### Viton® Tubing Formulations

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### FDA Viton Tubing Formulations

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### PTFE Tubing Formulations

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