

Achieving Operational Success with Masterflex[®] and Avantor Fluid Handling

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Why Masterflex[®] Peristaltic Pumps for BioPharma?



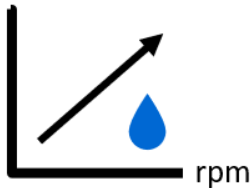
Simple Process Validation

- Fluid is completely contained in the tube and tubing is made from validated virgin, biocompatible materials



Cell Vitality/Molecular Integrity

- Peristaltic pumps are low shear, reducing the physical impact on cells and large molecules, increasing overall cell vitality for a more effective product/API.



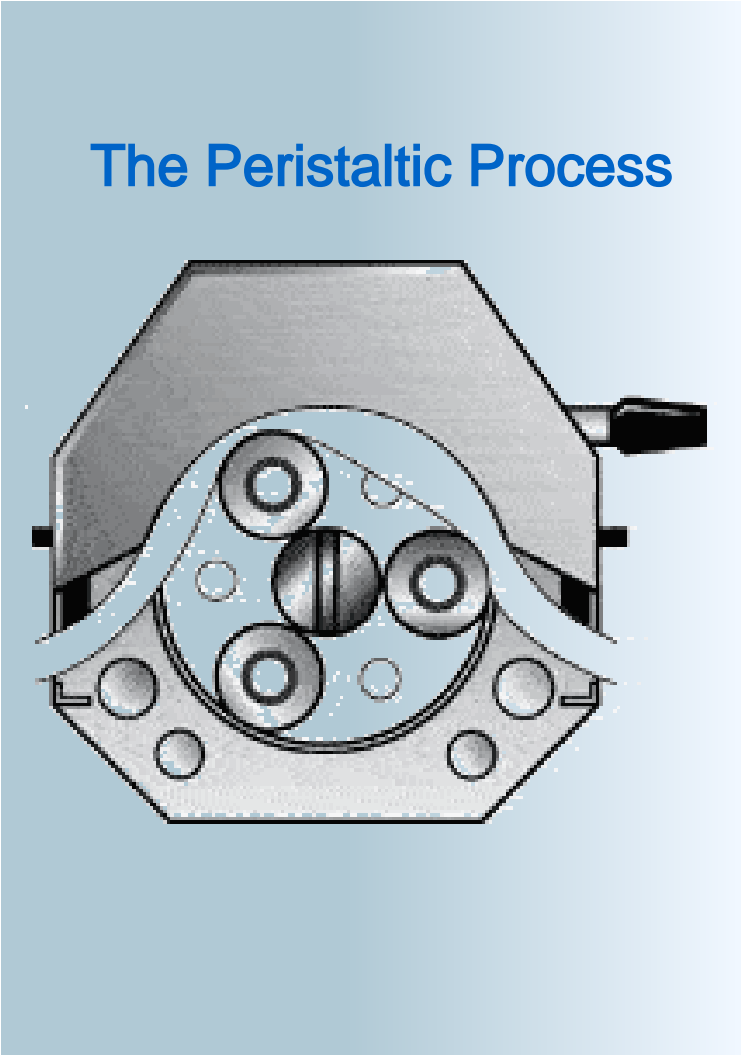
Accurate & Linear Fluid Delivery

- Positive displacement ensures high -accuracy volumetric flows across pressure ranges and viscosities in a linear relationship to rpm; the occlusion ensures no product slippage

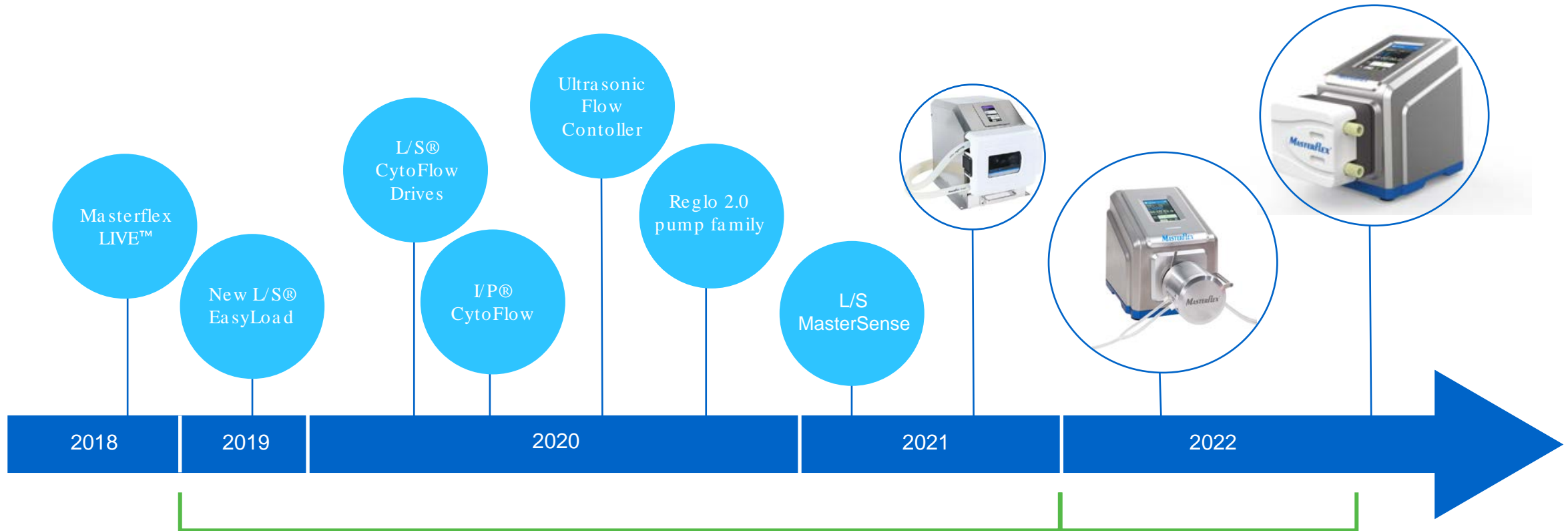


Masterflex[®] Exclusive: Fluid Path Ownership

- Masterflex[®] offers control over almost every aspect of the fluid path such as pump, tubing, components, sensors, and the world class assembly services to bring it all together and deliver on your schedule



Our growth gives you more choices



15+ New products



10+ New product patents



4+ New product launches

TUBING

- 24+ formulations
- Designed for demanding peristaltic pump
- Compliance and traceability

SINGLE-USE CUSTOM ASSEMBLIES

- Build To Suit
- ISO 7, 13485 certified cleanroom capacity

FLUID PATH FITTINGS & COMPONENTS

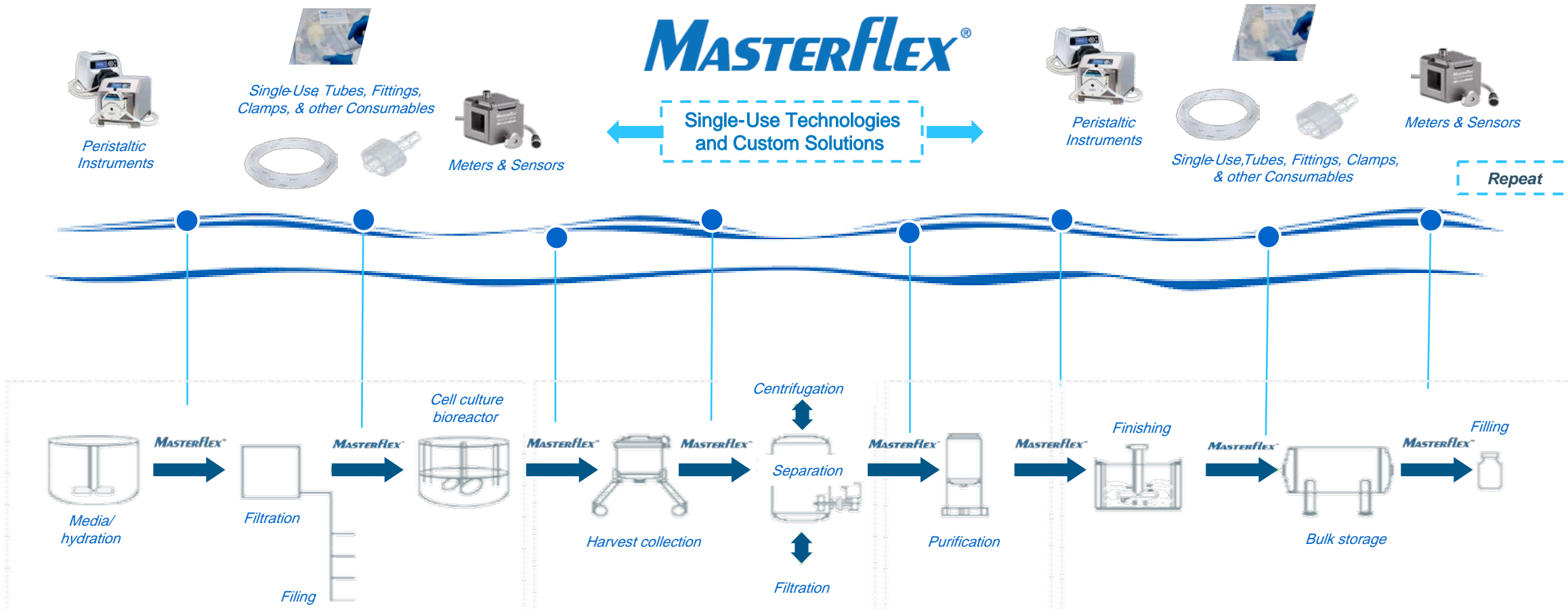
- Wide Selection
- Compliance and traceability

SENSORS AND CONTROLLERS

- Critical process sensing: pressure, temperature
- Non-invasive and single use
- Connectivity with Masterflex[®] pumps



End-to-End Engineered Pumps & Single-Use Technologies



Masterflex® provides the only end-to-end engineered solution for critical fluids at guaranteed flow rates only when all used together

Masterflex® MasterSense™ Pump Products

POSITIVE DISPLACEMENT

SCALE-UP SIMPLICITY

ROBUST CONNECTIVITY



**Microflow
Ismatec® Series**
> 0.0001 to 300 mL/min



**High-Accuracy
L/S Series**
> Up to 3.4 LPM



**Powerful Systems
I/P Series**
> Up to 26 LPM



**Highest Flow Rate
B/T Series**
> up to 42 LPM

MasterSense™ Pressure Sensing Technology

Pump Head
+ Tubing + Drive



Flexible
Solutions



Drive

20+ configurations

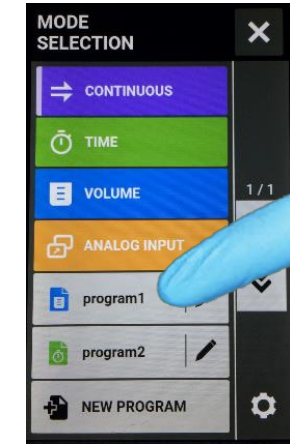
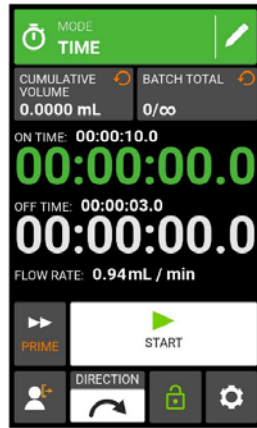
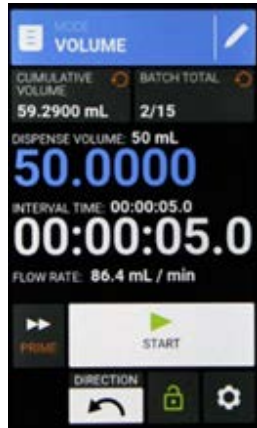
Pump Head

12+ options & stackable

Tubing

22+ Formulations

New Interface Design – MasterSense Pumps



VOLUME, TIME, CONTINUOUS
DISPENSING MODES

3 LEVEL
AUTHENTICATION

SAVE & RECALL
PROGRAMS



Performance Reimagined L/S® MasterSense

Pump lets you save and retrieve commonly used dispense programs for rapid setup

Over-the-air firmware updates
– Direct download or transfer via flash drive
– Unique to Masterflex

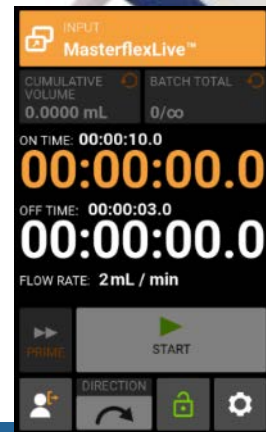
Flexible operational control via touchscreen, MasterflexLive®, analog remote control, or EtherNet/IP™ or Profibus network protocols



5" (12.7 cm) capacitive TFT/RGB touch screen for crisp resolution and a wide viewing angle; glove compatible

Continuous run, volume dispense, and time dispense modes – batch control and interval/off time in volume and time modes

Compact size optimizes ease of use, accuracy, and reliability; accepts all L/S® pump heads and tubing formulations



Masterflex® MasterSense™ Integrated Pressure Monitoring



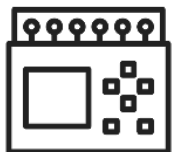
We have integrated the most widely used pressure sensing technology with industry-leading peristaltic pumping technology to create a unique way for our customers to monitor their inline fluid pathway pressure.

Easy As 1, 2, 3!

1. Install in-line pressure sensor
2. Connect sensor and pump

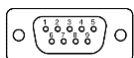


3. Configure alarms and start pump



Plug & play with the latest technology

- EtherNET/IP[®] with preconfigured EDS file
- PROFIBUS command codes



Easy integration into legacy systems

- Analog I/O (4 -20 mA, 0-10 V, TTL)



Cloud based control with MASTERFLEXLIVE[™]

- Monitor, control and run programs
- Safe & secure access to operational history



Over the Air Firmware Updates

- Download directly into the pump
- Option for USB or connect your pump



Pump Head Selection: L/S®



Standard



Easy-Load®



Easy-Load® II



Easy-Load® 3



High-Performance



Cytoslow®



PTFE-Tubing



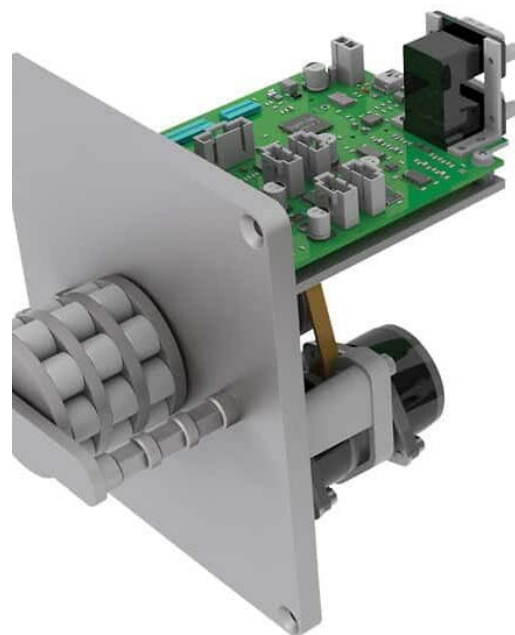
Multichannel

Pump Head Selection: OEM & Panel Mount Options

— **Complete Pump Assemblies also include:**

- Motors
- Brackets
- DIN Rails
- Shafts
- Couplings
- Enclosures

- **Reglo ICC:**
Multichannel pump up to 35mL for small spaces



- **Microflex:** Simple single-channel pump up to 50mL with cover shield



- **Miniflex:** Single or Double channel pump up to 350mL flows



Tubing Selection: Why Masterflex®?



Precise Extrusion Meeting Exacting Standards

- Dimensions & Tolerances Matter – We Control Closely
- Optimal Performance in Masterflex Pump Heads
- Lot to Lot consistency
- Factory tested and optically inspected



Engineered for Optimal Life & Performance

- Formulated for peristaltic pump dynamics
- Subjected to rigorous pump performance testing



Compliance with Multiple Regulations

- EX: USP VI, FDA 21 CFR, 3A Sanitary, cGMP, Reach, ROHS, ADCF, NSF-51
- Lot control, fully traceable
- Certification & Validation Support



Risk Mitigation

- 20+ formulations with permanent inventory
- Product Availability
- Speed Scale Up –
 - Multiple sizes across formulations
 - R&D, pilot, and production
- Proven Pumping Performance
- Regulatory Support
- Expertise in product selection

Fluid Path Components Selection



BARBED FITTINGS



MICROBORE CONNECTORS



FITTINGS KITS



COMPRESSION FITTINGS



FLARE FITTINGS



THREADED FITTINGS



PINCH CLAMPS



LUER FITTINGS AND ASSEMBLES



QUICK DISCONNECTS



ASEPTIC FITTINGS



SANITARY FITTINGS



SANITARY GASKETS AND CLAMPS



IN-LINE FILTRATION



DISPENSING NOZZLES



IN-LINE STATIC MIXERS

Masterflex® Single-Use Sensors



High accuracy 1%, low viscosity, low set-up and operating cost

MASTERFLEX® SINGLE-USE SENSORS



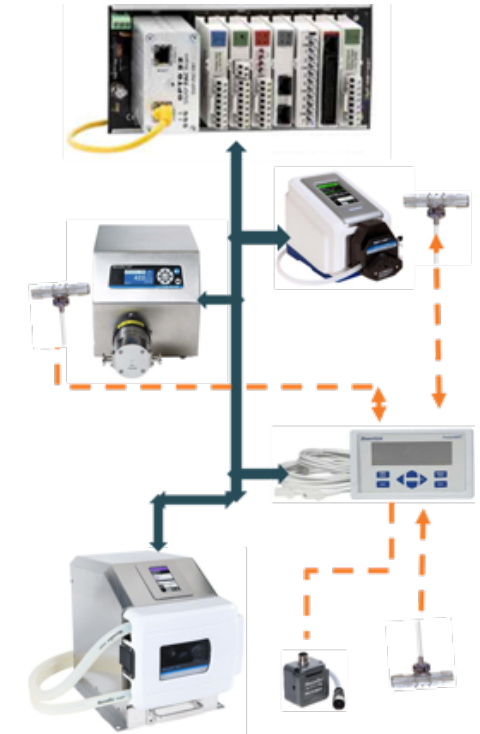
Non-contact, high accuracy reusable with accurate dispense and flow control

MASTERFLEX® ULTRASONIC SENSORS AND CONTROLLER



Leading brand, pressure and temperature sensing

PENDOTECH SINGLE-USE SENSORS



INTEGRATION READY FOR YOUR SYSTEM



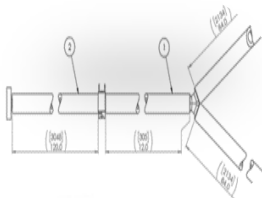
Sanitary Overmold Assemblies

- Silicone, TPEs



Masterflex® Sampling Bottles

- Square – 125 to 2000 mL, Conical



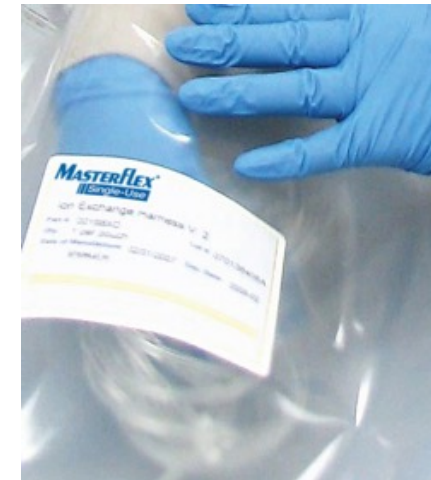
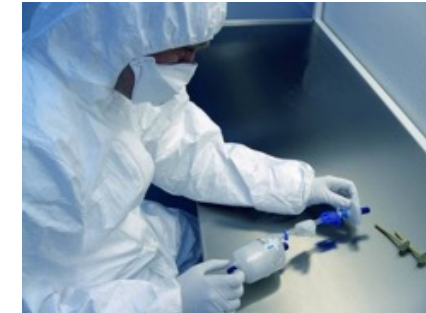
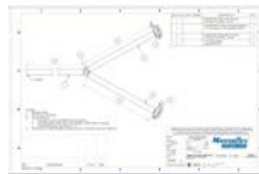
Double Ys

- Silicones, TPEs, Specialties



Masterflex® Single-Use Bundles

- Custom Assemblies or Cut to Length Tubing





Connect With Us For Single-Use Simplicity

Get the convenience of our industry -leading consulting, comprehensive product offering and custom assemblies for complete workflows.

3 LEVELS OF STERILITY

SIMPLE ASSEMBLY

GAMMA IRRADIATION/
MICROBIALLY CONTROLLED

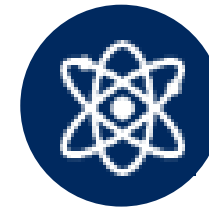
VALIDATED STERILE



ISO CLASS 7
(CLASS 10,000) CLEANROOM



CERTIFIED, COMPLIANT, AND
REGISTERED



GAMMA IRRADIATION



LOT TRACEABILITY

Custom Engineered Solutions

CONCEPT	<ul style="list-style-type: none">- Starts with understanding your performance and cost requirements
DESIGN	<ul style="list-style-type: none">- Innovative solutions utilizing the latest tools such as performance modeling & 3D CAD
ENGINEERING	<ul style="list-style-type: none">- Concept Design and Fabrication done in centralized Location
TESTING	<ul style="list-style-type: none">- Performance testing to actual conditions- Compliance to UL, ETL, and CE under ISO:9001 and ISO:13485 standards
SERVICES	<ul style="list-style-type: none">- After-sales support, quality assurance audits



A finished prototype



Questions