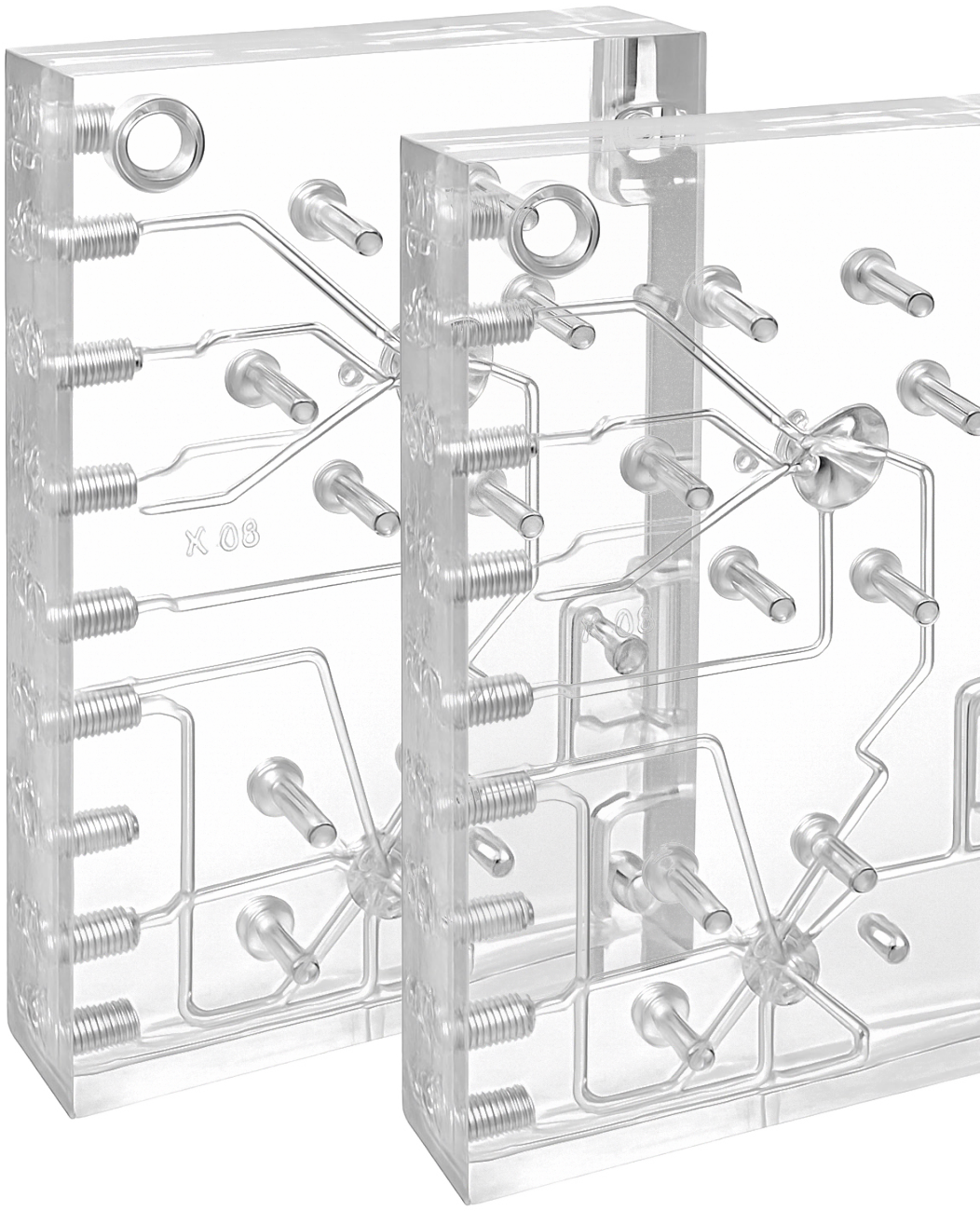
COC & COP Manifold Technology

Advanced Fluidic Solutions for Next-Generation Life Science Instruments



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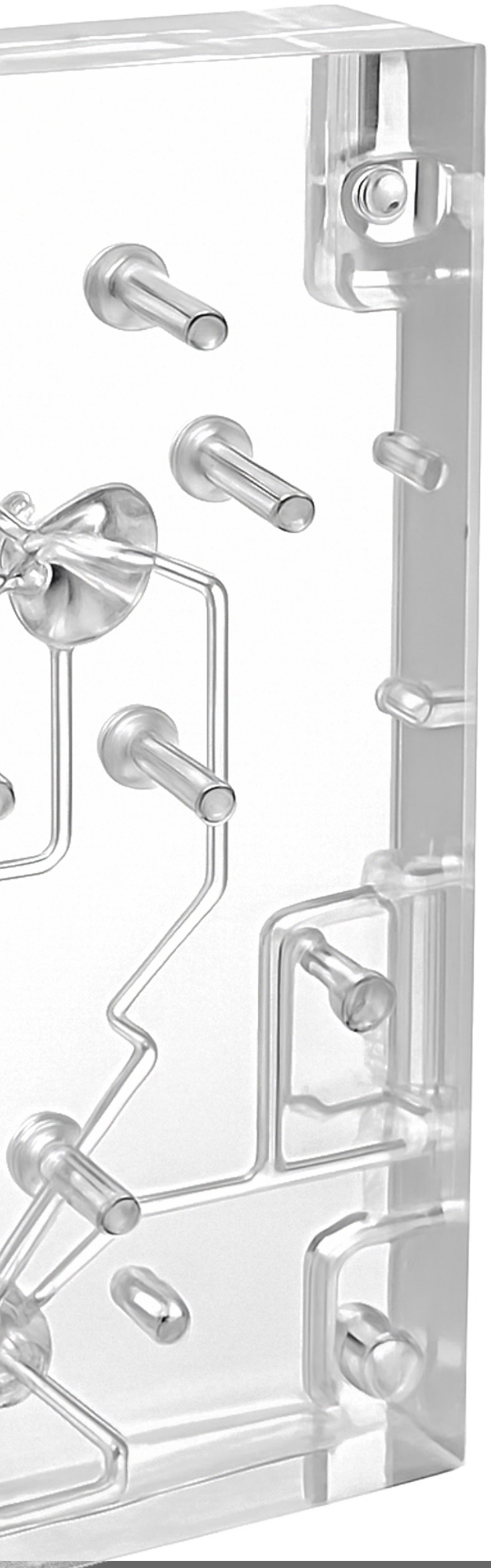


Advanced Fluidic Solutions for Next-Generation Life Science Instruments

As life science instrumentation advances toward higher sensitivity, faster throughput, and greater diagnostic reliability, fluidic system design has become increasingly critical. Modern diagnostic and analytical platforms must detect extremely small concentrations of biomarkers while maintaining precise control over sample handling, reagent distribution, and cleaning cycles.

AFP's COC and COP manifold technology addresses these demands by combining advanced polymer materials with innovative bonding processes to create highly reliable, contamination-free fluidic architectures. Compared with traditional materials such as acrylic, Ultem, and polycarbonate, COC and COP offer significantly improved chemical resistance to aggressive polar solvents, acids, bases, and harsh wash fluids commonly used in diagnostic workflows.

This enhanced chemical compatibility allows instrument manufacturers to implement stronger cleaning protocols without risking material degradation, swelling, or leaching within the fluid path. The result is reduced sample carryover, improved assay accuracy, and greater reproducibility—supporting the use of increasingly sensitive reagents for detecting trace levels of biomarkers or diseased cells.

In addition to chemical durability, COC and COP provide excellent optical clarity, low autofluorescence, UV transparency, and biocompatibility. When combined with diffusion bonding, these materials enable highly stable manifold structures that improve fluidic performance, system reliability, and overall instrument efficiency—representing a groundbreaking new technology that delivers unrivaled performance gains through COC and COP diffusion bonded manifolds.

Key Highlights

- Reduced sample carryover
- Superior chemical compatibility
- Clean diffusion bonding technology
- Reliable microfluidic performance

Industry Drivers

The Challenge: Increasing Sensitivity in Modern Diagnostics

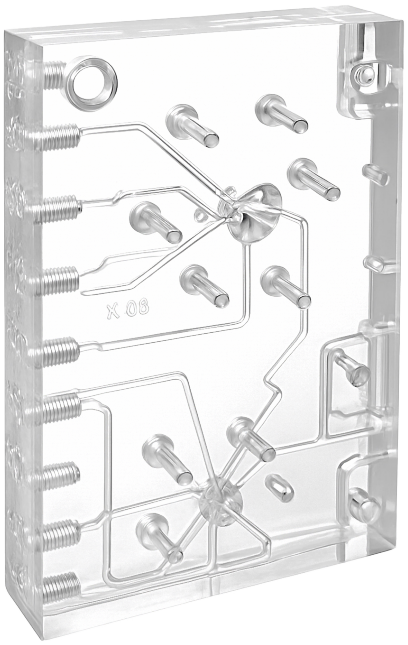
Life science instruments are becoming increasingly sensitive, enabling the detection of extremely small quantities of biomarkers and disease cells. While this improves diagnostic capabilities, it also introduces new challenges for fluidic system design.

Even trace contamination between samples can compromise results.

Increasing Assay Sensitivity

Modern diagnostics require:

- Detection Of Extremely Small Biomarker Concentrations
- Earlier Disease Detection
- Greater Diagnostic Accuracy



Throughput Pressure in Modern Laboratories

Diagnostic laboratories require instruments capable of processing **large numbers of samples quickly and reliably**.

Extending wash cycles to reduce carryover is often not an option.

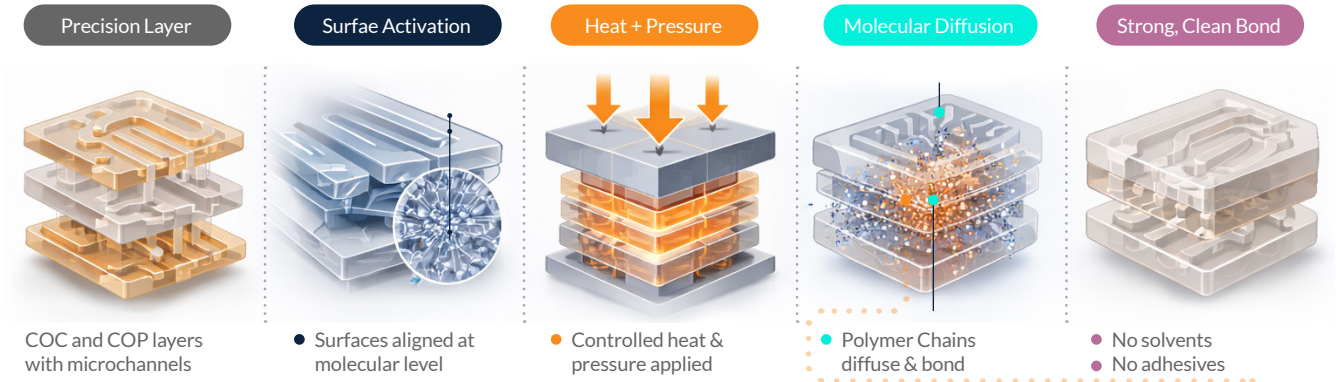
Adding even a few seconds to wash cycles can:

- Reduce instrument throughput
- Lower laboratory productivity
- Impact profitability across an installed instrument base

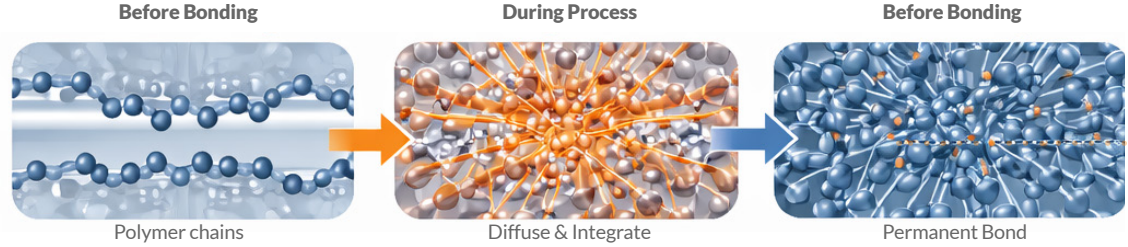
Instrument manufacturers must therefore **reduce contamination without sacrificing speed.**

Diffusion Bonding Technology

A Clean, **Solvent-Free** Process That Creates Strong, Permanent Bonds Between COC and COP Layers



How It Works at the Molecular Level



More Aggressive Cleaning Chemistries

To maintain throughput while minimizing carryover, many instruments now rely on **stronger cleaning reagents**, including:

- High-concentration bleach solutions (15–16%)
- Strong oxidizers
- Aggressive surfactants
- Tissue-dissolving reagents

These chemicals improve cleaning performance but can **damage traditional manifold materials**.

Limitations of Traditional Manifold Materials

Many fluidic manifolds are manufactured using materials such as **Ultem, acrylic, or other engineering plastics.**

While historically effective, these materials can degrade when exposed to modern cleaning chemistries.

Common issues include:

- Stress cracking
- Polymer swelling
- Surface degradation
- Dimensional instability

Over time, these effects can negatively impact system performance, leading to:

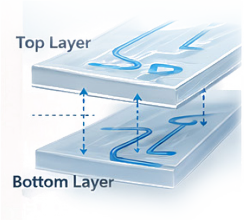
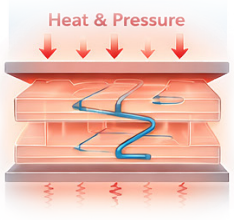
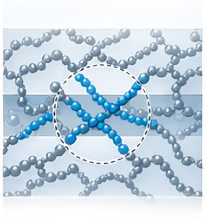
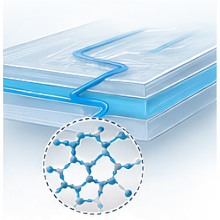
- Inconsistent flow rates
- Increased carryover risk
- Reduced instrument reliability

Key Advantages

- No Residues
- High Strength
- Low Distortion
- Long-term Stability

Diffusion Bonding Process for COC and COP Manifolds

Creating Strong, **Solvent-Free, Molecular Bonds** Between Polymer Layers

Precision Microchannels	Apply Heat & Pressure	Polymer Chain Diffuse	Molecular Bond Forms	Bonded Manifold
				
COC and COP Layers with Aligned Microfluidic Channels • Clean, dry surfaces • Precision alignment	• Controlled temperature • High uniform pressure	• Polymer chains interpenetrate at molecular level	• Strong, clean interface - no voids, no adhesive.	**Final COC and COP Manifold with Sealed Microfluidic Paths** • Leak-tight • Solvent-free • Chemically pure

Manufacturing Process

We maintain full traceability from raw material selection through final assembly, ensuring every component meets strict performance and quality standards. Our controlled manufacturing methods provide consistency at every stage, forming the foundation for reliable, high-precision fluidic systems.

Our proprietary diffusion bonding process enables complete manifold integration, creating robust, seamless structures designed for advanced liquid handling devices. This approach ensures optimal alignment, structural integrity, and repeatable performance in demanding applications.

By tightly controlling materials and processing conditions, we eliminate common failure modes such as pigmentation, warping, crazing, and cracking. The result is a clean, stable fluidic architecture that maintains its integrity over time.

This end-to-end control ultimately extends product longevity, delivering durable, contamination-free performance that customers can rely on in critical environments.

Materials Designed for Advanced Fluidic Systems

Cyclic Olefin Copolymer (COC) and Cyclic Olefin Polymer (COP) materials provide an advanced solution for modern diagnostic fluidic systems.

These materials combine chemical resistance, dimensional stability, and purity, making them well suited for high-performance analytical instruments.

Key Material Advantages

- Excellent chemical resistance
- Low extractables and leachables
- High purity polymer structure
- Optical clarity for analytical systems
- Low moisture absorption
- Strong dimensional stability

These characteristics allow diagnostic systems to use **aggressive cleaning protocols while maintaining precise fluidic performance**.

The Critical Challenge in Polymer Manifolds

Bonding Technology

Polymer manifolds typically consist of multiple layers containing **microfluidic channels and flow paths** that must be sealed together.

Traditional bonding methods introduce several risks.

Thermal Bonding

- Potential distortion of microchannels
- Changes in flow path geometry

Solvent Bonding

- Residual chemicals in the fluidic system
- Long-term material stress

Adhesive Bonding

- Potential extractables and leachables
- Contamination risk within fluid pathways

For highly sensitive diagnostic systems, these risks can compromise **performance, reliability, and regulatory compliance.**

Key Advantages of Diffusion Bonding

No Adhesives

Molecular-Level Bonding

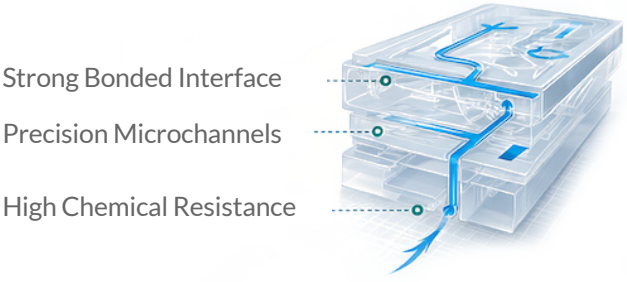
No Solvents

Clean, Contamination-Free

Minimal Channel Distortion

Long-Term Reliability

Results



Advanced Diffusion Bonding Technology

AFP utilizes **advanced diffusion bonding techniques** to create clean, stable interfaces between COC and COP manifold layers.

This process eliminates the need for **solvents or adhesives**, creating strong molecular bonds between polymer surfaces.

Benefits of Diffusion Bonding

- No solvent contamination
- No adhesive materials
- Strong, stable bonds
- Minimal distortion of microfluidic channels
- Improved long-term reliability

The result is a **high-integrity fluidic structure** optimized for sensitive analytical applications.

Addressing Real-World Engineering Challenges

AFP's COC and COP manifold technology helps overcome common challenges faced by instrument manufacturers.

Reduced Carryover

Improved chemical compatibility enables **more effective cleaning protocols**, reducing contamination between samples.

Stable Fluidic Performance

Precision bonding maintains consistent microchannel **geometry**, ensuring reliable flow control.

Improved Chemical Compatibility

COC and COP materials support exposure to aggressive cleaning reagents used in modern diagnostic systems.

Simplified Regulatory Validation

Low extractables and clean bonding processes help reduce **regulatory testing complexity.**

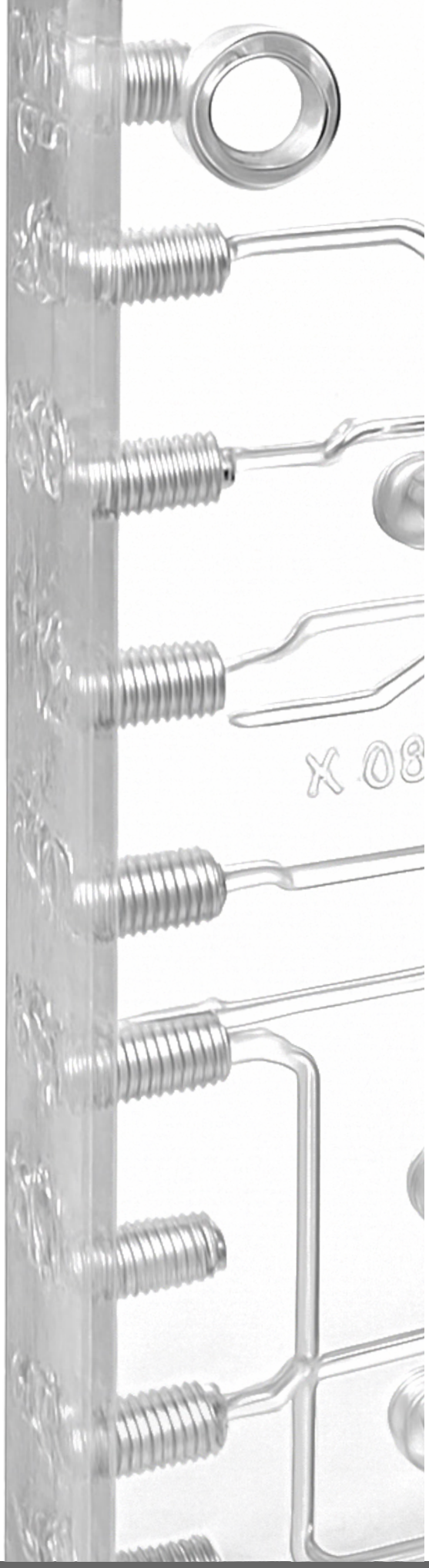
Faster Development & Customization

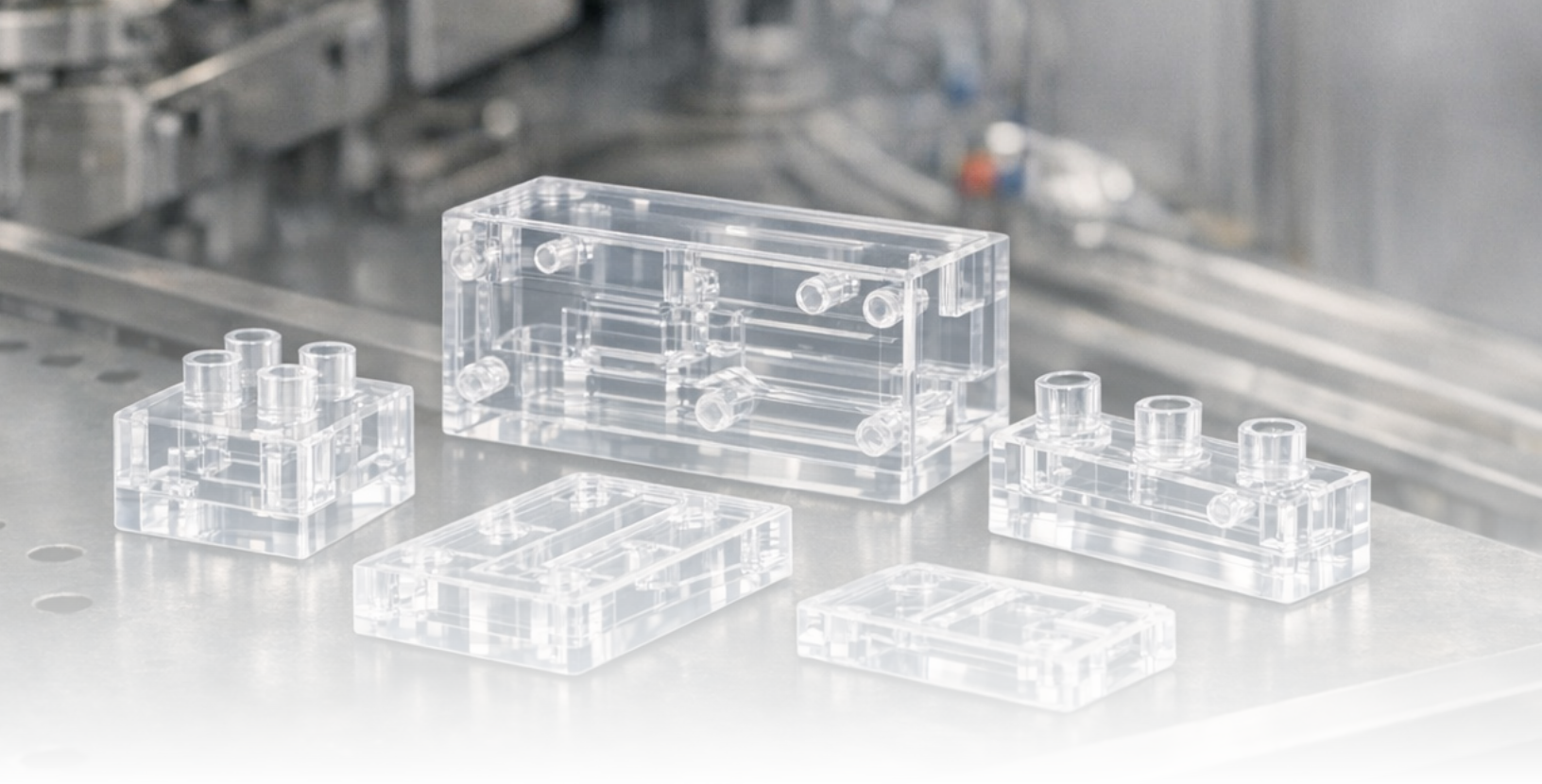
Instrument development cycles are becoming shorter, particularly in fast-moving fields such as genomics and molecular diagnostics.

AFP supports OEMs with:

- Rapid prototyping
- Custom fluidic architectures
- Fast iteration cycles
- Integration with valves and sensors

These capabilities allow manufacturers to **accelerate instrument development and bring new platforms to market faster**.





Applications

COC and COP manifold technologies are ideal for a wide range of life science instruments, including:

- In Vitro diagnostic (IVD) systems
- Molecular diagnostic platforms
- Genomics and sequencing instruments
- Clinical chemistry analyzers
- Liquid handling systems
- Biologics and drug discovery instrumentation

These systems benefit from reliable, chemically resistant fluidic architectures capable of supporting high-sensitivity assays.

Supporting the Next Generation of Life Science Instruments

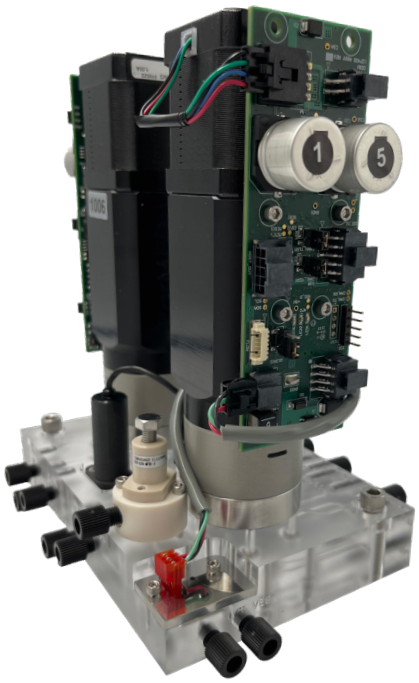
As diagnostic technologies continue to advance, fluidic systems must deliver:

- Lower sample carryover
- Higher chemical resistance
- Improved reliability
- Faster throughput
- Reduced contamination risk

COC and COP manifold technologies provide the foundation for robust, scalable fluidic architectures designed for next-generation analytical and diagnostic instruments.

Precision Fluidic Solutions for Analytical and Diagnostic Systems

AFP Life Sciences combines advanced materials expertise, precision manufacturing, and fluidic engineering to help instrument manufacturers develop high-performance systems capable of meeting the demands of modern diagnostics and analytical science.



Material Matters: How Manifold Material Impacts Chemical Resistance and Rinse-Out Performance

Property	Ultem (PEI)	Acrylic (PMMA)	COC and COP
Chemical Resistance	Good resistance to many solvents and cleaning agents	Moderate resistance; sensitive to many organic solvents and stress cracking	Excellent resistance to a wide range of acids, bases, and solvents
Surface Chemistry	Higher surface energy; more interaction with fluids	Moderate surface interaction	Very low surface energy; highly inert
Adsorption / Carryover	Moderate risk of analyte adsorption	Moderate to high risk depending on chemistry	Extremely low adsorption and extractables
Rinse-Out Performance	Good but may require longer wash cycles	Moderate rinse-out; residues can remain in some applications	Excellent rinse-out due to smooth, non-reactive surfaces
Clarity / Optical Properties	Amber/transparent but not ideal for optical detection	Excellent optical clarity	Excellent optical clarity
Typical Use in Fluidics	Durable manifolds where mechanical strength is needed	Low-cost manifolds or visual flow applications	High-performance diagnostic and analytical manifolds
Best Advantage	Mechanical strength and thermal stability	Cost-effective and clear	Superior chemical resistance and fastest rinse-out performance

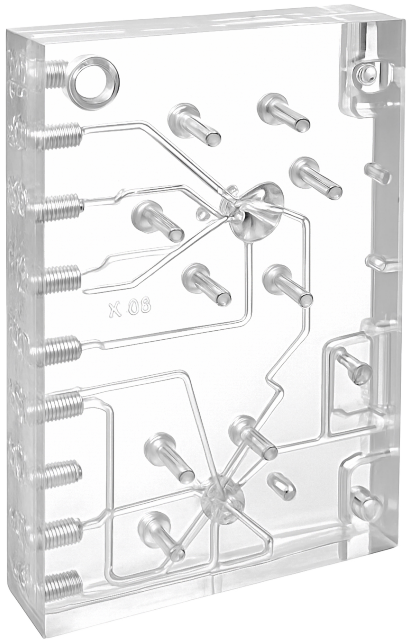
Key Features

Ultem (PEI): Strong and durable with good chemical resistance, but its surface chemistry can lead to some analyte interaction.

Acrylic (PMMA): Cost-effective and optically clear but limited chemical resistance and higher potential for carryover.

COC and COP: Best choice for low carryover, chemical compatibility, and fast rinse-out, making them ideal for IVD, genomics, and analytical liquid handling systems.

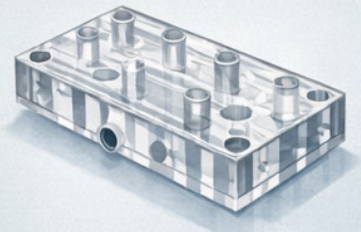
COC and COP manifolds offer superior chemical resistance and extremely low surface interaction, enabling faster rinse-out and reduced carryover compared with Ultem or acrylic manifolds.



Material Matters:

How Manifold Material Impacts Chemical Resistance and Rinse-Out Performance

Choose the Best Material for Your Fluidic Manifolds

ULTEM (PEI)	ACRYLIC (PMMA)	COC ✓ COP
		
CHEMICAL RESISTANCE	**CHEMICAL RESISTANCE**	**Excellent Resistance**
Good Resistance	Moderate Resistance	✓ Excellent Resistance
ADSORPTION & CARRYOVER	**ADSORPTION & CARRYOVER**	**ADSORPTION & CARRYOVER**
Moderate Carryover Risk	High Carryover Risk	✓ Ultra-Low Carryover
RINSE-OUT PERFORMANCE	**RINSE-OUT PERFORMANCE**	**RINSE-OUT PERFORMANCE**
Longer Wash Cycles	Residual Contamination	✓ Fast, Complete Rinse-Out!
		
Durable but higher carryover	*Clear but prone to residue*	*Superior for Diagnostics*

THE CLEAR CHOICE FOR FLUIDIC PERFORMANCE

- Exceptional Chemical Resistance
- Rapid, Reliable Rinse-Out

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