

*HyperShear*TM HPLC Mixers



*HyperShear*TM HPLC Mixer Features:

- Static or Dynamic Mixers with highly efficient vortex shear mixing
- Reduce baseline noise, increase sensitivity, and improve gradient accuracy
- Mixing volume optimization is easy with interchangeable mixer cartridges
- In-line, binary, and ternary formats
- Available in stainless steel or biocompatible PEEK
- Ideal for microbore HPLC and LC/MS
- Compact design is easily integrated into any HPLC system
- Increased reaction efficiency for post column derivatization

HyperShear™ HPLC Mixers

ASI manufactures a wide range of Mixers to solve the most demanding HPLC mixing problems. ASI HyperShear HPLC Mixers incorporate a highly efficient cross-flow shearing mechanism which produces vortex shear mixing over a wide flow range. This mixing technology typically delivers between 25 % to 200 % better mixing efficiency compared to conventional stir bar or tortuous path mixers. HyperShear HPLC Mixers are available in both static and dynamic formats with volumes ranging from 0.5 µL to 1.5 mL. Most mixers are available in biocompatible PEEK.

Comparison of Baseline Noise

The baseline of this plot has been enlarged to show the noise levels associated with each mixer. Note the significant reduction in baseline noise with the ASI static mixer.

Conditions:

Gradient Program:
CH₃CN/H₂O = 50/50 --> (15 min.) 90/10
Flow Rate: 0.1mL/min.
Temp.: 40°C
Sample Size: 1µL
Sample: Solvent front
Detection Wavelength: 254nm

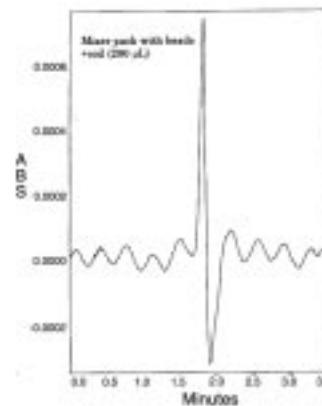
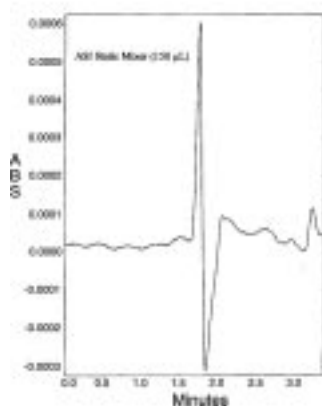


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Micro Flow Series

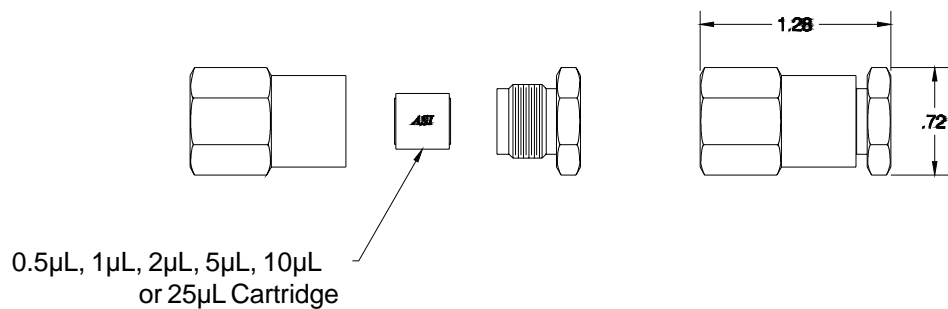
Stainless Steel



In-Line Complete Assembly - Cartridge and Housing

Description	ASI Part Number
In-Line Mixer Assembly SS 0.5 µL	401-000.5
In-Line Mixer Assembly SS 1 µL	401-0001
In-Line Mixer Assembly SS 2 µL	401-0002
In-Line Mixer Assembly SS 5 µL	401-0005
In-Line Mixer Assembly SS 10 µL	401-0010
In-Line Mixer Assembly SS 25 µL	401-0025

In-Line Assemblies



Port Size: 10-32 CPI (Standard HPLC Fittings for 1/16" Tube)

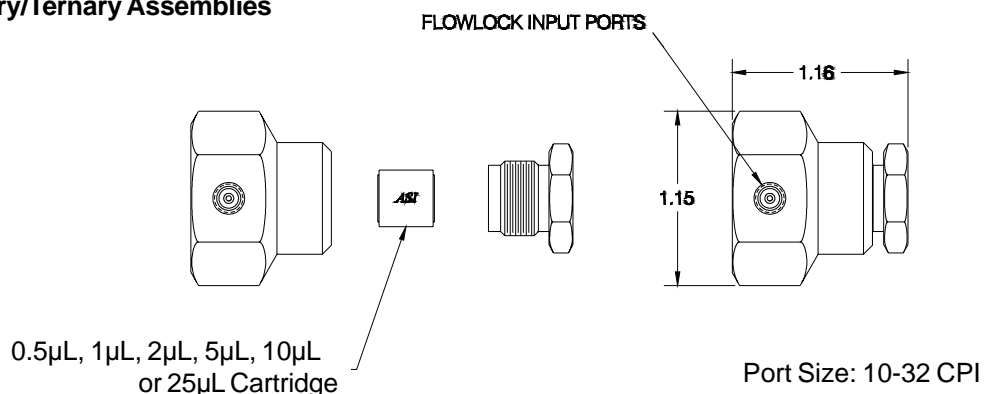
Binary Tee Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Binary Tee Mixer Assembly SS 0.5 μ L	402-000.5
Binary Tee Mixer Assembly SS 1 μ L	402-0001
Binary Tee Mixer Assembly SS 2 μ L	402-0002
Binary Tee Mixer Assembly SS 5 μ L	402-0005
Binary Tee Mixer Assembly SS 10 μ L	402-0010
Binary Tee Mixer Assembly SS 25 μ L	402-0025

Ternary Tee Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Ternary Tee Mixer Assembly SS 0.5 μ L	403-000.5
Ternary Tee Mixer Assembly SS 1 μ L	403-0001
Ternary Tee Mixer Assembly SS 2 μ L	403-0002
Ternary Tee Mixer Assembly SS 5 μ L	403-0005
Ternary Tee Mixer Assembly SS 10 μ L	403-0010
Ternary Tee Mixer Assembly SS 25 μ L	403-0025

Binary/Ternary Assemblies



Cartridges / Housings

Description	ASI Part Number
Mixer Cartridge SS 0.5 μ L	400-000.5
Mixer Cartridge SS 1 μ L	400-0001
Mixer Cartridge SS 2 μ L	400-0002
Mixer Cartridge SS 5 μ L	400-0005
Mixer Cartridge SS 10 μ L	400-0010
Mixer Cartridge SS 25 μ L	400-0025
In-Line Micro Flow Series SS Housing	401-0000
Binary Tee Micro Flow Series SS Housing	402-0000
Ternary Tee Micro Flow Series SS Housing	403-0000

Low Flow Series

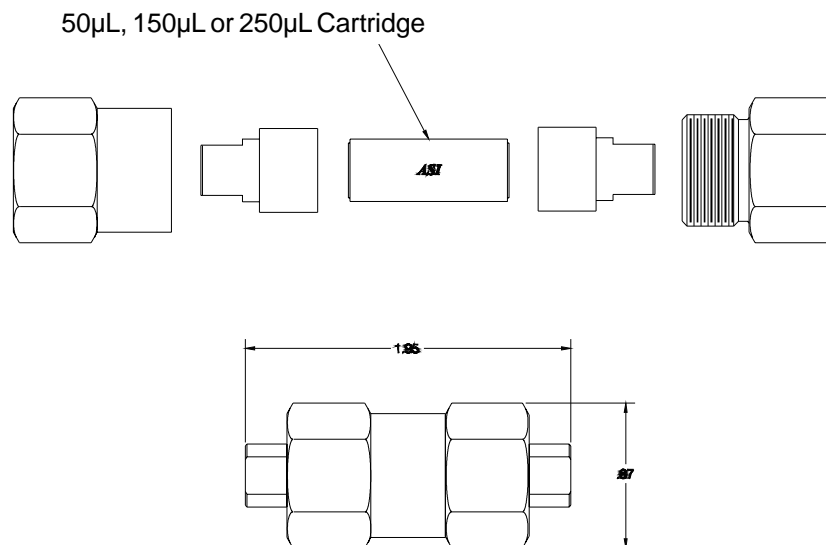
Stainless Steel



In-Line Complete Assembly - Cartridge and Housing

Description	ASI Part Number
In-Line Mixer Assembly SS 50 µL	411-0050
In-Line Mixer Assembly SS 150 µL	411-0150
In-Line Mixer Assembly SS 250 µL	411-0250

In-Line Assemblies



Port Size: 10-32 CPI (Standard HPLC Fittings for 1/16" Tube)

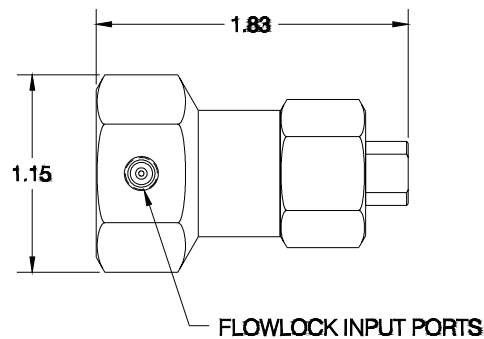
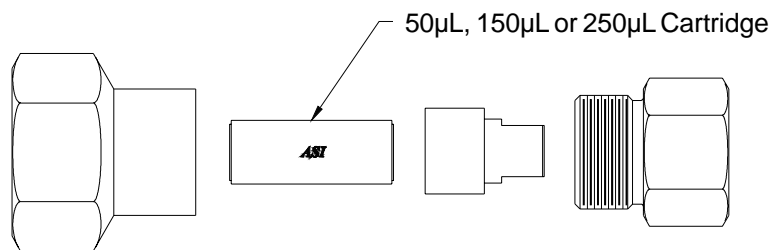
Binary Tee Complete Assembly - Cartridge and Housing

Description	ASI Part Number
Binary Tee Mixer Assembly SS 50 μ L	412-0050
Binary Tee Mixer Assembly SS 150 μ L	412-0150
Binary Tee Mixer Assembly SS 250 μ L	412-0250

Ternary Tee Complete Assembly - Cartridge and Housing

Description	ASI Part Number
Ternary Tee Mixer Assembly SS 50 μ L	413-0050
Ternary Tee Mixer Assembly SS 150 μ L	413-0150
Ternary Tee Mixer Assembly SS 250 μ L	413-0250

Binary/Ternary Assemblies



Port Size: 10-32 CPI

Cartridges / Housings

Description	ASI Part Number
Mixer Cartridge SS 50 μ L	410-0050
Mixer Cartridge SS 150 μ L	410-0150
Mixer Cartridge SS 250 μ L	410-0250
In-Line Low Flow Series SS Housing	411-0000
Binary Tee Low Flow Series SS Housing	412-0000
Ternary Tee Low Flow Series SS Housing	413-0000

Low Flow Series Biocompatible PEEK

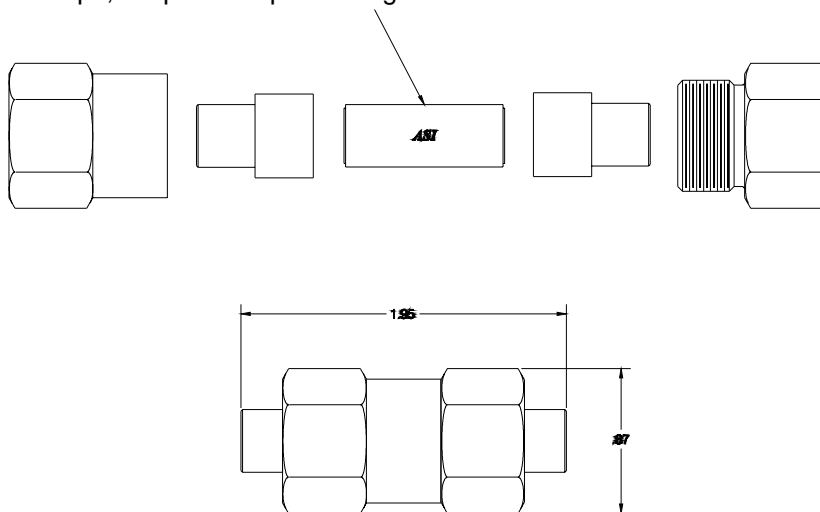


In-Line Complete Assembly - Cartridge and Housing

Description	ASI Part Number
In-Line Mixer Assembly PEEK 50 µL	411-0050B
In-Line Mixer Assembly PEEK 150 µL	411-0150B
In-Line Mixer Assembly PEEK 250 µL	411-0250B

In-Line Assemblies

50µL, 150µL or 250µL Cartridge



Port Size: 10-32 CPI (Standard HPLC Fittings for 1/16" Tube)

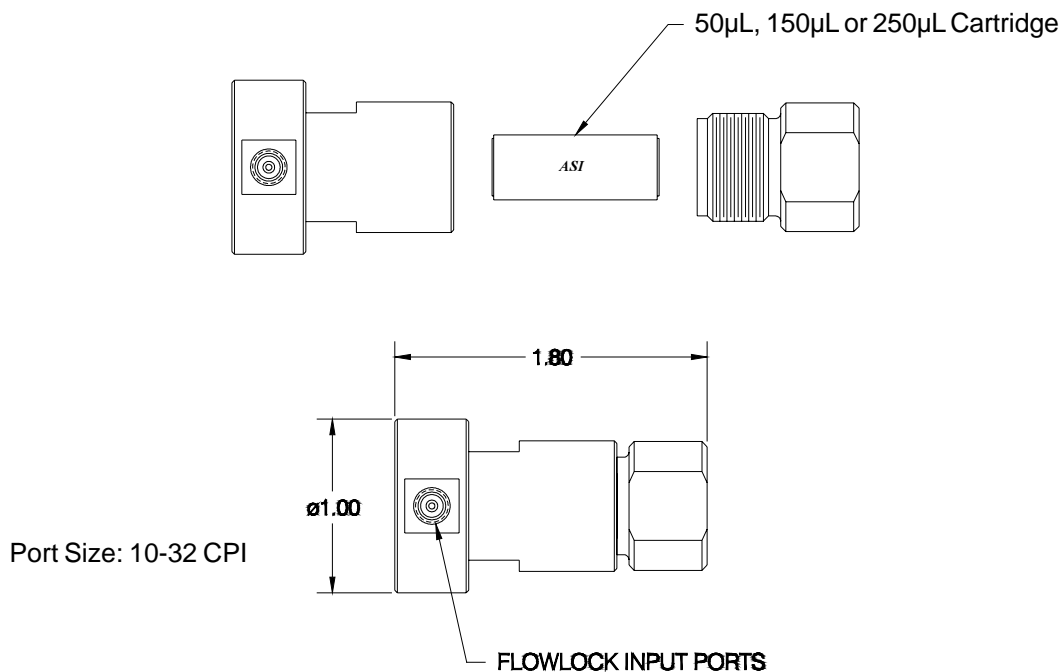
Binary Tee Complete Assembly - Cartridge and Housing

Description	ASI Part Number
Binary Tee Mixer Assembly PEEK 50 μ L	412-0050B
Binary Tee Mixer Assembly PEEK 150 μ L	412-0150B
Binary Tee Mixer Assembly PEEK 250 μ L	412-0250B

Ternary Tee Complete Assembly - Cartridge and Housing

Description	ASI Part Number
Ternary Tee Mixer Assembly PEEK 50 μ L	413-0050B
Ternary Tee Mixer Assembly PEEK 150 μ L	413-0150B
Ternary Tee Mixer Assembly PEEK 250 μ L	413-0250B

Binary/Ternary Assemblies



Cartridges / Housings

Description	ASI Part Number
Mixer Cartridge PEEK 50 μ L	410-0050B
Mixer Cartridge PEEK 150 μ L	410-0150B
Mixer Cartridge PEEK 250 μ L	410-0250B
In-Line Low Flow Series PEEK Housing	411-0000B
Binary Tee Low Flow Series PEEK Housing	412-0000B
Ternary Tee Low Flow Series PEEK Housing	413-0000B

Analytical Flow Series

Stainless Steel, Biocompatible PEEK



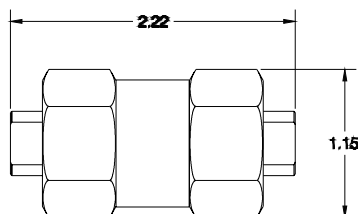
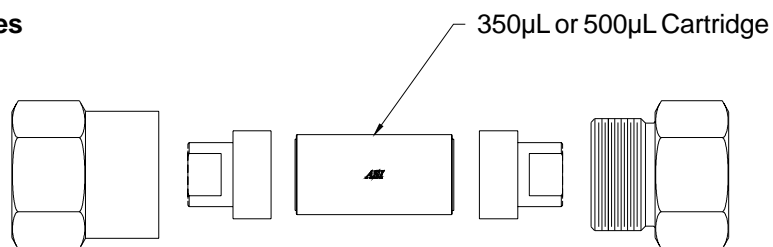
In-Line Complete Assembly - Cartridge and Housing Stainless Steel

Description	ASI Part Number
In-Line Mixer Assembly SS 350 µL	421-0350
In-Line Mixer Assembly SS 500 µL	421-0500

Biocompatible PEEK

Description	ASI Part Number
In-Line Mixer Assembly PEEK 350 µL	421-0350B
In-Line Mixer Assembly PEEK 500 µL	421-0500B

In-Line Assemblies



Port Size: 10-32 CPI (Standard HPLC Fittings for 1/16" Tube)

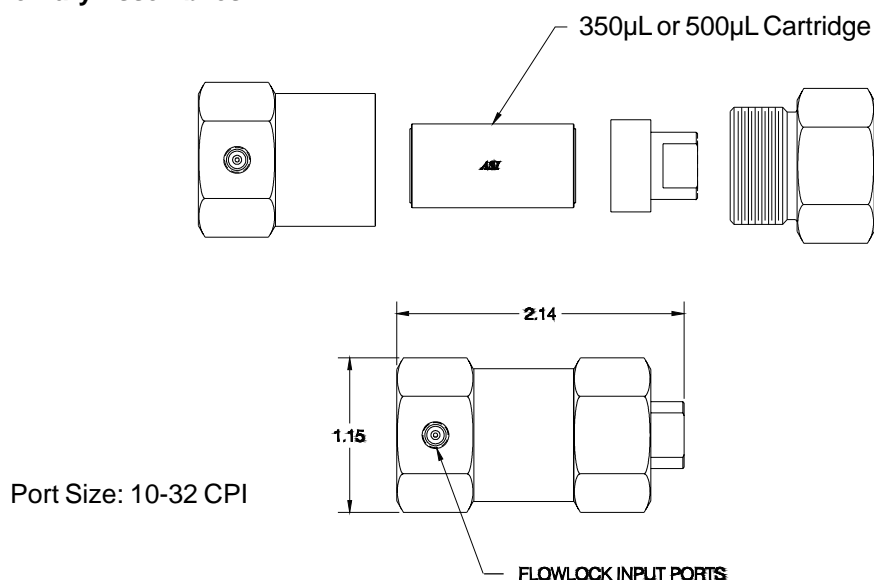
Binary Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Binary Tee Mixer Assembly SS 350 μ L	422-0350
Binary Tee Mixer Assembly SS 500 μ L	422-0500

Ternary Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Ternary Tee Mixer Assembly SS 350 μ L	423-0350
Ternary Tee Mixer Assembly SS 500 μ L	423-0500

Binary/Ternary Assemblies



Cartridges / Housings Stainless Steel

Description	ASI Part Number
Mixer Cartridge SS 350 μ L	420-0350
Mixer Cartridge SS 500 μ L	420-0500
In-Line Analytical Flow Series SS Housing	421-0000
Binary Tee Analytical Flow Series SS Housing	422-0000
Ternary Tee Analytical Flow Series SS Housing	423-0000

Biocompatible PEEK

Description	ASI Part Number
Mixer Cartridge PEEK 350 μ L	420-0350B
Mixer Cartridge PEEK 500 μ L	420-0500B
In-Line Analytical Flow Series PEEK Housing	421-0000B

High Flow Series

Stainless Steel, Biocompatible PEEK



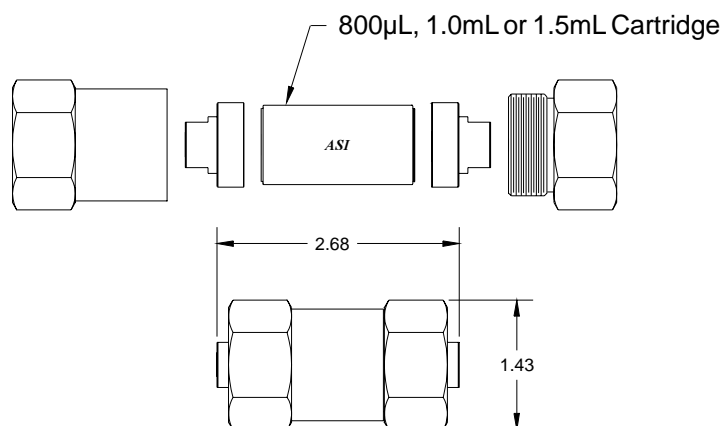
In-Line Complete Assembly - Cartridge and Housing Stainless Steel

Description	ASI Part Number
In-Line Mixer Assembly SS 800 µL	431-0800
In-Line Mixer Assembly SS 1.0 mL	431-1000
In-Line Mixer Assembly SS 1.5 mL	431-1500

Biocompatible PEEK

Description	ASI Part Number
In-Line Mixer Assembly PEEK 800 µL	431-0800B
In-Line Mixer Assembly PEEK 1.0 mL	431-1000B
In-Line Mixer Assembly PEEK 1.5 mL	431-1500B

In-Line Assemblies



Port Size: 10-32 CPI (Standard HPLC Fittings for 1/16" Tube)

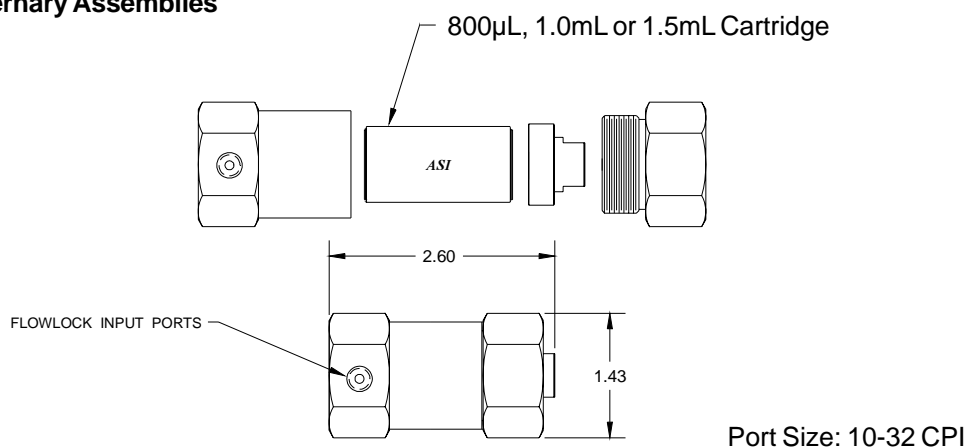
Binary Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Binary Tee Mixer Assembly SS 800 μ L	432-0800
Binary Tee Mixer Assembly SS 1.0 mL	432-1000
Binary Tee Mixer Assembly SS 1.5 mL	432-1500

Ternary Complete Assembly, Stainless Steel - Cartridge and Housing

Description	ASI Part Number
Ternary Tee Mixer Assembly SS 800 μ L	433-0800
Ternary Tee Mixer Assembly SS 1.0 mL	433-1000
Ternary Tee Mixer Assembly SS 1.5 mL	433-1500

Binary/Ternary Assemblies



Cartridges / Housings Stainless Steel

Description	ASI Part Number
Mixer Cartridge SS 800 μ L	430-0800
Mixer Cartridge SS 1.0 mL	430-1000
Mixer Cartridge SS 1.5 mL	430-1500
In-Line High Flow Series SS Housing	431-0000
Binary Tee High Flow Series SS Housing	432-0000
Ternary Tee High Flow Series SS Housing	433-0000

Biocompatible PEEK

Description	ASI Part Number
Mixer Cartridge PEEK 800 μ L	430-0800B
Mixer Cartridge PEEK 1.0 mL	430-1000B
Mixer Cartridge PEEK 1.5 mL	430-1500B
In-Line High Flow Series PEEK Housing	431-0000B

Static Mixer Application Notes

Selecting the Right Size Mixer Cartridge

ASI offers static mixers with volumes that range from 0.5 microliters to 1,500 microliters. Choosing the right size mixer is a trade off between delay volume, mixing noise, and step gradient definition and repeatability. **Please refer to the Charts on pages 48 and 49 for more information on gradient accuracy as a function of flow rate and mixing volume.**

The following observations will provide some guidelines to help choose the right size mixer.

- For any given flow rate, the more the mixing volume the better the mixing, and the lower the baseline noise.
- The smaller the mixing volume, the better the definition and sharpness of linear gradients.
- Multi-pump high pressure gradient systems typically require far less mixing volume than low pressure single pump gradient systems when running linear gradients.
- A 150 µL in-line static mixer can be added after a dynamic or static onboard mixer to further reduce mixing noise.

Multi-pump High Pressure Gradient Systems

Linear Gradients

If a larger mixing volume can be tolerated for a particular flow rate, the larger the volume will lower the mixing noise. The upper limits to mixing volume will be the maximum delay time that can be tolerated, and possible distortion (tailing) of the gradient at the beginning and end of the gradient. The lower limit will be defined by the amount of mixing noise that can be tolerated.

Please refer to table 1 (page 47) for specific recommendations.

Binary or Ternary – Steady State Composition

Always select the largest volume that will still provide an acceptable delay volume. In general, the more mixing volume, the better the mixing will be. For most pump systems, a 150 µL cartridge will provide adequate mixing.

Examples of this type of pump system include:

Shimadzu LC-10AD and LC-10ADVP
Beckman System Gold®
Gilson® Model 305
Agilent® Model 1100

Single-pump Low Pressure Mixing Gradient Systems

Linear Gradients

These systems generally require more mixing volume to perform linear gradients than multi-pump high pressure systems. The following will explain why this is the case. In a low pressure system the composition can only be changed once every pump stroke. Since the pump stroke volume of most pumps is 100 μL , and it takes a mixer volume that is about 3 times the batch volume to provide adequate mixing, we need 350 μL of mixer volume, at least, to do adequate mixing. More insoluble combinations may require even more mixing volume.

In general, choose the largest size mixer cartridge that will still provide an acceptable delay volume. For most applications this will be at least 350 μL .

Binary or Ternary – Steady State Composition

Always select the largest volume that will still provide an acceptable delay time. In general, the more mixing volume, the better the mixing will be. For most applications this will be at least 350 μL .

Examples of this type of pump system include:

Agilent® 1090
Perkin Elmer series 200
TSP Spectra Vision®
Waters model 626
Varian Star® 9000

Mixer Cartridge Selection Guide for High Pressure Mixing

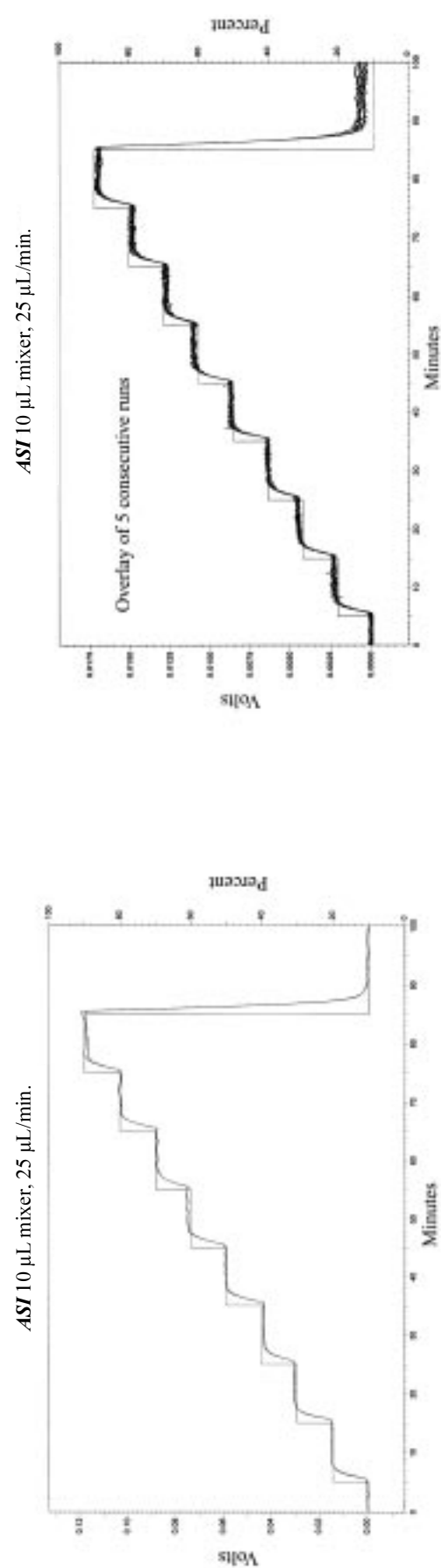
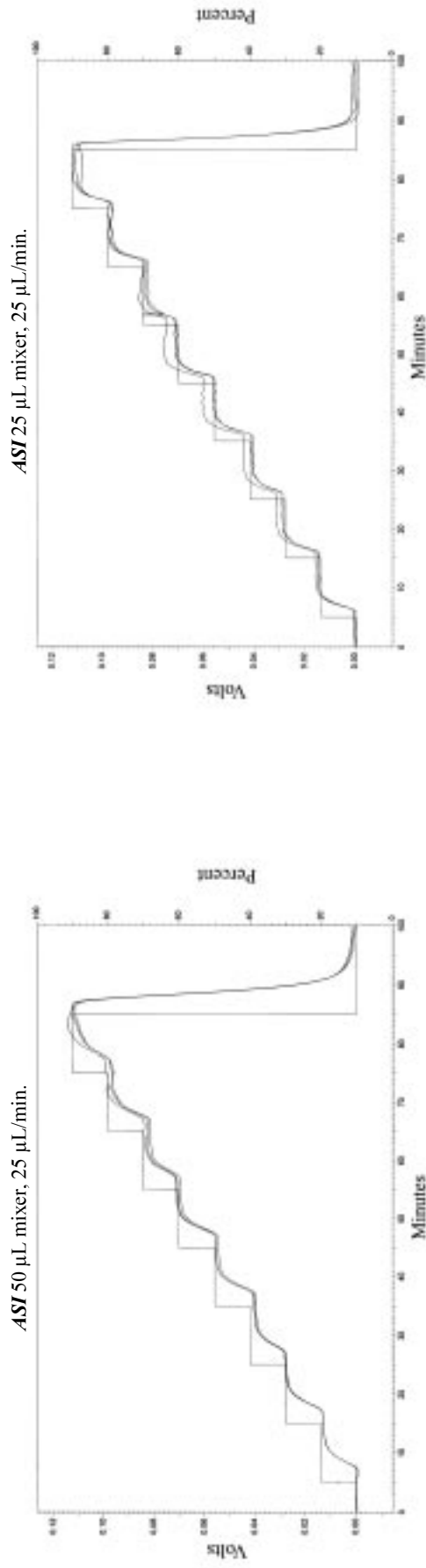
Linear Gradients - High Pressure Mixing

Larger mixing volume can be tolerated for a particular flow rate, with the larger the volume the lower the mixing noise. The upper limits to mixing volume will be the maximum delay time that can be tolerated, and possible distortion (tailing) of the gradient at the beginning and end of the gradient. The lower limit will be defined by the amount of mixing noise that can be tolerated. The following cartridge volumes are a compromise between these two limits.

Table 1.

Flow	Mixer Cartridge Volume
0-5 micro liter/min.	5 micro liter
5-10	10
10-20	25
20-150	50
150-500	150
500+	250

Chart 1 Effect of Mixer Volume on Gradient Accuracy with a Constant Flow Rate

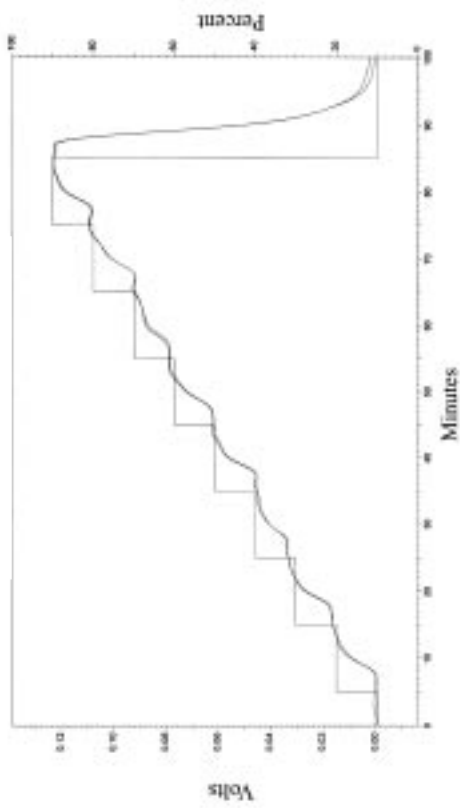


HPLC System configuration:
 Shimadzu LC-10ADVP pumps with micro-flow modification
 Shimadzu SPD-10AVP UV-VIS detector
 Shimadzu Class-VP v5.03 software

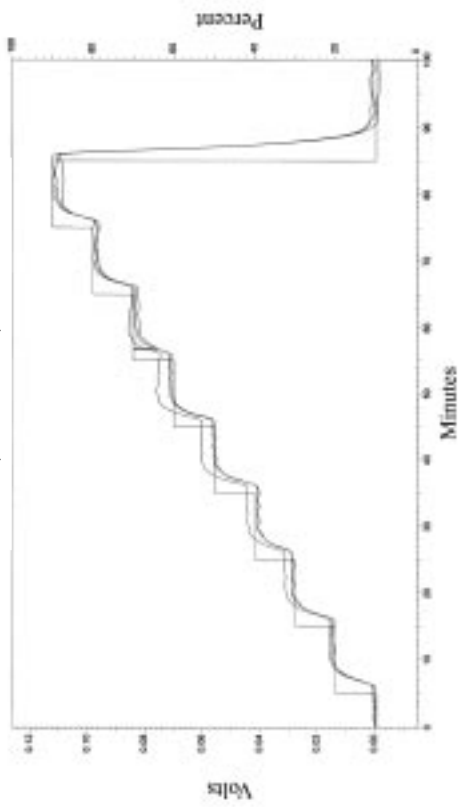
HPLC conditions:
 Gradient: 10-90% B in 10 min. steps
 A = H₂O
 B = 0.3% Acetone in H₂O

Chart 2 Effect of Flow Rate on Gradient Accuracy with a Constant Mixing Volume

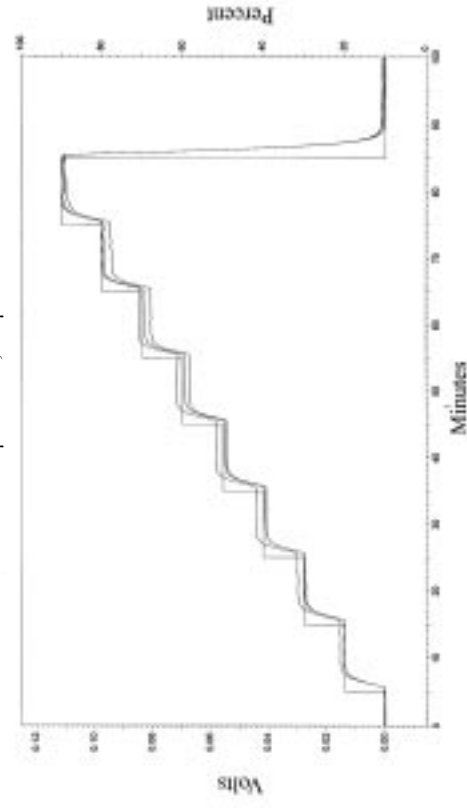
ASI 25 μL mixer, 10 $\mu\text{L}/\text{min}$.



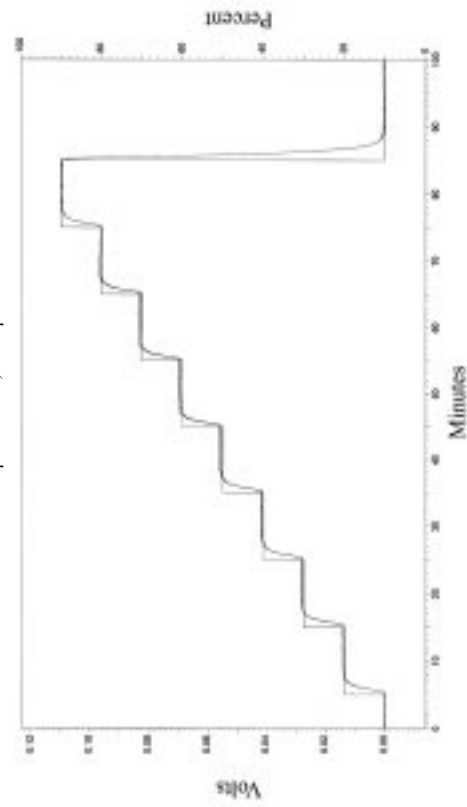
ASI 25 μL mixer, 25 $\mu\text{L}/\text{min}$.



ASI 25 μL mixer, 50 $\mu\text{L}/\text{min}$.



ASI 25 μL mixer, 100 $\mu\text{L}/\text{min}$.



HPLC System configuration:

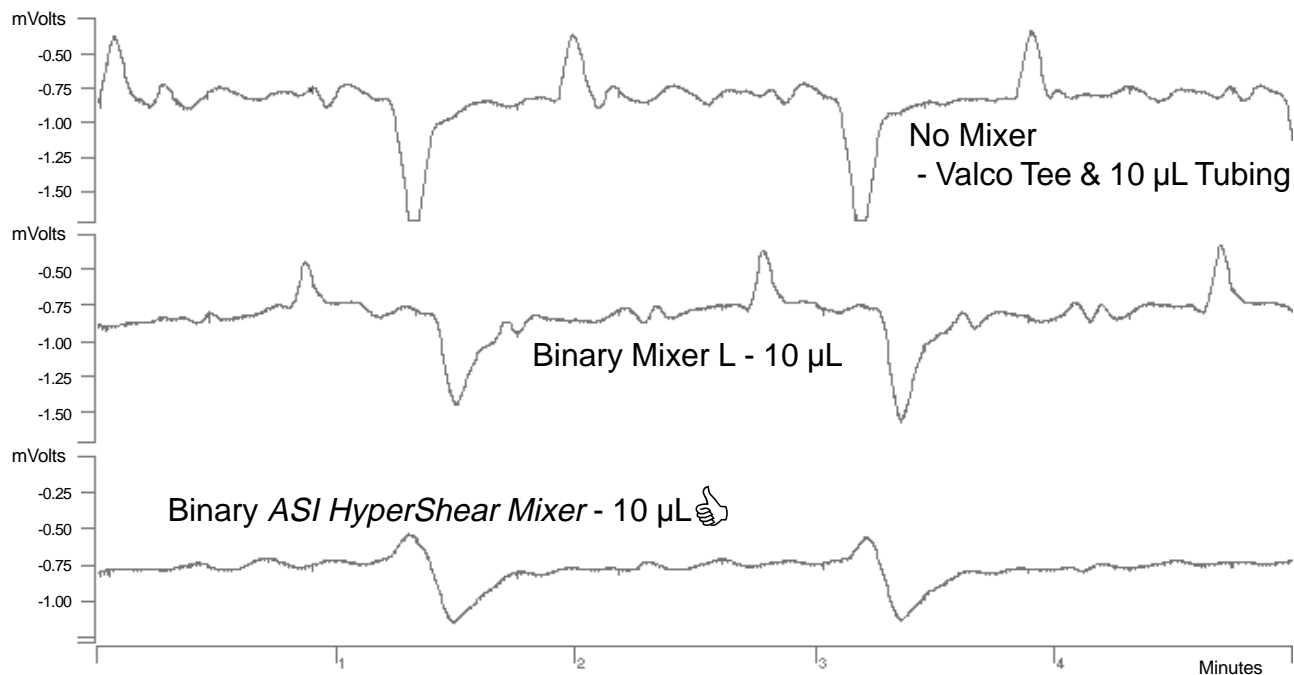
Shimadzu LC-10ADVP pumps with micro-flow modification
 Shimadzu SPD-10AVP UV-VIS detector
 Shimadzu Class-VP v5.03 software

HPLC conditions:

Gradient: 10-90% B in 10 min. steps
 A = H₂O
 B = 0.3% Acetone in H₂O

Binary Static Mixer Comparison -10 μ L

Less Noise - Lower Detection Limits



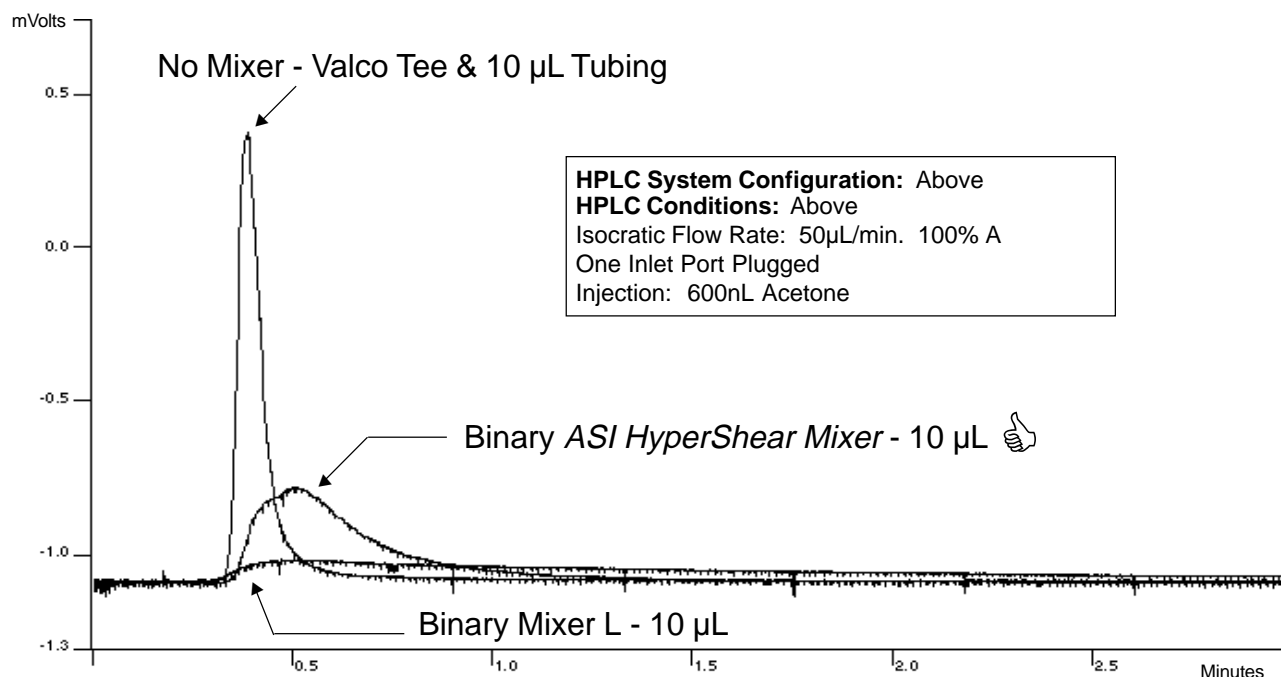
HPLC System Configuration:

ASI Model 500G Gradient System
ABI Model 785 UV/VIS @ 254 on-column
Varian Star Data Acquisition

HPLC Conditions:

MP: A = H₂O, B = H₂O/Acetone
Flow Rate: 50 μ L/min. 50% B
Pressure: 1,700 PSI with restrictor

Superior Mixing with Less Dispersion



HPLC System Configuration: Above

HPLC Conditions: Above
Isocratic Flow Rate: 50 μ L/min. 100% A
One Inlet Port Plugged
Injection: 600nL Acetone

HyperShear™ Dynamic Mixers



HyperShear Dynamic Mixer, 1.0 mL



HyperShear Combination Static/Dynamic Mixer,
150 μ L, 250 μ L or 350 μ L

***HyperShear*™ Dynamic Mixer Features:**

- Vortex sheer mixing that is twice as efficient as conventional stir bar mixers**
- Models with fixed or adjustable mixing volumes**
- Compact design allows easy integration into any HPLC system**
- Available in 120 VAC or 220 VAC**

Binary/Ternary Complete Assembly

Description	ASI Part Number
Binary Tee Dynamic Mixer Assembly 150 μ L 120 VAC	462-0150A
Binary Tee Dynamic Mixer Assembly 150 μ L 220 VAC	462-0150U
Binary Tee Dynamic Mixer Assembly 250 μ L 120 VAC	462-0250A
Binary Tee Dynamic Mixer Assembly 250 μ L 220 VAC	462-0250U
Binary Tee Dynamic Mixer Assembly 350 μ L 120 VAC	462-0350A
Binary Tee Dynamic Mixer Assembly 350 μ L 220 VAC	462-0350U
Binary Tee Dynamic Mixer Assembly 1.0 mL 120 VAC	462-1000A
Binary Tee Dynamic Mixer Assembly 1.0 mL 220 VAC	462-1000U
Ternary Tee Dynamic Mixer Assembly 1.0 mL 120 VAC	463-1000A
Ternary Tee Dynamic Mixer Assembly 1.0 mL 220 VAC	463-1000U