QuickSplit™ Adjustable Flow Splitter

ASI Analytical Scientific Instruments US

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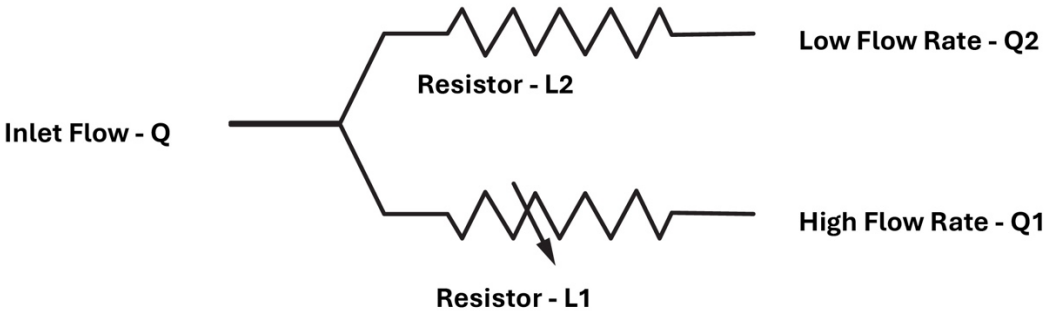
ASI QuickSplit™ Adjustable Flow Splitter

Unlike conventional splitters that use long lengths of capillary tubing, the ASI *QuickSplit* Adjustable Flow Splitter uses fluid resistors to achieve a wide range of split ratios. The flow path of the *QuickSplit* Adjustable Flow Splitter contains two fluid resistors that form a parallel flow path. The low flow rate stream passes through a fixed resistor cartridge, while the high flow rate stream passes through an adjustable fluid resistor (metering valve). The ratio of these two resistors creates the split flow ratio. The fluid resistors are analogous to resistors used in an electrical circuit. The fixed fluid resistor elements are designed as cartridges for easy replacement with resistance values (L2) rated in PSI/mL/min. Because of the extremely low internal volume of the fluid resistors, the solvent composition in both resistors at any instant in time is the same, and therefore viscosity changes associated with gradient runs do not impact the split ratio.

Due to the rugged design, the split ratio repeatability is +/- 2% of setting, and unlike alternative splitter valves or tees, will not be influenced by actions that affect inlet flow such as turning the pump off and on, or pressure spikes. Because the *QuickSplit* Adjustable Flow Splitter incorporates a metering valve, split ratios can be changed frequently and the low flow rate will be stable and reproducible. The *QuickSplit* Adjustable Flow Splitter will create split ratios that are not affected by changes in solvent viscosity and provides direct real time control over split ratio optimization. To understand how the *QuickSplit* Adjustable Flow Splitter works, it helps to look at a diagram of an Adjustable Flow Splitter, **see below**. The diagram shows the relationship of the fixed and adjustable fluid resistors relative to the flow paths and how a split ratio is calculated.

Schematic flow diagram of the *QuickSplit* Adjustable Flow Splitter



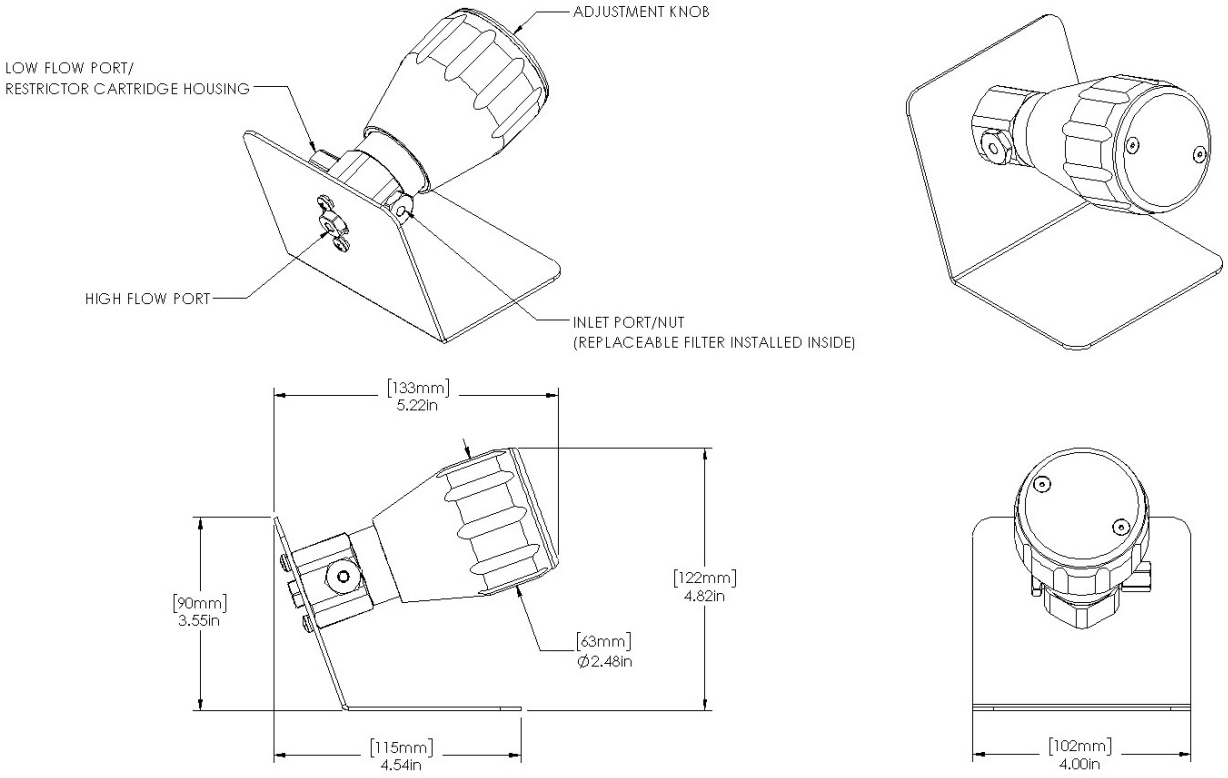
L1 = Adjustable fluid resistor (metering valve)

L2 = Fixed fluid resistor (resistance value varies depending on cartridge rating)

R = Split ratio = Q1/Q2 = Resistance ratio = L2/L1

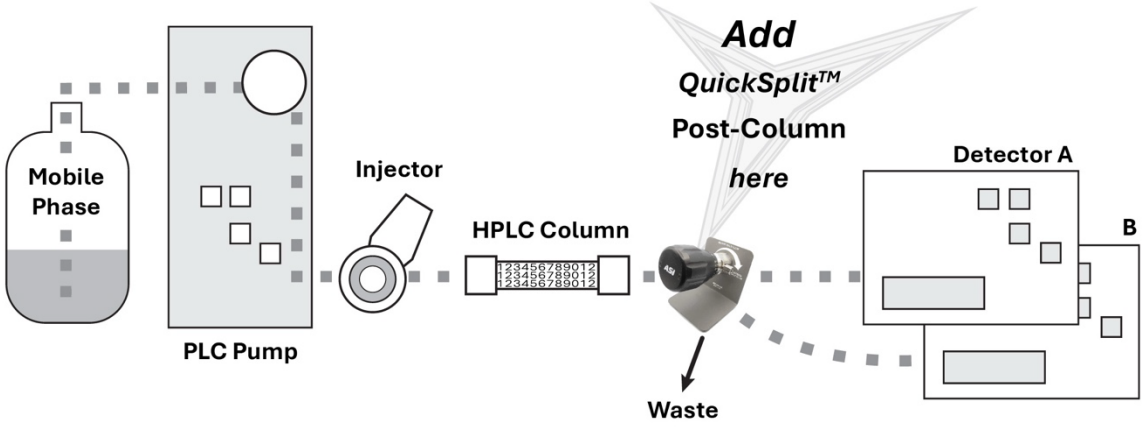
Since the flow rate is inversely proportional to resistance, changing the resistance in either flow path results in a change to the split ratio. Changing resistance is accomplished by adjusting the metering valve on the high flow rate channel or exchanging the fixed fluid resistor cartridge in the low flow rate channel with a resistor cartridge which has a different resistance rating. Adjusting the metering valve is analogous to changing the capillary tubing length or diameter on conventional tee type flow splitters. The *QuickSplit* Adjustable Flow Splitter has a convenient mounting bracket and hand adjustment knob to control the split ratio. A calibrated Vernier scale tracks the split ratio setting and each splitter is shipped with calibration data. Split ratios are not affected by changes in solvent viscosities, which makes this product suitable for gradient applications as well as isocratic. The *QuickSplit* Adjustable Flow Splitter is shipped configured for either post-column or pre-column applications.

Dimensions and Port Locations



Post-Column Applications, for Single and Multiple Detectors

While **Figure below** does not cover all possible Post-Column Flow Splitter configurations, it depicts the most common one. Post-Column flow splitter specifications should be reviewed carefully in the subsequent product literature before selecting a splitter to order. If you have questions about which splitter is right for your application, please contact the technical support group at *ASI*.



Pre-Column Applications, for Single and Multiple Columns

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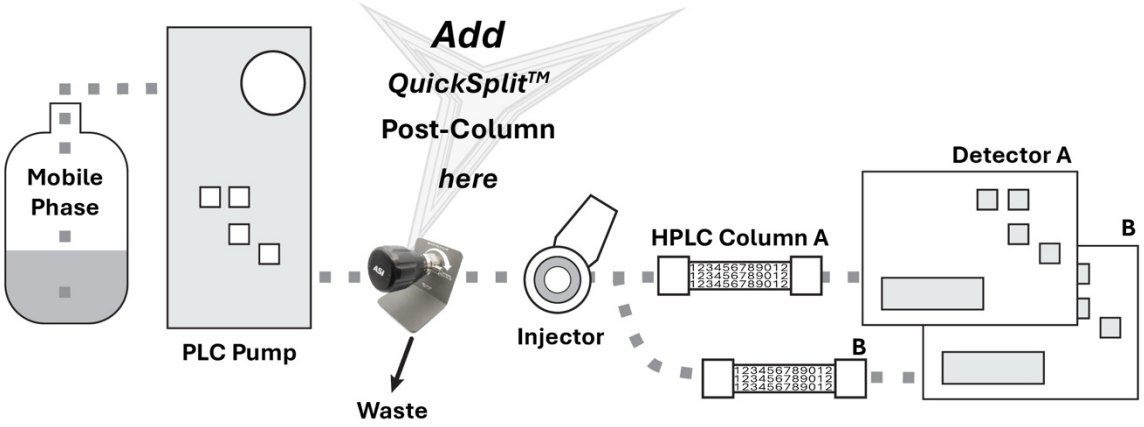
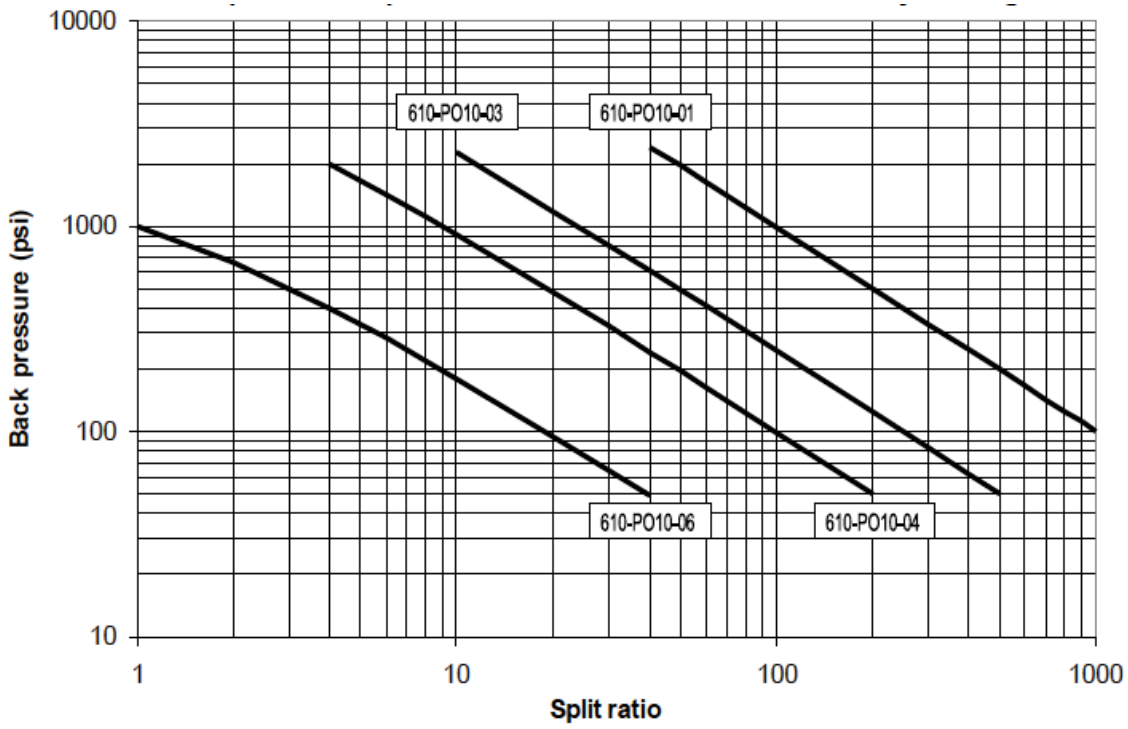


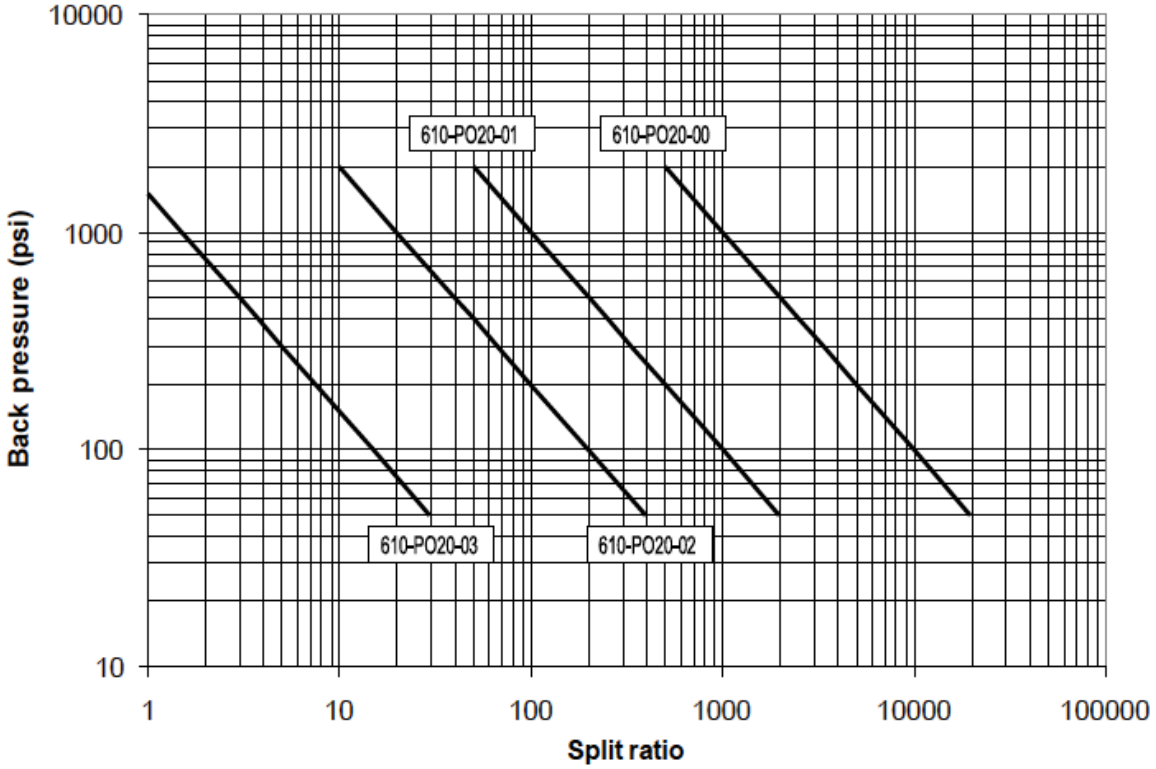
QuickSplit Adjustable Flow Splitter Selection Charts

Note: We can calibrate your flow splitter for your solvent, inlet flow, and ratio range, if specified when you order.

Back pressure vs Split ratio for water at 1 mL/min. 610-PO10 Analytical range



Back pressure vs Split ratio for water at 20 mL/min. 610-PO20 Semi-prep range



Reading and Adjusting Settings on 610 Adjustable Flow Splitter

Each 610 splitter is shipped with a **Test Log and Chart** that plot **Vernier scale setting vs. Split ratio**.

The Vernier scale is marked, on splitter knob and body, to show splitter setting.

The body is marked with a coarse scale, each line representing 25 positions.

This scale is read where the edge of the knob lies on the scale. When '0' knob mark aligns with body scale vertical line, we have exact coarse scale settings at labelled values:

0 on coarse scale

50 on coarse scale

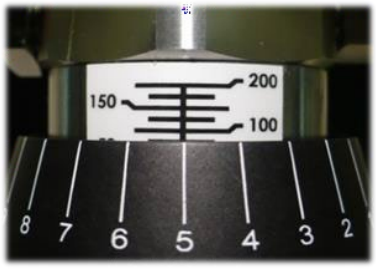
75 on coarse scale

The fine scale is marked on the knob, in 25 positions, numbered 0-24, and is read as marks align with the vertical line on the body scale. 25 positions equal one complete turn of the knob, and one division on the coarse scale.

This enables us to obtain all the settings between the coarse scale lines:

25 coarse + 9 fine = 34

50 coarse + 14 fine = 64



75 coarse + 5 fine = 80

Adjust Flow Splitter Operation

To vary Split Ratio, simply turn Adjustment Knob.

Turning Knob *counterclockwise* will increase Split Ratio (decreasing Low Split Flow); turning Knob clockwise will decrease Split Ratio (increasing Low Split Flow). For a given Inlet Flow, Split Ratio and Low Split Flow vary inversely.

Varying Inlet Flow at the same Knob Setting changes Low Split Flow directly and proportionately (i.e.: doubling Input Flow doubles Low Split Flow).

If you wish to keep a constant Low Split Flow while varying Input Flow, you must adjust Knob accordingly. When increasing Inlet Flow, turn Knob counterclockwise (increasing Split Ratio). When decreasing Inlet Flow, turn Knob clockwise (decreasing Split Ratio).

To closely approximate desired Low Split Flow, consult the Manufacturing Test Log (see Figure 1) shipped with your splitter. The data in the Test Log is measured with NO Back Pressure downstream from the splitter.

The 2nd column of data shows Low Split Flow, labelled “Capillary Flow”. The 4th column, labeled “Back Pressure, PSI”, shows Pressure drop generated by the splitter when providing that particular Low Split Flow. These numbers in 2nd and 4th columns vary in tandem.

Turning Knob	counterclockwise	clockwise
Split Ratio	increases	decreases
Back Pressure	decreases	increases
Low Split Flow	decreases	increases

Finding Split Flow using Back Pressure

Use pressure drop across the flow splitter and Ohms Law.

$$P = L \times Q2 \times V$$

Q2: Desired split flow, mL/min.

L: Fluid resistor value PSI/mL/min. (from calibration sheet)

P: Pressure drop across splitter, PSI

V: Viscosity in centipoise

Note: Once it’s set, the split ratio will remain constant regardless of changes to inlet flow rate or solvent viscosity. Regarding gradients with different viscosity mobile phases, the low split flow will remain constant if the inlet flow is constant. Accuracy is ± 10% of the listed value, on account of system-to-system variability.

Sample Manufacturing Test Log

Figure 1

Manufacturing Test Log for 610-PO10-04 (Sample)

S/N:xxxx

Customer : xxxxxx
Ship date : xx.xx.xxxx
Leak check at inlet at 4,000 psi pass
Leak check at outlet at 4,000 psi pass
Solvent = Water
Input flow rate = 1.00 mL/min.
Split Ratio Range = 5:1 to 100:1

Vernier scale setting	Capillary flow, mL/min	Split ratio	Back Pressure, PSI
19	***0.0075***	**132.333**	***31***
22	***0.015***	**65.6667**	***69***
25	***0.0256***	**38.0625**	***122***
28	***0.0361***	**26.7008**	***178***
31	***0.0477***	**19.9644**	***243***
34	***0.0565***	**16.6991**	***286***
37	***0.0709***	**13.1044**	***357***
39	***0.0841***	**10.8906**	***423***
41	***0.1012***	**8.88142**	***509***
43	***0.1168***	**7.56164**	***589***
45	***0.1347***	**6.4239**	***681***
46	***0.143***	**5.99301**	***723***
47	***0.156***	**5.41026**	***791***
48	***0.1618***	**5.18047**	***824***
49	***0.1725***	**4.7971**	***884***
50	***0.1799***	**4.55864**	***920***

Resistor cartridge value = xxxx psi/(ml/min)
Comments :

Note: The above data is for zero back pressure downstream from flow splitter. Back pressure generated by splitter will vary depending on solvent viscosity, however split ratio will not be affected.

Pre-column Applications and Custom Configuration

Setting the Split Ratio on Pre-column Applications

It is more useful to work with actual flow rate rather than split ratio. Basic procedure is as follows:

1. Measure the pressure drop resulting from column at desired flow rate, using the same mobile phase as used in the method.
2. Refer to the Manufacturing Test Log to find the correct setting to achieve the pressure drop found in step1. (See sample Test Log, **Figure 1**). Adjust the knob to this setting.
3. Connect the low flow side to the column, and the inlet to the pump.
4. Adjust the pump flow rate until the pressure found in step one is achieved. The flow through the column will now match the desired flow rate in step one.

The flow through the column can be adjusted either by changing the splitter setting, or by changing the pump flow rate.

Configuring for Custom Split Ratio Ranges

Note: We can calibrate your flow splitter for your solvent, inlet flow, and ratio range, if specified when you order.

A variety of resistor cartridges can be ordered from ASI to configure the Adjustable Flow Splitter for split ratios other than standard. Please contact technical service at 800-344-4340 for assistance in selecting the correct resistor cartridges. We will gladly assist you in determining the best splitter configuration for your application.

Installation Instructions

Inlet Port/Nut (replaceable filter is installed inside)

Low Flow Port /Resistor Cartridge Housing

High Flow Port

Connections:

The standard ports on ASI splitters accommodate male 10-32 thread fittings made from 316 Stainless Steel or PEEK. Connect these ports with Parker Hannifin or equivalent nuts and ferrules for 1/16" OD tubing. Splitters may also be ordered with ¼-28 flat bottom, or 5/16-24 CPI ports at inlet and high flow ports.

Inlet Port/Inlet Frit:

The inlet port is machined into the inlet nut for all splitters. The inlet nut houses a replaceable inlet frit. The frit volume varies with the type of splitter. The inlet frit can be accessed and changed by removing the inlet nut.

High Flow Port:

The inner diameter of tubing connected to this port should be large enough to avoid generating excessive back pressure, which can affect the split ratio. This change in split ratio may be corrected with further adjustment on adjustable splitters. If this flow is routed to a chromatography detector or a fraction collector, the choice of tubing ID may affect peak dispersion.

Low Flow Port:

The tubing ID connected to this port should be small enough to minimize peak dispersion and large enough to eliminate additional back pressure downstream from the splitter. Please refer to Table 1 as a guide to estimate the back pressure from various connecting tubing. Install the HPLC column prior to testing all precolumn flow splitters.

Fluid Resistor Cartridge Replacement:

A resistor cartridge is located in the resistor housing (except Nano Adjustable Splitters).

Caution and Useful Information

CAUTION:

Flow splitters must generate significant back pressure in order to do their work. The Manufacturing Test Log sent with each adjustable splitter lists pressure drops, per setting, at stated inlet flows. Please observe the Maximum Operating Pressure rating (MOP) of any devices upstream from the splitter. Small ID tubing may also add significant back pressure. If you have maximum pressure drop requirements for your splitter, please let us know when you order.

Table 1: Pressure drop, PSI per inch of tubing with water

Tubing I.D. (microns)										
Flow mL/min.	10	15	20	30	40	50	75	100	127	254
0.0001	413 psi	82 psi	26 psi	5 psi	2 psi	1 psi	0	0	0	0
0.001	4,130 psi	816 psi	258 psi	51 psi	16 psi	7 psi	1 psi	0	0	0
0.01		8,158 psi	2,581 psi	510 psi	161 psi	66 psi	13 psi	4 psi	2 psi	0
0.1				5,099 psi	1,613 psi	661 psi	131 psi	41 psi	16 psi	1 psi
0.5					8,065 psi	3,304 psi	653 psi	206 psi	79 psi	5 psi
1.0						6,608 psi	1,305 psi	413 psi	159 psi	10 psi

Important Equations

R= Q1 / Q2

R = (Q-Q2) / Q2

R = Split ratio

Q1 = High flow rate

Q2 = Low flow rate

Q = Input flow

Maintenance and Trouble Shooting Guide

Routine Maintenance:

Replace inlet filter every six months or if the pressure drop across the splitter increases more than 200PSI. Never store the splitter with pure water, as biological growth may cause clogging.

Please see below for inlet filter ordering information:

Part Number	Descriptions
600-0063-2NANO	Nano Adjustable Flow Splitter, Inlet Filters, Pack of 5
600-0063-2	Analytical 610-PO10/PR10 Post/Pre-column Adjustable Flow Splitter, Inlet Filters, Pack of 5
600-0125-10	Semi-Prep 610-PO20CS Adjustable Flow Splitter, Inlet Filters, Pack of 5
600-0188-10	Prep 610-PO30-CS and PO40-CS Adjustable Flow Splitter, Inlet Filters, 10 Micron x .188 dia. Pack of 5
600-0188-20	Prep 610-PO30-CS and PO40-CS Adjustable Flow Splitter, Inlet Filters, 20 Micron x .188" dia., Pack of 5

Loss of MS Sensitivity:

In some cases QuickSplit Flow Splitters can build up a static charge resulting in a loss of sensitivity at the MS. This behavior is typically limited to MS systems using an electrospray source. The problem is solved by grounding the flow splitter to a suitable ground.

High Pressure:

Post-column flow splitters are calibrated assuming there is no pressure drop down stream from the splitter. Any pressure drop created by the connecting tubing will affect the accuracy of the split ratio.

If the splitter is exhibiting high pressure (>40 bar) as delivered remove all down stream connecting tubing and test with water at the calibration flow rate (refer to the Test Log that came with the splitter).

Note: Precolumn flow splitters must have the HPLC column installed to flow splitter prior to this testing.

Blockage:

Isolate the blockage to the low flow port or high flow port by plugging one of the ports while checking the flow at the other. If the blockage is isolated to the low flow resistor cartridge, you may try to sonicate the cartridge and reverse the flow to dislodge any contaminates. If the resistor cartridge function cannot be restored, you will need to purchase a new resistor.

If the blockage is localized to the adjustable portion of the splitter, remove the low flow resistor housing and cartridge and flush the splitter with water (1ml/min) while adjusting the valve from the highest split ratio (max counterclockwise) to the lowest split (max clockwise) a couple of times. Caution! Please do not turn the adjustable knob all the way to the left or right because it might cause damage of mechanism inside. If this procedure does not solve the problem, the splitter will need to be repaired at ASI.

Leaks:

Make sure all threaded connections are secure and tight. Inlet filter must be seated properly in the inlet nut to insure leak free operation. If the leak appears to be coming from the main body of the splitter, call ASI technical support.

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