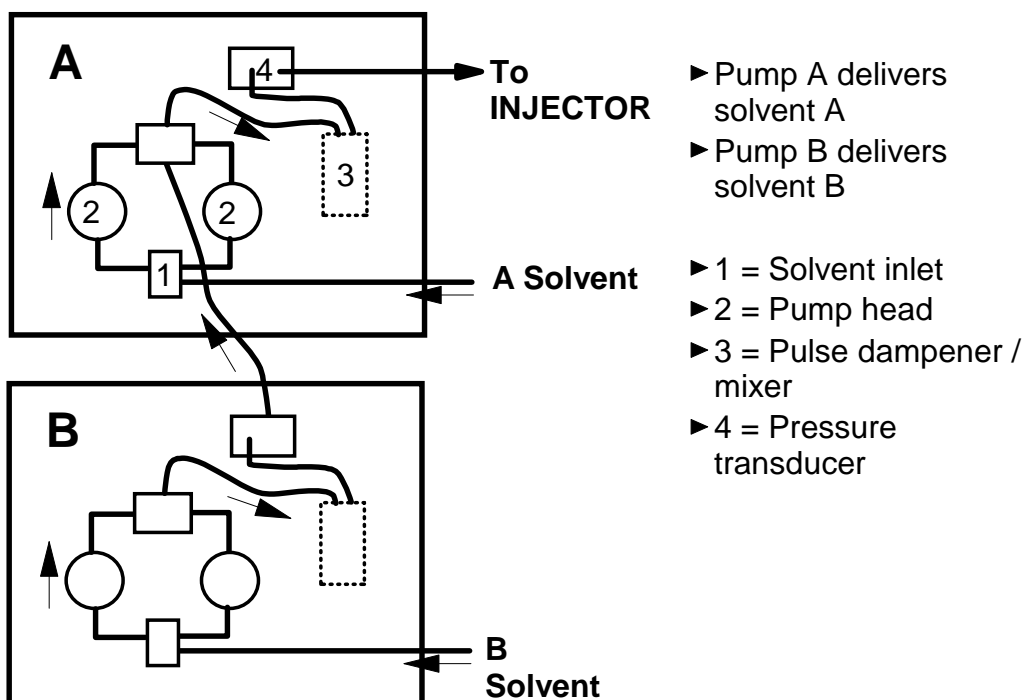# Gradient Solvent Delivery

High Pressure Gradient Systems: Configuration Options

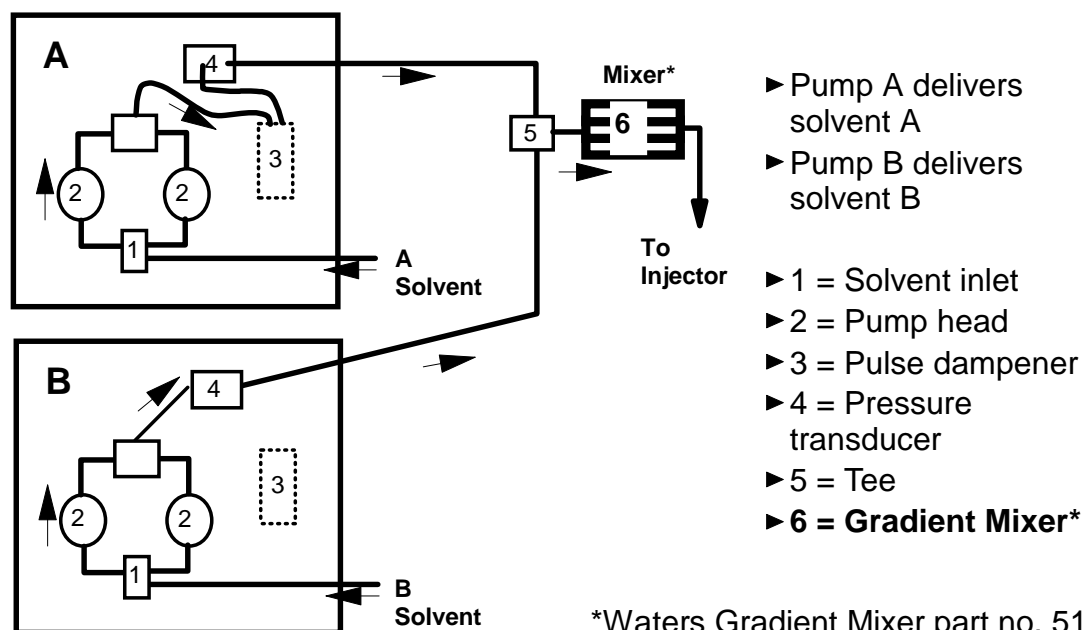**High Pressure or Multi-pump Gradient Systems**

Historically, high pressure or multi-pump gradient systems (e.g. Waters 510's) were the first type of gradient system. There is one pump for each solvent (multi-pump) and a controller or computer which controls the rate of solvent delivery from each pump, and therefore dictates the gradient formation. This technique is known as the high pressure gradient system because the solvents are mixed after the pump as contrasted to a single pump, low pressure, gradient system (e.g. Waters 600 series). A standard (traditional) configuration and an optimized configuration for high pressure gradient systems will be discussed.

Traditional Configuration

► Pump A delivers solvent A

► Pump B delivers solvent B

► 1 = Solvent inlet
► 2 = Pump head
► 3 = Pulse dampener / mixer
► 4 = Pressure transducer

Mixing of the solvents is done through "concurrent stream blending".

Optimized Volume Configuration

► Pump A delivers solvent A

► Pump B delivers solvent B

► 1 = Solvent inlet
► 2 = Pump head
► 3 = Pulse dampener
► 4 = Pressure transducer
► 5 = Tee
► **6 = Gradient Mixer***

*Waters Gradient Mixer part no. 51518

Advantages of the Optimized High Pressure Gradient System vs. the Traditional Configuration
1. Lower delay volume
2. More accurate gradients
3. Shorter reequilibration times
4. Better retention time reproducibility

For critical applications, including low flow rates, the optimized configuration is recommended.

Waters 510 Pump Configurations for Binary Gradients

Parameter	Traditional	Optimized
Number of pumps	2	2
Number of solvents	2	2
High pressure limit	6000 psi	6000 psi
Mixer	Pulse dampner	**Gradient Mixer P/N 51518**
Delay volume	about 2.5 mL	**0.5 mL**
Compositional ripple	Higher	**Lower than traditional configuration**