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Enhanced Sample Delivery Mechanism for Ultra Low Dispersion and Carryover Performance

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The needle-in-flow-path design of the ACQUITY UPLC PLUS Series Sample Managers (FTN-H and FTN-I) deliver high-precision injections with excellent sample recovery. This sample delivery system gives laboratories the flexibility of working with a wide injection range for a wide variety of LC.

GOAL

Design considerations for a simple and flexible sample delivery system suitable for a variety of LC separations. Optimization of precision, accuracy, and carryover performance is preserved across a broad injection volume and application range.

BACKGROUND

There are two common injector design strategies used in autosamplers, the fixed-loop and the needle-in-flow-path designs. Each approach has its benefits and/or drawbacks in terms of performance, throughput, and usability. The alternative designs allow an analyst to choose the solution that is best for their chromatographic goals. Fixed-loop designs are preferred for applications that require the lowest extra-column band spread for high resolution separations. They also tend to have the fastest cycle times since the needle is off-line during analysis for cleaning and next injection preparation. However, these autosamplers often require the injection mode to be carefully selected for optimal performance.

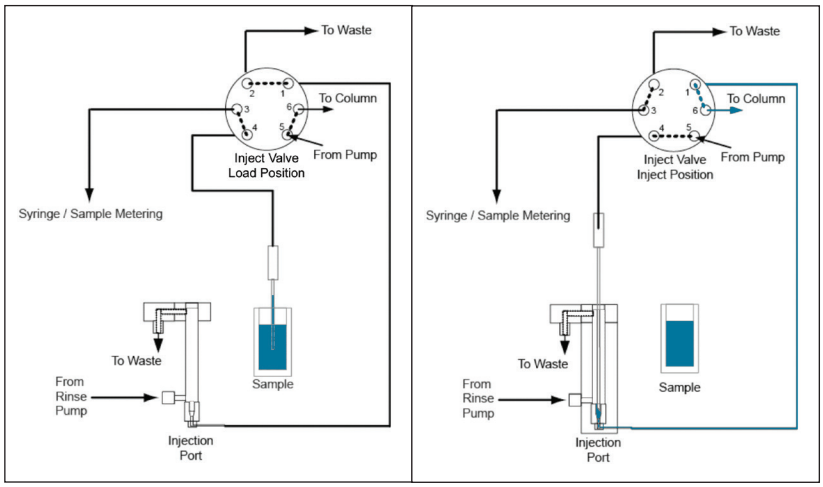

Figure 1. The fluidic path of the ACQUITY™ UPLC™ PLUS Series FTN Sample Manager in both the load and inject positions.

Comparatively, autosamplers that utilize a needle-in-flow-path design provide the greatest flexibility and ease of use. This style of sample delivery typically offers the widest injection volume range without the need for multiple configuration changes. Most importantly, it requires very little method development for optimal performance.

THE SOLUTION

ACQUITY UPLC PLUS Series with its flow-through-needle sample manager (SM-FTN) addresses two design challenges for reliable UPLC performance: robust sealing of the needle at high pressures, and minimizing the potentially negative contribution of the LC on separation performance in efforts to preserve chromatographic performance. These challenges have been addressed with innovative design features and are highlighted by taking a detailed look at the injection sequence (Figure 1). Once an injection is initiated, the inject valve diverts flow from the needle so it can collect sample from the vial. The sampling mechanism is an RΘZ configuration (versus XYZ) in which the needle only moves in a diagonal direction and the sample tray rotates to position the vial under the needle's path. The needle is lowered into the vial to withdraw the exact volume requested and returns to the injection port. The needle lowers and pushes against the internal sealing surface of the port. A force transducer measures the sealing force and only applies the pressure needed to seal to 15,000 psi, ensuring that no leaks will occur and the lifetime of the sealing surface is maximized. Finally, the injection valve turns and the sample is pushed down the injection port, through the injection valve, and out to the column. The injection port is located as close as possible to the inject valve to minimize dispersion of the sample as it travels to the chromatographic column. After the injection is made, the needle is washed for a specified amount of time to minimize sample carryover. With the flow-through needle design, the wide injection volume range required to run both HPLC and UPLC applications is achieved. The system's flexible design is still ideally suited for low dispersion UPLC separations with typical band spread of 8 to 9 µL (Figure 2).

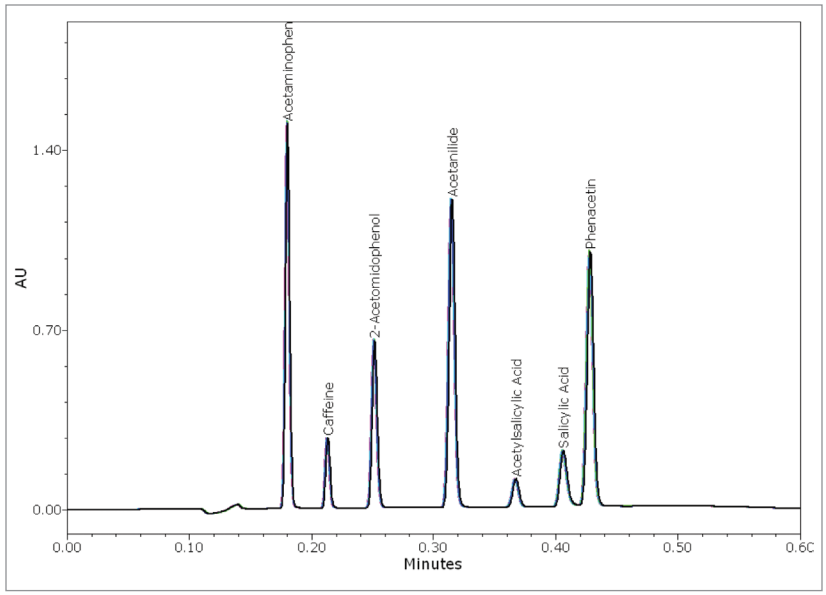

Figure 2. The ACQUITY UPLC PLUS Series was designed to support HPLC, UHPLC, and UPLC separations with exceptional accuracy, precision and linearity.

SUMMARY

The ACQUITY UPLC PLUS Series was designed to maximize separations performance and flexibility for research, development and routine analysis applications. The FTN-H/FTN-I autosamplers fit into the workflow of these laboratories by offering a simple, flexible design while maintaining the performance requirements of low-dispersion UPLC separations.

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