TECHNICAL NOTE

Liquid Chromatography

PerkinElmer LC 300 Autosampler Intermediate Loop Decompression (ILD) Injection Valve

Features

- The ILD™ injection valve ensures injection of an accurate and reproducible sample volume
- The ILD injection valve minimizes the pressure drop during injection that is observed for traditional injection valves
- The ILD injection valve can improve column lifetime by preventing pressure shock to the column during valve switching

Injecting an accurate sample volume with excellent reproducibility into an ultra high performance liquid chromatography (UHPLC) system is challenging. At the start of analysis, prior to sample aspiration into the sample loop, the injection valve is in the inject position. In this position, the sample loop is under ultra-high pressure as mobile phase is flowing from the LC pump through the sample loop to the LC column. For full loop and partial loop fill injection modes, when the injection cycle starts, the syringe fills the needle and some of the buffer tubing with sample to prepare to load the sample loop. The injection valve switches to the load position causing the compressed liquid in the sample loop to expand at the outlet, into the sample needle. This results in an uncontrolled dilution of the sample at the inlet of the sample loop, and although the syringe draws a correct sample volume into the loop, part of the sample has been diluted owing to the change from high pressure to ambient pressure as the valve switches. Introducing a sample volume into the UHPLC system that has been partially diluted results in peaks that represent an inaccurate analyte concentration.

Figure 1. Intermediate Loop Decompression (ILD) injection valve.

During an injection cycle, the injection valve will switch from the inject position to the load position and then back to the injection position. Each of these valve switches causes the column to experience a relatively large drop in pressure. Over time, this can cause channeling and other disruptions to the column packing, negatively impacting column performance and leading to shorter column lifetimes. This is especially true for sub-2 µm particle columns commonly used with UHPLC instrumentation, as these columns are more susceptible to damage from large pressure fluctuations.

PerkinElmer®
For the Better

The patented Intermediate Loop Decompression (ILD™) injection valve (Figure 1) in PerkinElmer's LC 300 family of autosamplers solves this problem.[1] The ILD injection valve is a 7-port valve with a strategically placed radial groove in the rotor seal (Figure 2). This radial groove is connected to an additional waste outlet port in the center of the valve (Figure 3). This allows for decompression of the sample loop when the valve switches position from ultra-high pressure (inject) to ambient pressure (load). When the injection valve switches into the load position, the radial groove passes by one of the sample loop ports (position 2 on the valve). The liquid in the sample loop is then allowed to expand via the central outlet port to waste, releasing pressure. Therefore, the sample loop will be at ambient pressure as the valve continues to switch and arrives at the load position. This is called Intermediate Loop Decompression. Automated synchronization controls the exact timing and speed of switching the injection valve. When the valve switches to the inject position, the LC pump, before the valve is fully switched back, assists in minimizing the pressure drop during injection by briefly maintaining the operating pressure.

Thus, the ILD injection valve ensures that an accurate sample volume will be injected onto the UHPLC system every time, and that the column does not experience quick pressure increases or decreases during the injection cycle. The result is excellent reproducibility and longer column lifetimes.

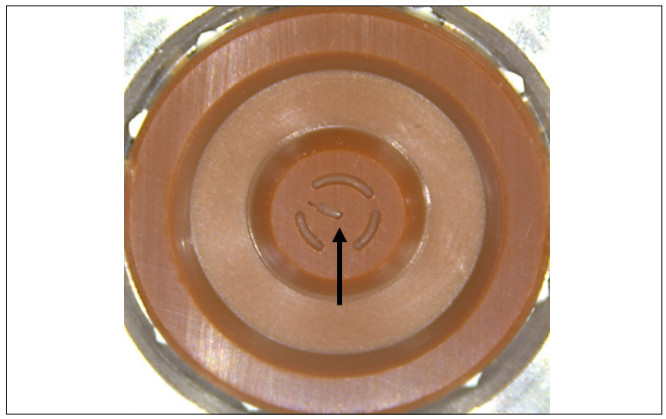

Figure 2. ILD injection valve rotor seal, arrow pointing to the additional radial groove in the center of the rotor seal.

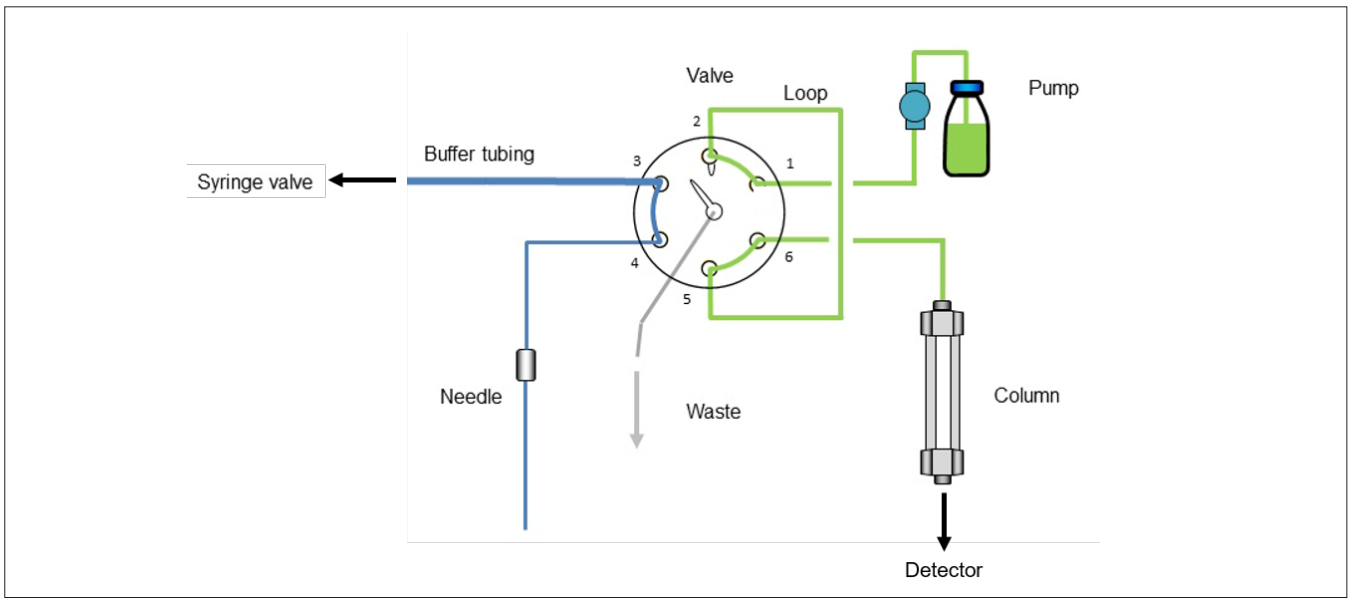

Figure 3. Schematic of ILD injection valve plumbing (valve shown in the inject position).

References

1. U.S. Patent No. 8,322,197 B2, European Patent No. 2196801

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com

PerkinElmer®

86980 PKI