

Solution to Increased Pressure in Analytical Laboratories

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Principal Engineer
Waters Corporation

Haydon Kerk Motion Products help Waters Corp make a Large Splash with a Small UPLC Unit

Pricing pressures, intense competition and strict regulatory demands are challenging scientists and researchers in the fast-growing, highly regulated pharmaceutical, life-science, biochemical, industrial and environmental industries to make important breakthroughs faster and more efficiently.

Heightened productivity in scientific labs has become paramount for companies to succeed. Waters Corporation, a leading manufacturer of high-performance liquid chromatography instruments, mass spectrometers and thermal analyzers and rheology instruments, understands this pressure first-hand. As a major supplier to analytical laboratories around the world, Waters is known for its continual commitment to providing innovative solutions that help customers better understand the secrets of chemistry.

The Creation of a New Category in Separation Science

Waters’ reputation as a creator of pioneering technology was highlighted with the release of ACQUITY Ultra Performance Liquid Chromatography™ (UPLC), a category of separation science. UPLC represented a revolutionary improvement over High Performance Liquid Chromatography (HPLC), the widely accepted chemical separation technique. By offering increased resolution, sensitivity and speed, UPLC greatly improved productivity and provided scientists with considerably more information in a single run.

The new system uses the power of 1.7-micron particles to give laboratories as much as nine times higher throughput, three times higher routine sensitivity, and two times greater resolution or peak capacity than current HPLC instruments can achieve with larger particles.

Additionally, the UPLC process reduces time and cost per sample from the analytical process. Rather than one minute to analyze each sample, Waters’ UPLC System cuts the minimum analysis time down to a mere 15 seconds. The 75% reduction per sample, multiplied by the millions of samples that the typical laboratory analyzes, results in dramatic time savings and process improvement.





As with most breakthrough products, the development of UPLC did not come without challenges, but rather required considerable collaboration on many levels.

Design Challenge: Achieving High Performance with a Small Footprint

While the performance of the ACQUITY System was certainly at the forefront for Waters' engineers who developed the product, it was not their sole design criterion. Management envisioned a system that would offer a much smaller footprint than traditional HPLC systems and ensure that it would consume less of a laboratory's valuable bench space. The compact footprint would also allow users to more easily stack and arrange various modules. Waters' engineers hoped that a completed basic system would consist of a sample manager, one of several UPLC detectors, and a high-pressure pump. Several upgrades would also be available, including a high-capacity sample organizer.

Accomplishing this goal required the use of smaller internal components in the main unit and the optional module, which holds an additional 21 sample plates. Initial efforts to create required parts did not yield desirable results, according to Ken Plant, a principal engineer on the Waters' UPLC project. "Initially we attempted to devise a homemade solution, an adaptation of a mechanism we had developed about eight years ago," he explained. "That mechanism created an XYZ movement to replace our traditional Z rotational movement and had served us quite well in our older models.

However, a system of off-the-shelf pulleys and belts simply could not be squeezed into the smaller footprint we were looking for. If it was going to happen, we knew it would require some truly 'out-of-the-box' thinking. "More to the point, it became clear that in our effort to produce this compact mechanism, we could benefit from the use of specialized outside resources."

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Solution: Customized Motion Control from Kerk

One of Plant's colleagues had worked with a company called Haydon Kerk Motion Products when he was involved in the automation industry, and he felt that Haydon Kerk might be able to offer the optimal combination of reliability and miniaturization for this mechanism.

After consulting with Waters' engineers, Haydon Kerk presented Waters with components that would allow engineers to produce a sample manager – the heart of the UPLC system – that would meet the company's reduced size requirements and produce the increased speed and performance that was so vital to the UPLC concept.

"We considered several vendors, but Haydon Kerk had the best set of performance data," said Plant. "While other vendors were selling off-the-shelf commodity items, Haydon Kerk's tailored-made products allowed for customization and flexibility to react to customer needs. We were impressed that Haydon Kerk was willing to work with our engineers to customize components and ensure that they would mesh into our system."



Haydon Kerk was quick to recognize the creativity demonstrated by Waters' engineers. "At Haydon Kerk, we take pride in being a provider of innovative solutions," says Haydon Kerk's applications engineer. "Waters has effectively utilized our products and resources and has achieved a truly remarkable solution to a difficult design challenge."

Within the sample manager, Haydon Kerk components are being utilized to drive the robotic XYZ mechanism holding the needle that draws liquid samples from each sample plate. To achieve the X and Y movements, the ACQUITY arm incorporated one Kerk ¼-inch lead screw and two specially adapted Kerk nuts, and the Z motion was accomplished through two Kerk spline shafts and splined bushings.

In the optional sample organizer, a ½-inch lead screw and anti-backlash nut was employed to produce the Z axis motion, which allowed the robotic machine to shuttle as many as 21 sample plates back and forth to the sample manager.

The spline shafts, which run parallel to each other and feature custom splined bushings, provide a drive mechanism for two axes of motion. They are excellent alternatives for applications where hex shafts or square shafts are used (Waters' original mechanism utilized square shafts). The assembly utilizes lightweight alloy steel spline shafts treated with Haydon Kerk's proprietary low friction Kerkote® TFE coating mated with Kerkite® composite polymer bushings.

It wasn't simply performance or size that made the Haydon Kerk components so desirable. "Haydon Kerk's products offer extremely long wear-life," Plant said. "This was a critical consideration, as our chromatography systems need to operate at a very high level of reliability. Continuous uptime is very important to most of our customers."

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– Dr. Anton D. Jerkovich
Novartis Pharmaceuticals Corporation
Waters Corporation customer

Results: Good Things Come in Small Packages

The launch of the UPLC has been a tremendous success, with praise from countless customers, including some of the world's most prestigious pharmaceutical companies. "The ACQUITY UPLC (System) will become the choice for the development of fast LC methods in the pharmaceutical industry," said Dr. Anton D. Jerkovich of Novartis Pharmaceuticals Corporation, a Waters customer.

The success of the ACQUITY System is also reflected in the sales figures; Waters has sold more than 1000 core units, and expects sales will continue to increase.

With the help of Haydon Kerk Motion Products – good things do indeed come in small packages. ■