LC-MS

Beyond discovery

All-in-one nano-, capillary- and micro-flow Vanquish Neo UHPLC system binary pump

The Thermo Scientific™ Vanquish™ Neo UHPLC system is equipped with a novel high-pressure binary gradient pump, which supports continuous and uninterrupted flow delivery covering the full range of nano- to micro-flow applications with highly reproducible long or short gradients. Unique active flow control over the entire flow range makes it suitable for virtually any high-sensitivity LC-MS application without requiring pump hardware changes (Figure 1). The ultra-high pressure pump capable of up to 1,500 bar (21,750 psi) (Figure 2) offers broad compatibility with state-of-the-art UHPLC columns and permits fast sample loading and column washing and equilibration for increased sample throughput.
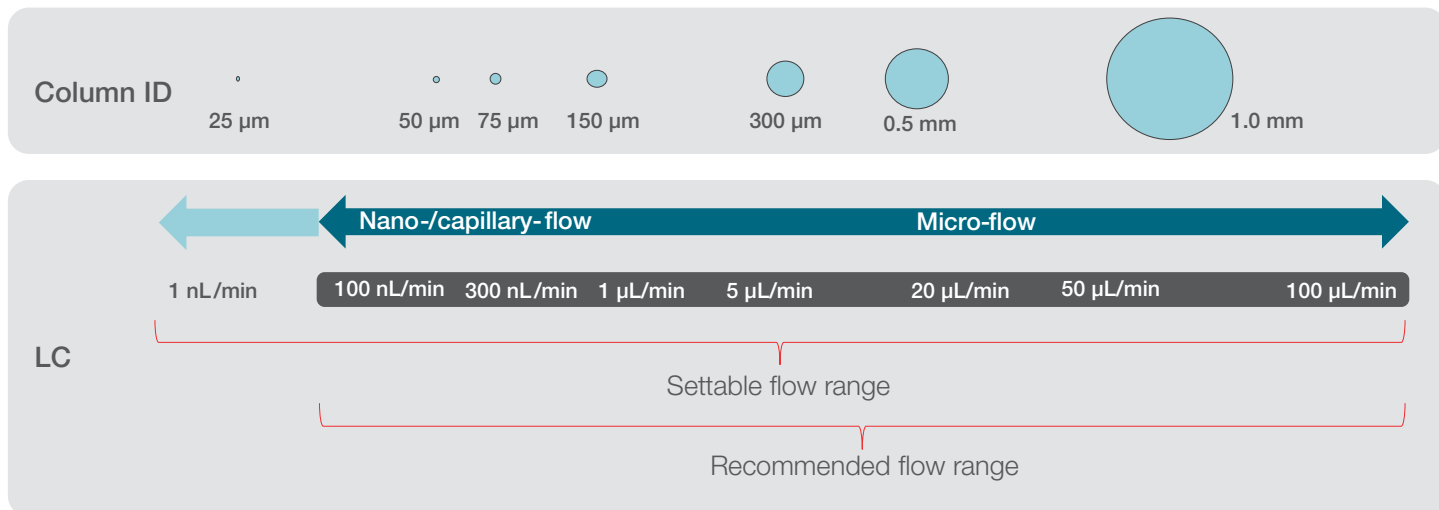

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Figure 1. The Vanquish Neo UHPLC system flow rate range matches perfectly with nano, capillary and micro column requirements, with a settable range from 1 nL/min to 100 µL/min and a recommended range from 100 nL/min to 100 µL/min.
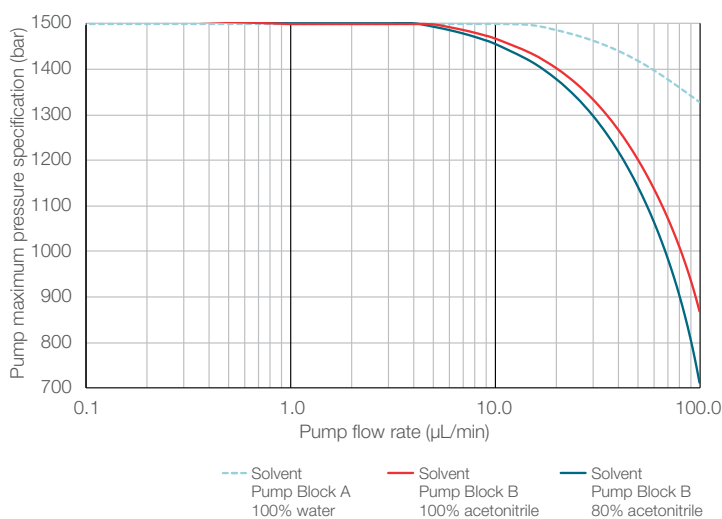

Figure 2. Flow-pressure footprint for the Vanquish Binary Pump N operated with 100% water for Solvent A and different compositions for Solvent B. The pressure up to 1500 bar is available for flow rates up to 3 µL/min. In the range from 3 µL/min to 100 µL/min the maximum available pressure for the column gradually decreases depending on the flow rate and solvent viscosity.

Fast sample loading and fast column equilibration increase productivity

The Vanquish Neo UHPLC system allows the user to define column dependent variables, such as dimensions, maximum flow, and maximum pressure in the "Fluidic Setup" (Figure 3). These parameters are then used by the system to set default method parameters and pump limits during method creation. This prevents accidental damage of consumables caused by settings that exceed specifications.

The Vanquish Binary Pump N offers options for fast sample loading and fast equilibration which are particularly important when optimizing the throughput for nanoLC applications where the transfer of the sample to column and column equilibration at nano flow rates are often the limiting steps.
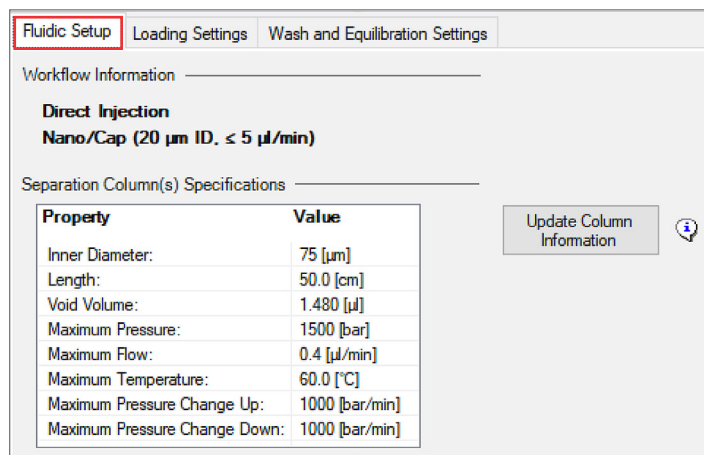

Figure 3. "Fluidic Setup" panel in Vanquish Neo instrument method editor.

If "Fast Loading" and the "Pressure Control" loading mode are activated (Figure 4), the pump will increase the flow for sample loading until the user or consumable specification-defined pressure is reached. Alternatively, the user can define the flow rate under which sample loading should occur by selecting "Flow Control" in the mode box. When selecting "Combined Control" mode, the pump operation will be limited by either the flow or the pressure, depending on which limit is reached first.

Independent of the selected loading mode the novel LC system-based intelligence precisely calculates the volume of delivered solvent. When the "Loading Volume" parameter is set to "Automatic", the volume required to transfer the complete sample plug to the separation column during the loading step is calculated by the system for any sample injection volume set by the user in the sequence.

In the same way, the duration of the column equilibration phase, which might also be a major contributor to the run cycle time in many applications, can be reduced using "Fast Equilibration" settings with options to enable "Flow Control", "Pressure Control" or "Combined Control" pump operation modes for accelerated column equilibration (Figure 5). By setting the "Equilibration Factor" the user defines the number of column void volumes that the system will deliver to equilibrate the column at the end of the run. The system automatically calculates the column void volume based on the information about column dimensions (length and internal diameter) entered in the "Fluidic Setup".

The "Fast Loading" and "Fast Equilibration" features allows to increased throughput by exploiting the 1500 bar pressure capabilities of the Vanquish Neo UHPLC system (Figure 6 and Table 1).
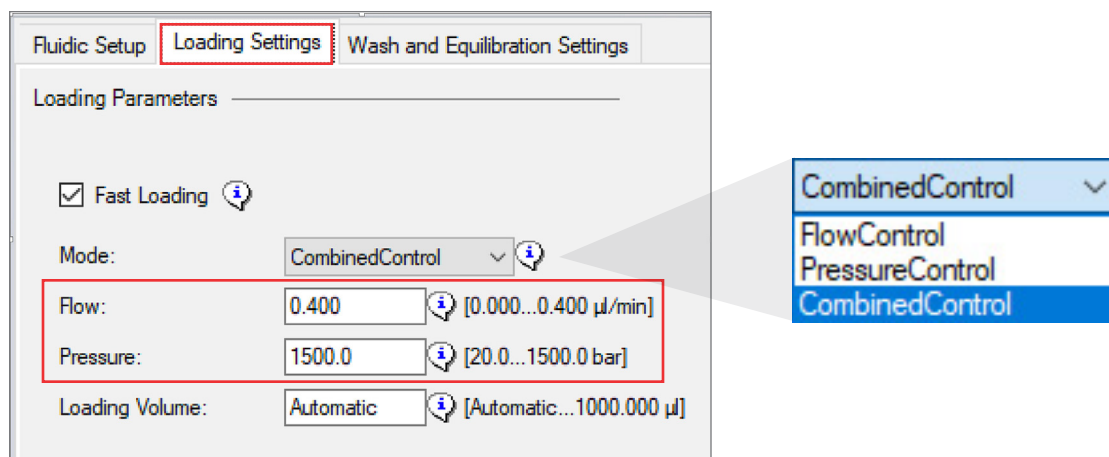

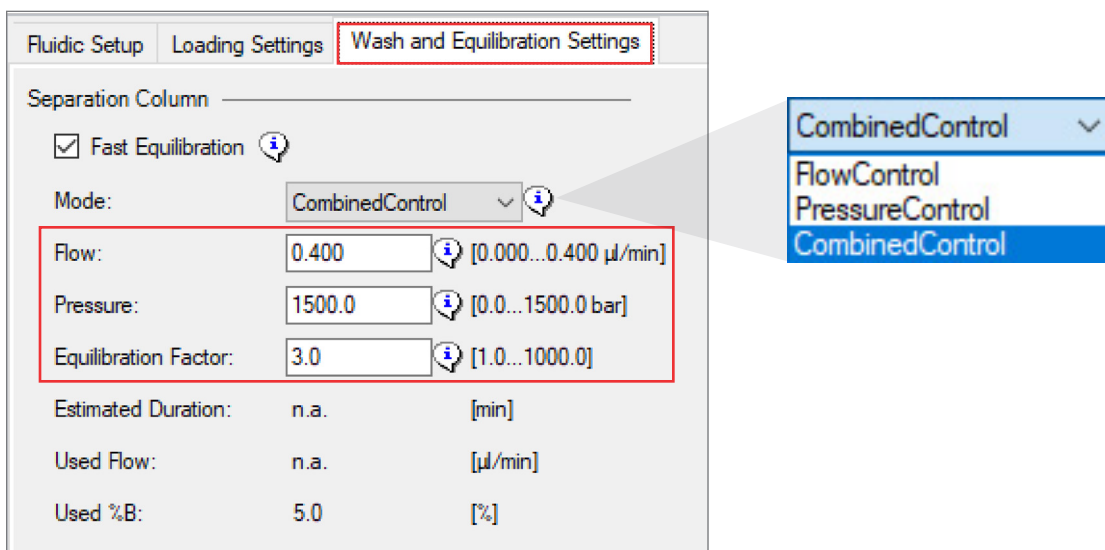Figure 4. "Fast Loading" parameters in Vanquish Neo instrument method editor.

Figure 5. "Fast Equilibration" parameters in Vanquish Neo instrument method editor.
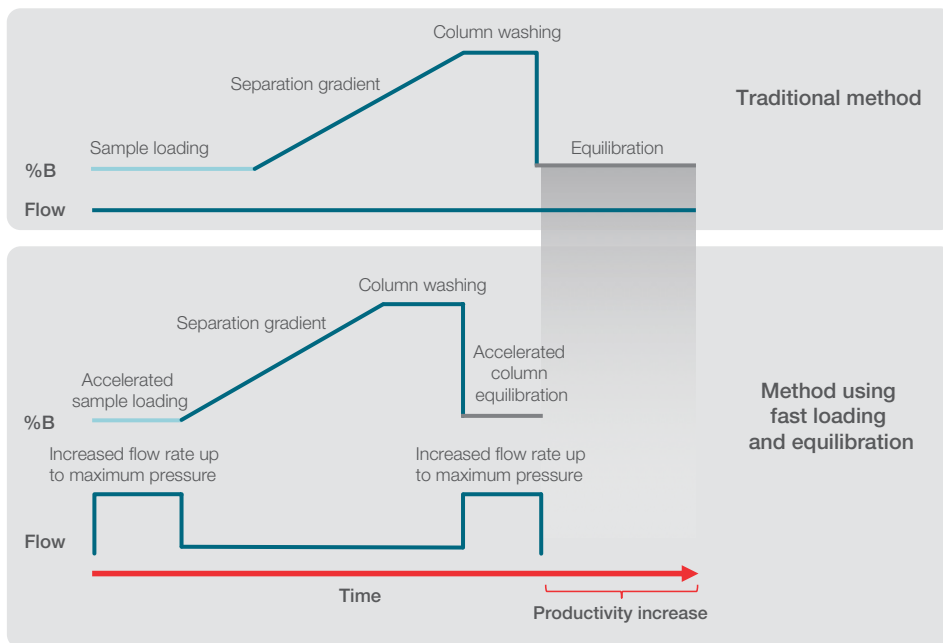
Figure 6. "Fast Loading" and "Fast Equilibration" features enable productivity.

ProFlow XR technology with active flow control for industry-leading gradient precision and reproducibility

LC-MS applications using nano-, capillary- and micro-flow rates require precise flow delivery by UHPLC pumps to ensure reproducible and accurate gradient formation. Thermo Scientific™ ProFlow™ XR technology comprises the most sensitive and accurate flow measurement technology available for active flow control across the entire flow rate range. Active flow control minimizes the influence of even small leakages in the pump and leads to best-in-class performance. All Vanquish Neo Binary Pumps are factory pre-calibrated for the most commonly used LC-MS solvent blends and are standardized against a factory standard, resulting in high pump-to-pump reproducibility. The factory calibration procedure utilizes an advanced multi-point flow-calibration algorithm yielding precise and reproducible flow delivery without the need for regular recalibration. A custom solvent calibration routine, combined with a self-guided user wizard is available for applications requiring other solvent types.

The most reliable pump technology for a new standard in nano-, capillary- and micro-flow UHPLC

Large sample cohort LC-MS analysis requires the utmost LC-MS system dependability and robustness. The Vanquish Binary Pump N is equipped with several unique technological features making it the standout leader in durability. Active shut-off valves in the solvent lines reduce uncontrolled pump pressure fluctuations resulting in an increased tolerance to solvent outgassing. Sealless pressure sensors eliminates potential leak paths, significantly reducing the risk of leaks or malfunctions. The pump pistons coated with diamond like carbon (DLC), an extremely wear resistant material, affords increased robustness and piston lifetime, even under conditions of high pressure and high stress.

Smart features for seamless pump operation, day in and day out

LC pump purging for air bubble removal is often required after solvent exchange and before system operation. For low-flow UHPLC systems these can be time-consuming procedures requiring multiple manual user interventions. The Vanquish Neo pump offers fully-automated pump and flow meter purging routines, eliminating the need for manual intervention. These standard routines can also be executed and monitored remotely. Furthermore, disconnecting solvents prior to pump maintenance is now a thing of the past thanks to the automatic shut-off valves installed in front of the pump inlets (Figure 7).
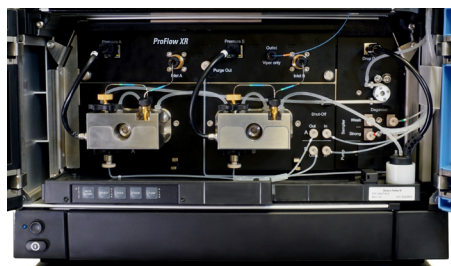

Figure 7. Binary Pump N with open doors.

Table 1. The estimated throughput increase for three typical "Direct Injection" workflows (1 µL injection volume with 5 µL loading volume) when using the "Fast Loading" and "Fast Equilibration" features.

	75 µm × 15 cm column		75 µm × 50 cm column		1 mm × 15 cm column	
Fast loading and fast equilibration	OFF	ON	OFF	ON	OFF	ON
Flow rate during loading and equilibration	Constant at 300 nL/min	Variable*–up to 1500 bar	Constant at 300 nL/min	Variable*–up to 1500 bar	Constant at 50 µL/min	Constant at 100 µL/min
Gradient length	24 min	24 min	60 min	60 min	16 min	16 min
Column equilibration, sample pickup, and loading	30 min	6 min	36 min	14 min	6 min	4 min
Cycle time	54 min	30 min**	96 min	74 min**	22 min	20 min
Injections per day	27	48	15	20	65	72
Productivity increase (%)	–	81%	–	30%	–	11%

* Depends on column backpressure.
** Calculated using the typical back pressure generated by a column packed with porous 2 µm particles.

Learn more at **thermofisher.com/vanquishneo**

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