

Thermo Scientific Vanquish Core HPLC System Cost of Ownership

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Introduction

The Thermo Scientific™ Vanquish™ HPLC and UHPLC systems provide best-in-class flexibility, efficiency and productivity for HPLC & UHPLC applications in both single channel and dual channel options. The latest addition to the Vanquish platform, the Thermo Scientific™ Vanquish™ Core HPLC system, directly addresses the challenges of routine analysis laboratories. The Vanquish Core HPLC system builds upon the many innovative and robust features inherent to the Vanquish platform, with further enhancements that enable system intelligence, exceptional ease-of-use, and smart diagnostics. In this whitepaper, we quantify the direct benefits that these features bring to your laboratory in terms of reduced cost of ownership.

Improved system operation due to hardware performance

Many modern pharmacopeias, including the U.S. Pharmacopeia, have hundreds of monographs using 5 µm particle size columns. Now, with growing frequency, fast HPLC and UHPLC monographs are being published using sub-3 µm particle columns. Consequently, it is important for a modern chromatography system to be able to comfortably accommodate both traditional HPLC

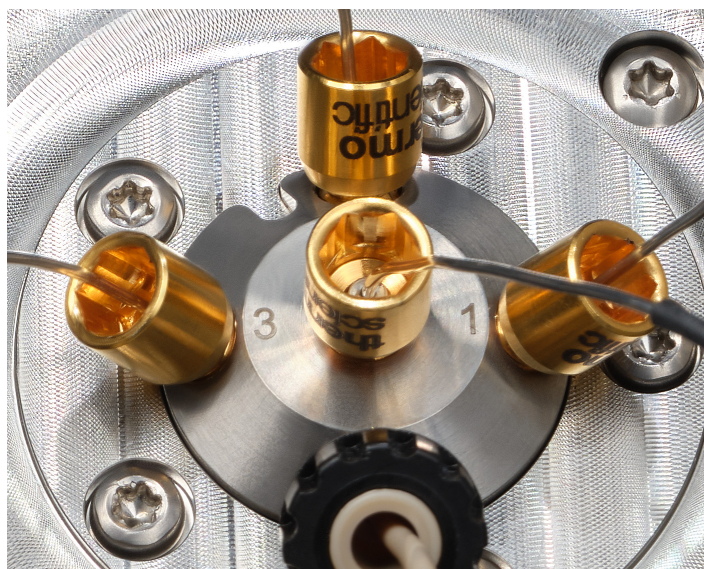


Figure 1. Viper Fingertight Fittings ensure leak-free connections with near-zero dead volume

methods utilizing 3 – 5 µm HPLC Columns, as well as more modern sub-3 µm UHPLC methods on a single system. HPLC instruments designed for routine analyses typically accommodate between 400 to 600 bar maximum pressure. The Vanquish Core HPLC System provides operation up to 700 bar, ensuring that more modern chromatographic methods can also be run on this system with ease. The Vanquish Core HPLC System, like the rest of the Vanquish platform, utilizes Thermo Scientific™ Viper™ Fingertight fittings (figure 1) that ensure connections are virtually dead-volume free and leak free up to 1500 bar without the need of any tools. First implemented on the Thermo Scientific™ Vanquish™ Horizon UHPLC system, the Vanquish Core HPLC system makes use of Thermo

Scientific™ SmartInject technology, ensuring virtually no pressure spike at the time of injection, greatly reducing the wear on the column and thereby extending its life (See [AppNote 72362](#)). The “Prepare Next Injection” option (see [TechNote 172](#)) enables the user to prepare the next injection, eliminating the time required to move the sample carousel and the needle and to aspirate the sample. Saving a few seconds per injection, this feature provides significant time savings over the course of months and years, particularly for high throughput laboratories.

In addition, the Vanquish Core HPLC System allows the user to automatically purge/prime mobile phase lines, freeing up the analyst to perform more value-added activities, further improving laboratory productivity. To meet the method requirements and preferences of the laboratory, the Vanquish Core HPLC System has several pump options, including isocratic, quaternary, binary, and dual gradient, enabling the analyst to select the best option that emulates legacy LC system behavior, and streamlining analytical method transfer to a more modern LC platform.

Table 1. Estimated laboratory costs and usage (for an average lab using any vendor’s instruments & software i.e. samples per day and minor interruptions per year for any vendor’s HPLC.)

Description / Parameter	Summary
Labor costs (FTE – Full Time Employee) covering salary, benefits, facilities, taxes.	380 USD/day
Cycle time for typical sample analysis	25 min/Sample
Hours of sample analysis	10 hours/day
Daily sample throughput	24 Samples/day
Days of operation per year	250 days/year
Annual sample throughput	6000 Samples/year
Sample revenue	30 USD/Sample
Average flow rate	1000 µl/min
Solvent use	600 ml/day
Solvent use per year	150 L/year
Column lifetime	500 Samples/Column
Column cost	500 USD/Column
Columns usage	12 Columns/year
Number of purges	1 Purge/day
Average number of minor system interruptions (running dry, leaking valves etc.)	2 Interruptions/year
Average (Internal) time spent troubleshooting and documenting minor interruptions	1 days/Interruption
Average number of major system interruptions (cannot be solved within a day)	1.5 Interruptions/year
Average (Internal) time spent troubleshooting and documenting major interruptions	2 days/Interruption
Average time spent by service to repair major interruptions (to running samples)	4 days/Interruption
Average service cost (time) of one call out (major interruption)	2000 USD/Call-out
Average material cost of one service call out (major interruption)	600 USD/Call-out

Table 2. Improved system operation and associated benefits due to hardware performance

Description / Parameter	Metric	Benefit	Samples
Viper fittings total	60 mins/year	2.4	Additional samples per year
Time saved per column change due to tool-free ease of use	5 mins/Column	\$72	Additional sample revenue
Viper fittings total	1250 mins/year	50	Additional samples per year
Time saved due to application (column and capillary) switching	5 mins/day	\$1,500	Additional sample revenue
SmartInject total	150 Samples/Column	2	Fewer columns per year
Percentage increase in column lifetime due to reduced pressure shocks	30%/Column ¹	\$1,000	Reduced spend on columns per year
Prepare next injection total	0.24 Samples/day	60	Additional samples per year
Time saved per injection due to preparing the following injection	0.25 mins/Sample	\$1,800	Additional sample revenue
Automatic purge total	500 mins/year	20	Additional samples per year
Time saved to manually purge the instrument	2 mins/Purge	\$600	Additional sample revenue
700 bar system back pressure total	2.67 Samples/day	667.5	Additional samples per year
Time saved by running a faster method (modernized) compared to the original	2.5 mins/Sample	\$20,025	Additional sample revenue

Improved system operation due to system intelligence

The Vanquish Core HPLC system comes with many new features that increase system intelligence, reducing the requirements of the user and avoiding interruptions before they happen. One of these innovative features includes System Health Checks, which can be scheduled to run automatically and unattended during times when the system is not in use. System Health Check results are logged over time, enabling operators to evaluate changes in performance and identify potential causes. Any decline will alert the user allowing them to proactively avoid unexpected instrument down time and prevent samples from needing to be re analyzed. By minimizing the likelihood of out-of-specification results due to instrument failures, improved data compliance can be realized. In addition, diagnostic tests can be performed when the system is idle, enabling the analyst to locate the problem more quickly, reducing downtime significantly.

An additional productivity enhancement is the Thermo Scientific™ Vanquish™ Solvent Monitor, enabling the analyst to measure current solvent and waste levels of up to 8 solvent/waste containers, ensuring the HPLC system has sufficient eluent and waste capacity to execute the sample sequence. The Vanquish Solvent Monitor comes with a selectable option which will only allow to start a new sequence if enough solvent is available, virtually eliminating error associated with inadequate eluent supply that would result in unexpected instrument downtime. If eluents exceed a defined threshold, the system presents visual indicators and warning messages regarding the problem that needs to be addressed. Therefore, the user is much less likely to let a system run dry, reducing the number of wear parts and consumables required over the life time of the system, reducing total cost of ownership.

An additional novel feature is the Vanquish User Interface, providing a beautiful overview to the system status at a glance (figure 2). The user must no longer log into the computer and log into the CDS, just to see the status of the system. Pump pressure, solvent levels, and equilibration status and other common parameters can be viewed instantly, reducing the time needed to log on multiple times per day and improving accessibility to the instrument's performance. The [Vanquish User Interface](#) displays step-by-step interactive guides to assist the operator in troubleshooting poor performance (such as increased baseline noise), and then provides the corresponding maintenance video to ensure the system is back up and running as quickly and efficiently as possible.



Figure 2. Vanquish User Interface

Table 3a. Improved system operation due to system intelligence

Description / Parameter	Summary
Health checks Percentage decrease in major interruptions per year due to health checks & warnings	0.375 Interruptions/year 25 %/year
Diagnostics Percentage decrease in time required for service engineer to diagnose when called out for major interruptions	1 day/Call-out 25 %/Call-out
Troubleshooting with Maintenance Videos Percentage decrease in time required for troubleshooting internal minor interruptions	0.5 day/Call-out 50 %/year
Solvent Monitor Percentage decrease in minor interruptions per year due to SOP adherence and avoided system running dry	0.2 Interruptions/year 10 %/year
User Interface Minutes saved checking on system performance by logging into the PC and looking at the CDS	41.67 hours/year 10 mins/day

These numbers are an estimation only. Your actual results will depend upon parameters unique to your laboratory

Table 3b. Related benefits due to system intelligence

Description / Parameter	Value	Unit	Per Unit	Summary	Benefit 1 (Internal Metrology)	Benefit 2 (Service)	Benefit 3 (Samples)
Health checks Percentage decrease in major interruptions per year due to health checks & warnings	0.375 25	Interruptions %	Year Year	0.375 Interruptions/year 25 %/year	0.75 Fewer FTE days per year \$285 Reduced FTE costs for metrology	1.5 Fewer service call-out days \$975 Reduced call-out cost for time & materials per year	54 Additional Samples per year \$1,620 Additional Sample Revenue
Diagnostics Percentage decrease in time required for service engineer to diagnose when called out for major interruptions	1 25	Days %	Call-out Call-out	1 day/Call-out 25 %/Call-out		\$500 Reduced call-out cost for time \$750 Reduced call-out cost for time per year	24 Additional Samples per year \$720 Additional Sample Revenue
Troubleshooting with Maintenance Videos Percentage decrease in time required for troubleshooting internal minor interruptions	0.5 50	Days %	Call-out Year	0.5 day/Call-out 50 %/year	0.5 Fewer FTE days per year \$190 Reduced FTE costs for metrology		12 Additional Samples per year \$360 Additional Sample Revenue
Solvent Monitor Percentage decrease in minor interruptions per year due to SOP adherence and avoided system running dry	0.2 10	Interruptions %	Year Year	0.2 Interruptions/year 10 %/year	0.2 Fewer FTE days per year \$76 Reduced FTE costs for metrology	4 Fewer Piston Seals per year need replacing \$200 Reduced materials costs per year	4.8 Additional Samples per year \$144 Additional Sample Revenue
User Interface Minutes saved checking on system performance by logging into the PC and looking at the CDS	41.67 10	Hours Mins	Year Day	41.67 hours/year 10 mins/day	5.21 Fewer FTE days per year \$1,980 Reduced FTE costs for metrology		100 Additional Samples per year \$3,000 Additional Sample Revenue

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Economic value due to reduced interruption costs

The Vanquish Core HPLC system reduces the likelihood of unplanned system downtime and enables analysts to get back to running samples much sooner if downtime is unavoidable (table 3a). In general, the Vanquish Core HPLC system acts as an additional staff member, always checking on system health and performance and making sure that the system is always prepared for the work ahead. Never again should the user need to log into the computer just to check the status and at a glance it should be clear if all is running well and if any solvent or waste containers need to be changed. This streamlining of the laboratory operations, via improved UI & UX (User Interface & User Experience), saves over **5 FTE** (Full Time Employee) days per year, translating into over **two thousand dollars** per year per system on average. Additionally, the system health checks, diagnostics, as well as troubleshooting & maintenance videos save on both internal metrology resources, as well as service costs. Together saving **over four thousand dollars** per system per year on average.

Finally, SmartInject allows you to replace columns less often, saving on average **two column purchases** or **one thousand dollars**. All together the Vanquish Core HPLC system saves the user an average of over **five thousand dollars** per system per year.

Economic value due to increased samples per year

The Vanquish Core HPLC System allows the user to run more profit generating samples per year due to its novel system intelligence features, resulting in a reduced number of interruptions as well as faster recovery from unexpected downtime should it occur (table 3b). With this consideration, time savings alone would allow almost **two hundred additional samples** to be run, which is almost **six thousand dollars** per year additional revenue (assume thirty dollars per sample). In addition, system performance and ease of use features such as Viper fittings, Prepare Next Injection, and automatic purge, save over **fifty hours per year**. These time savings can then be used for running additional samples, which is over **one hundred and thirty samples** and almost **four thousand dollars** per year additional revenue.

Further productivity enhancements can be realized if the analytical method can be modernized. By geometrically scaling the analytical method to a smaller particle technology column with equivalent resolving power, over **250 hours** can be saved, which is over 650 samples and over **twenty thousand dollars** per year additional revenue potential.

Therefore, if the analytical method is unchanged, the total increase in sample revenue due to the Vanquish Core is, on average, almost **ten thousand dollars** per year and if the analytical method is modernized this can an increase in almost **thirty thousand dollars** additional sample revenue per year.

Summary of the economic value of purchasing a Vanquish Core HPLC system

As you can see, the economic value that the Vanquish Core HPLC system can bring to your lab is significant. By increasing the UI & UX and making the instrument more intelligent, we can reduce the number of interruptions and reduce the time required to run samples again after unexpected interruptions. Additionally, by improving instrument performance, efficiency, and impact on wear parts and consumables, more time can be spent running samples and generating revenue.

On average, nearly **ten thousand additional dollars** in sample revenue due to saved time per system per year can be expected without changing your method. This improved value can be further enhanced if the method can be modernized, increasing revenue potential to nearly **thirty thousand additional dollars** per system per year.

Lastly, without any method modifications you can expect a total reduction in costs of over **five thousand dollars** per system per year. See Table 4 and Figure 2 for a summary of all values.

Table 4. Related Benefits due to System Intelligence

Original Method: OR	\$9,816	Total Increased Sample Revenue per Year
Modernized Method:	\$29,841	Total Increased Sample Revenue per Year
Original Method:	\$1,000	Reduction in Consumable Costs per Year
	\$2,531	Reduced Metrology Costs per Year
	\$1,925	Reduced Service Time & Materials Costs per Year
	\$5,456	Total Reduction in Costs per Year

These numbers are an estimation only. Your actual results will depend upon parameters unique to your laboratory

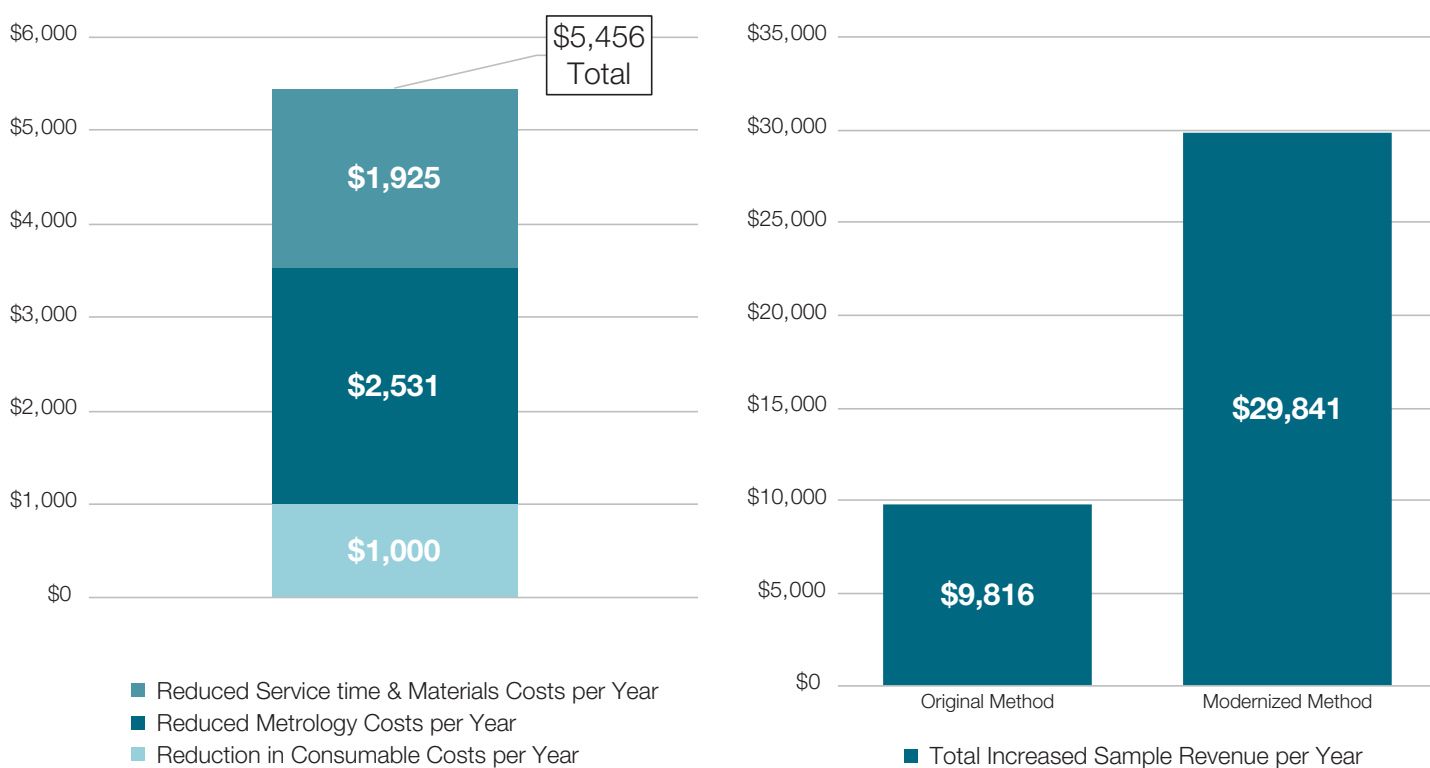


Figure 3. Visual summary of Cost Savings and Increased Sample Revenue per Year

References

1. *The HPLC-MS Handbook for Practitioners* edited by Stavros Kromidas. Page 214

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