

The Economic Value of Next Generation UHPLC Fluidic Connections

IDEX Health & Science Research & Development

Introduction

In this paper, fluidic connection experts from IDEX Health & Science explore the connection challenges facing modern UHPLC users. A practical review of the new MarvelX connection technology is presented to show how advances in connection technology enables users to achieve reliable performance to 19,000 psi with over 100 repeat uses, thereby reducing the overall cost to their UHPLC systems.

Performance

One of the biggest advances of next generation connections is that some products, like IDEX Health & Science's MarvelX, seal at the bottom of the connection port. This reduces and redefines the sealing area needed to make a connection capable of UHPLC pressures and significantly reduces the amount of force needed to properly install a connection. This reduction in force improves longevity of the fitting and reduces wear on the receiving port while maintaining high performance with a finger tight connection.

In the case of MarvelX, we can show (Figure 1) that installation force has been limited to 2 in-lbs of torque or less, while still maintaining an ultimate constant safe pressure rating of 19,000 psi (including a 1.5x safety factor.) The average UHPLC user is able to install

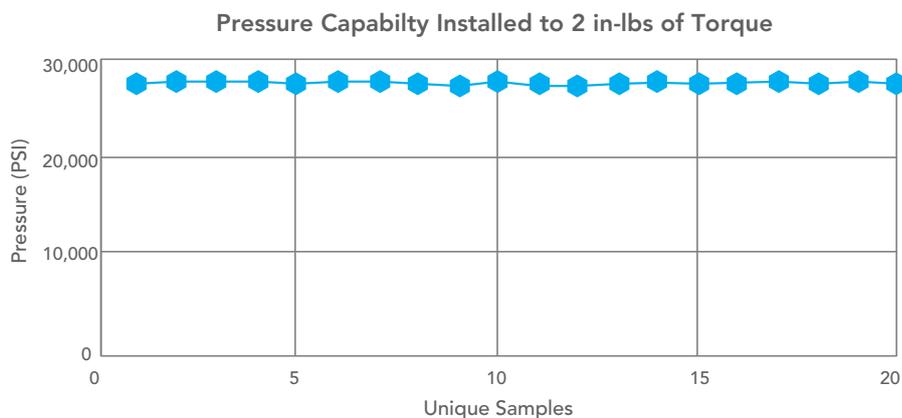


Figure 1. MarvelX SS 100µm ID x 350mm Long

this connection to 2 in-lbs without the use of tools. The fitting has been designed with a form that makes over-tightening by hand very difficult for a wide range of users. This combination of convenience and performance is not achievable with conventional coned fittings and sets this new style of connection apart.

The new sealing mechanism is also beneficial to mating components or receiving ports. When less force is needed to make a connection, there is less chance of damage to components, which can be witnessed in many common stainless steel mating parts as physical deformation or, in extreme cases, galling. It has

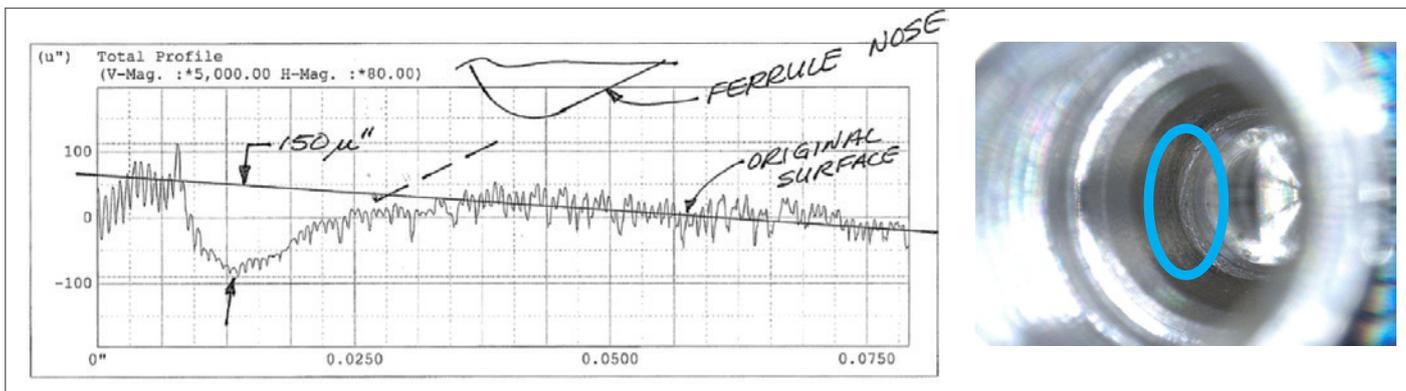


Figure 2. Receiving port profilometer trace and image of damage from a coned fitting

been shown that a metal coned fitting can indent a metal receiving port mating surface as much as 150 μ-inches (Figure 2) during a routine high force installation, typical of these conventional style connections.

By re-inventing the sealing mechanism and drastically decreasing required installation force with MarvelX, we avoid the potential to damage critical system components. When MarvelX is used with a properly manufactured UHPLC receiving port, the connection can be made and remade over 100 times while maintaining consistent performance. To demonstrate this, flow data was measured (Figure 3) for 5 unique samples over 100 repeat installation cycles.

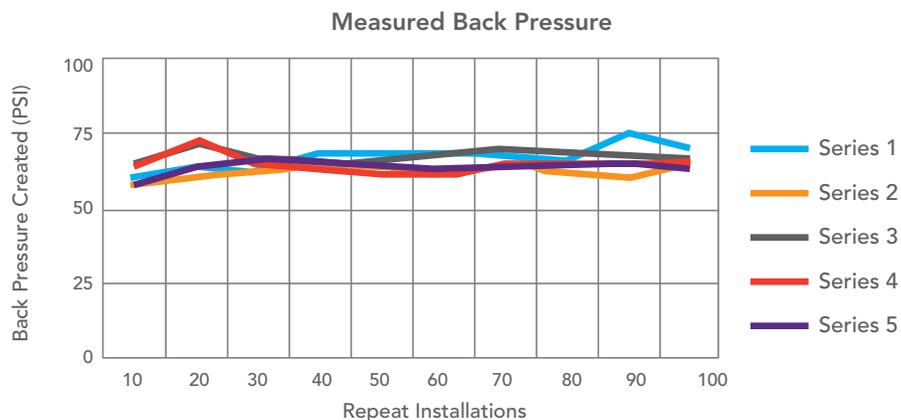


Figure 3. MarvelX SS 100μm ID x 350mm Long, Back Pressure

Back Pressure Performance was measured based on repeatability against a calculated tubing standard after every 10 repeat installations up to 100 cycles.

- Target Test Pressure: 19,000 PSI
- Test Flow Rate: 0.3mL/min
- Test Fluid: Water, Room Temperature
- Installation Torque: Approximately 2 in-lbs
- Calculated Max Back Pressure Allowed: 327 PSI
- Calculated Target Back Pressure: 97 PSI

Ease-of-Use

In addition to performance reliability in demanding UHPLC applications, we can compare connections for their ease of use, including features such as installation complexity and the ability to route through an instrument.

MarvelX has been designed to auto-adjust to various port depths (Figure 4), which can accommodate a range of receiving ports that include different valves and column manufacturers and models. The highlight of the design is that it is able to be used with industry standard 10-32 coned receiving ports, so no special considerations are needed when choosing mating hardware. Our data demonstrates that a single MarvelX fitting can be reused many times in different column ports or varying depth receiving ports and still make a high-performing, reliable seal. With most common connection products, a change to a new or different column would require a change of the connection as well.

Existing fittings and tubing for UHPLC are typically rigid stainless steel and can be difficult to bend and route to connection points. MarvelX is supplied with removable fittings and flexible tubing. Flexible tubing allows considerable leeway to route throughout an instrument, which is further eased by having only the tube to route, while the fittings can be installed subsequently. The separation of tubing from fittings also allows the tubing to be replaced independently of the fittings at a lower cost than

competitive products. Ease of routing, coupled with ease of fitting installation without tools, will significantly reduce the time required to make each connection.

In addition to reliable performance, enhanced re-usability and ability to use a connection in multiple different ports drive significant real economic value in UHPLC work flows.

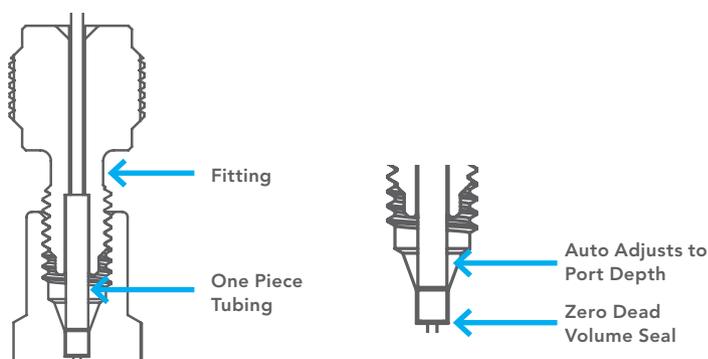


Figure 4. MarvelX Component Diagram

Economic Value

Let us examine a common application case for UHPLC connections and understand how MarvelX performance and ease of use can improve annual connection spending. This application case uses a common fitting system and 100µm ID, 350mm long stainless steel tubing in comparison to a stainless steel MarvelX with the same ID and length. This is connected to a column that will be changed once every four days.

	Common Connection System	MarvelX
Number of Instruments	3	3
Number of Connections per Instrument	1	1
Number of Connects/Disconnects per Day	0.25	0.25
Time to Install Each Connection (min)	1.7	0.5
List Prices for Each Connection	\$24	\$125
Cost of Labor to Install Connection (\$/Hr)	\$60	\$60
Number of Connections/Disconnects Before Replacement	1	100
Total Annual Connection Cost	\$4,626	\$465
Cost of Materials	\$4,320	\$375
Cost of Labor	\$306	\$90

Data above is based on

- 240 Working days per year
- List prices in the USA at the time of publication
- Properly installed connections used in industry standard applications
- The common connection system is replaced each time a column is changed to prevent dead volume

Conclusion

Reliable and high performing fluidic connections are important to maximize system value in UHPLC work flows.

MarvelX has been designed with robustness and ease-of-use in mind. The fitting can be finger tightened with no tools required. It simplifies and speeds installation reducing labor costs. Furthermore, any user can make

a perfect connection using MarvelX without any training or experience required. MarvelX auto-adjusts to the port depth and face seals at the port bottom every time it is connected minimizing additional internal volume in the system. The connection can be reused over 100 times in different ports so there is no need to replace connections when mating hardware is changed.

The level of robustness and ease of installation provide potentially thousands of dollars in savings to UHPLC labs even within a year time frame.

Find out how MarvelX™ adds real value to UHPLC applications at www.idex-hs.com/marvelx.

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