

THE NEW HALO® 1.5

# HALO®

A BETTER PATH TO SEPARATIONS



NEW DIMENSION • INCREASED SENSITIVITY • SOLVENT SAVINGS

TAKING SEPARATIONS TO A NEW DIMENSION

"I want more **sensitivity** with my conventional UHPLC system..."

"I need an **easy to use** microflow solution..."

"How can I get **more performance** from my LC and LCMS systems?"

"We have a goal to **reduce solvent consumption**..."

INNOVATION YOU CAN TRUST - PERFORMANCE YOU CAN RELY ON



# THE NEW HALO® 1.5 – DEFINING A NEW DIMENSION IN CHROMATOGRAPHY

The adoption of UHPLC instrumentation pushed LC separations to a new level of speed and resolution. In the years since, chromatographers continue to push separation limits in response to increasing challenges. How can I improve my separation in a faster time, or with less solvent consumption, increased sensitivity, or all of the above? While the specific drivers may be different, the overall goal is the same – ‘I need more, but without sacrificing anything’.

In 2006 Advanced Materials Technology broke from convention by introducing Fused-Core® particle technology to the market. These little HALO® particles delivered high-speed, high-performance separations without the consequence of high back pressures allowing scientists to adapt their HPLC systems to rival the UHPLC systems.

Now in 2022 AMT breaks new ground again with a 1.5 mm internal diameter HALO® column to push the boundaries of adopted UHPLC systems. Founded on all of the benefits of Fused-Core® particles, the HALO® 1.5 delivers increased sensitivity and reduced solvent consumption, allowing scientists to experience the benefits of capillary columns without the pains of specialized microflow systems.



## DELIVERING MORE PERFORMANCE

- ✓ More Sensitivity from conventional UHPLC Systems
- ✓ Higher Ionization Efficiencies from LCMS systems
- ✓ Reduced Solvent Consumption compared to 2.1 mm ID columns
- ✓ Easy to Implement microflow solution

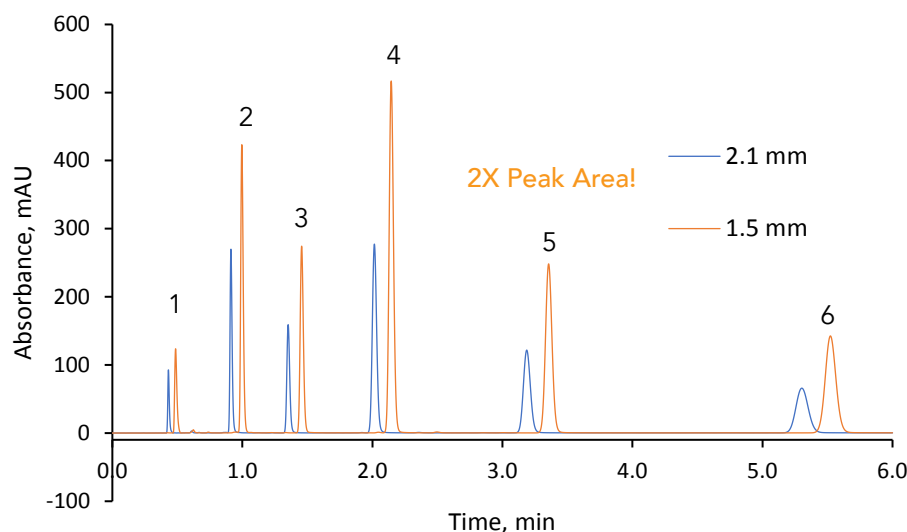
# MORE SENSITIVITY

"I want **more sensitivity** with my conventional UHPLC system"

Through newly designed specialized manufactured fluidic hardware, the new HALO® 1.5 delivers increased signal response in comparison to 2.1 mm ID columns and demonstrates higher efficiencies compared to 1 mm ID columns on optimized UHPLC systems.

## ISOCRATIC SEPARATION OF ALKYLPHENONES SHOWS AVERAGE OF 2X GREATER AREA USING 1.5 MM COLUMN

Using a 1.5 mm ID column compared to a 2.1 mm ID column, the peak areas are doubled and the sensitivity is improved using the same injection volume on both columns.



PEAK #	COMPOUND
1	Uracil
2	Acetophenone
3	Propiophenone
4	Butyraphenone
5	Valerophenone
6	Hexanophenone

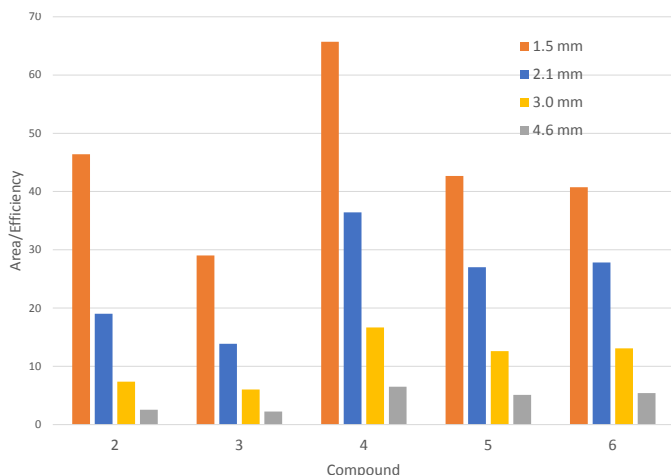
### TEST CONDITIONS:

Column: HALO 90 Å C18, 2.7  $\mu$ m, 1.5 x 100 mm  
 Column: HALO 90 Å C18, 2.7  $\mu$ m, 2.1 x 100 mm  
 Mobile Phase A: H<sub>2</sub>O  
 Mobile Phase B: ACN  
 Isocratic: 50/50 A/B  
 Flow Rate: 0.2 mL/min (1.5 mm); 0.39 mL/min (2.1 mm)  
 Pressure: 236 bar (1.5 mm); 310 bar (2.1 mm)  
 Temperature: 35 °C  
 Detection: UV 254 nm, PDA  
 Injection Volume: 0.5  $\mu$ L  
 Instrument: Shimadzu Nexera X2

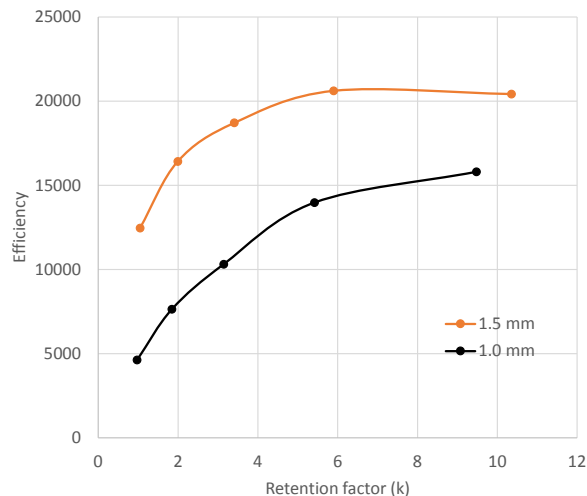
## DEMONSTRATION OF IMPROVED EFFICIENCY WITH HALO® 1.5

A mixture of alkylphenones was run on 1.0, 1.5, 2.1, 3.0, and 4.6 mm ID columns. The area/efficiency of the 1.5 mm ID column outperforms all of the analytical ID columns. While the 1.0 mm ID should perform better than the 1.5 mm ID, even on an optimized UHPLC system the dispersion is too great for a 1.0 mm ID column, thus causing lower efficiencies at all retention factors.

### Area/Efficiency for Analytical Column Dispersion



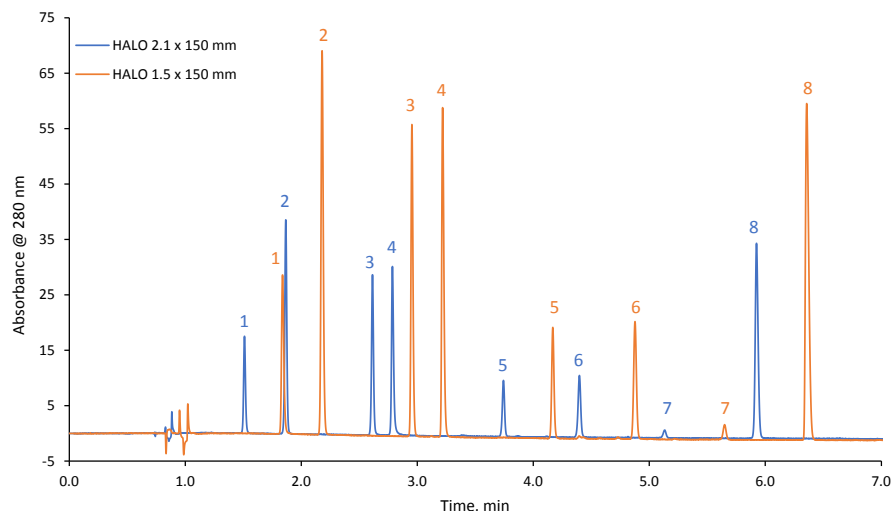
### Efficiency Comparison of 1.5 vs. 1.0 mm





## GRADIENT SEPARATION OF OTC COUGH AND COLD MEDICINES

With extracolumn dispersion minimized, the 1.5 mm ID column shows taller peaks compared to 2.1 mm ID column providing greatest benefit for minor components.



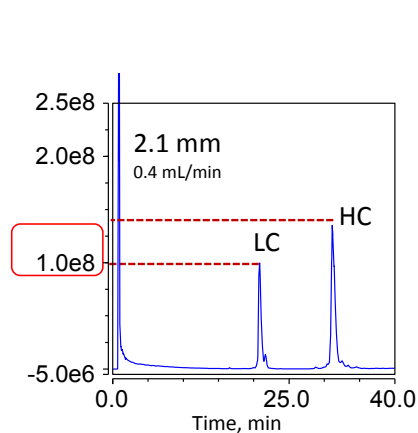
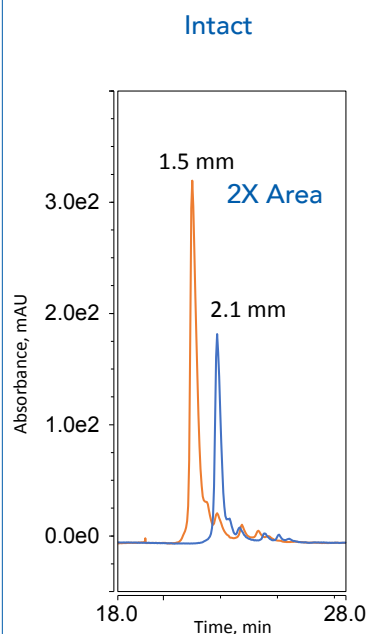
PEAK #	COMPOUND
1	Phenylephrine
2	Acetaminophen
3	Caffeine
4	Doxylamine
5	Guafenesin
6	Aspirin
7	Salicylic Acid
8	Dextromethorphan

### TEST CONDITIONS:

Mobile Phase A: Water/0.15% TFA  
 Mobile Phase B: ACN/0.1% TFA  
 Gradient: 5-50 %B in 8 min  
 Flow Rate: 0.2 mL/min for 1.5 mm  
 0.4 mL/min for 2.1 mm  
 Pressure: 425 bar/1.5 mm  
 470 bar/2.1 mm  
 Temperature: 35 °C  
 Injection Volume: 0.5 µL  
 Detection: UV 280 nm, PDA  
 Instrument: Shimadzu Nexera X2

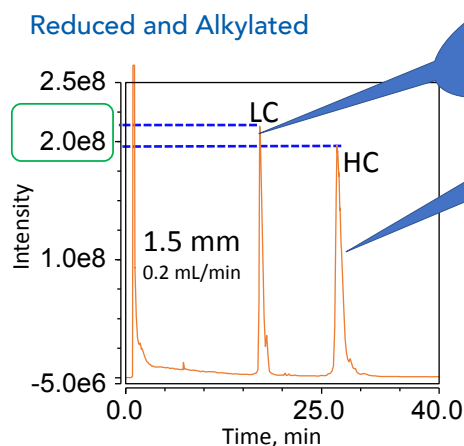
## 1.5 MM ID BENEFITS FOR INTACT AND REDUCED AND ALKYLATED MAB CHARACTERIZATION

The HALO 1000 Å Diphenyl in 1.5 mm ID shows double the area for intact trastuzumab compared to the same separation run on a 2.1 mm ID HALO 1000 Å Diphenyl column. Greater than double the area is observed when used for the separation of reduced and alkylated trastuzumab using MS detection.



### TEST CONDITIONS:

Column: HALO 1000 Å Diphenyl, 2.7 µm, 1.5 x 150 mm  
 Column: HALO 1000 Å Diphenyl, 2.7 µm, 2.1 x 150 mm  
 Mobile Phase A: Water/0.1% DFA  
 Mobile Phase B: 50% Acetonitrile/50% n-Propanol/0.1% DFA  
 Gradient: 27-36 %B in 40 min  
 Flow Rate: 0.2 mL/min for 1.5 mm ID, 0.4 mL/min for 2.1 mm ID



Back Pressure: 252 bar (1.5 mm), 272 bar (2.1 mm)  
 Temperature: 60 °C  
 Detection: PDA, 220 nm  
 Injection Volume: 3 µL of 1.0 mg/mL Trastuzumab  
 Sample Solvent: 100 mM Ammonium Bicarbonate  
 LC System: Shimadzu Nexera X2  
 MS System: ThermoFisher Q Exactive

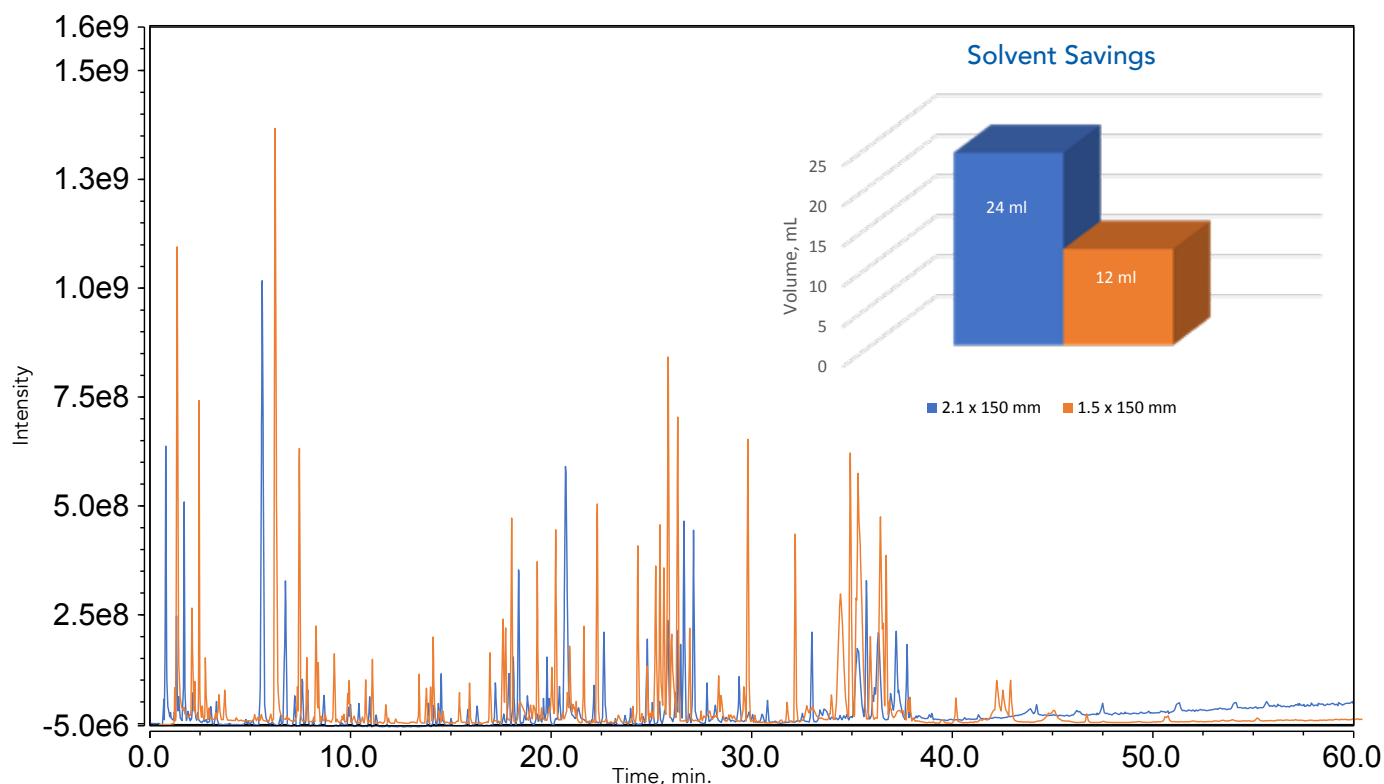
# SOLVENT REDUCTION

The costs associated with solvents continue to grow from both a purchase price perspective and price of waste removal. In step with efforts to decrease the amount of environmental impact generated from hazardous chemicals, companies are seeking solutions to go **greener**. A decrease in column ID is

## PEPTIDE MAP SOLVENT SAVINGS USING HALO 160 Å ES-C18 IN 1.5 MM ID



When a 1.5 mm ID column is used in comparison to a 2.1 mm ID column for a peptide map of trastuzumab, 50% of the solvent is saved since the 1.5 mm ID column is run at 0.2 mL/min compared to 0.4 mL/min for the 2.1 mm ID column. For a 60 minute analysis, only 12 mL of solvent is used vs. 24 mL of solvent for the 2.1 mm ID column. Not only is solvent saved, but the cost of waste disposal is also reduced.



### TEST CONDITIONS:

Column: HALO 160 Å ES-C18, 2.7  $\mu$ m, 1.5 x 150 mm  
Column: HALO 160 Å ES-C18, 2.7  $\mu$ m, 2.1 x 150 mm  
Mobile Phase A: Water/0.1% DFA  
B: Acetonitrile/0.1% DFA  
Gradient: 2-50 %B in 60 min  
Flow Rate: 0.2 mL/min for 1.5 mm ID  
0.4 mL/min for 2.1 mm ID  
Back Pressure: 310 bar (1.5 mm)  
444 bar (2.1 mm)  
Temperature: 60 °C

Detection: ESI +

Injection Volume: 2  $\mu$ L of 1.25 mg/mL Trastuzumab tryptic digest

Sample Solvent: 1.5 M Guanidine HCl/0.5% Formic Acid

LC System: Shimadzu Nexera X2

MS System: ThermoFisher Q Exactive

### MS CONDITIONS:

Spray Voltage (kV): 3.8

Capillary temperature: 320 °C

Sheath gas: 35

Aux gas: 10

RF lens: 50



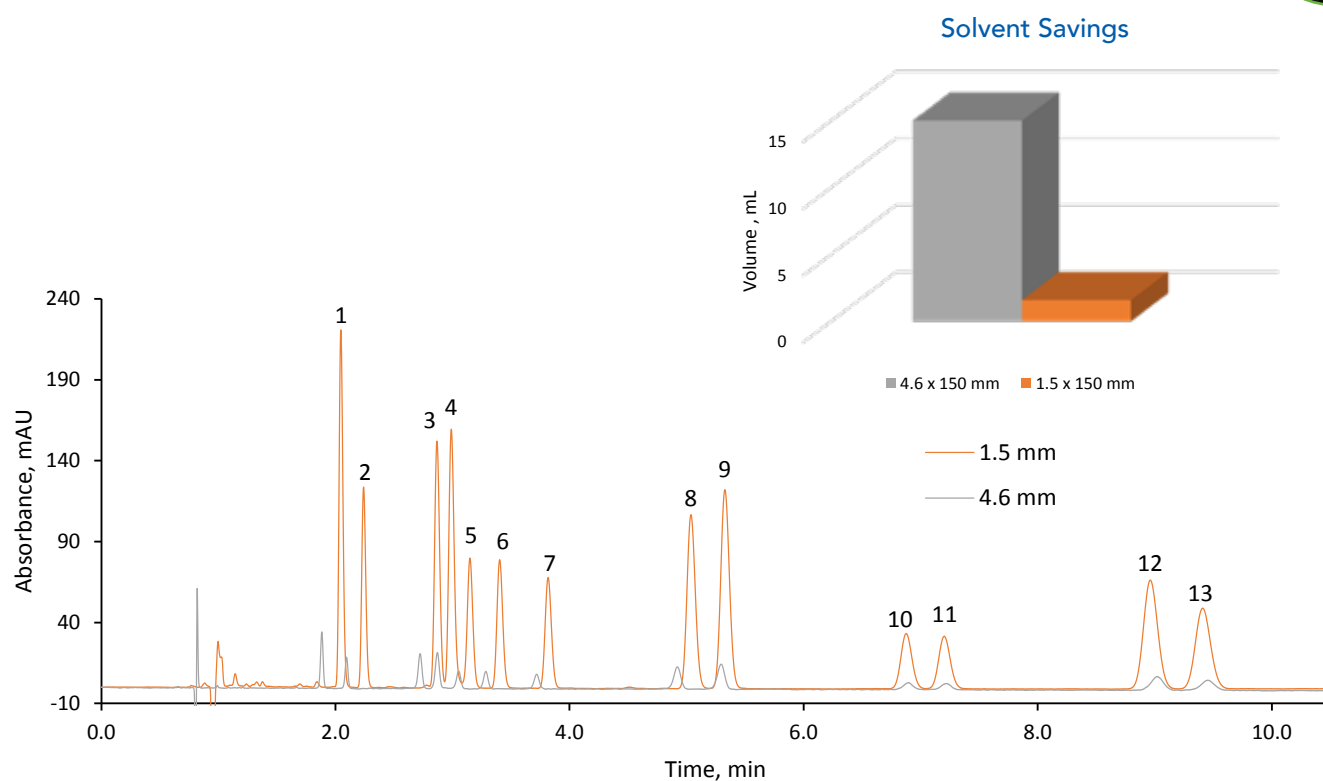
**"We have a goal to  
reduce solvent consumption"**

optimized with lower flow rates resulting in an overall solvent savings. Moving to the HALO® 1.5 helps analysts and companies reduce their solvent consumption.

An added benefit using the HALO® 1.5 is increased sensitivity without sacrificing speed!

#### >9X REDUCTION IN SOLVENT GOING FROM A 4.6 MM ID COLUMN TO A 1.5 MM ID COLUMN

An even larger amount of solvent is saved when a separation is moved from a 4.6 mm ID column to a 1.5 mm ID column. In this isocratic separation of 13 cannabinoids, note the sensitivity increase with the 1.5 mm ID column compared to a 4.6 mm ID column.



#### TEST CONDITIONS:

Column: HALO 90 Å C18, 2.7 µm  
Mobile Phase A: Water/ 0.1% Formic Acid  
Mobile Phase B: Acetonitrile/ 0.1% Formic Acid  
Isocratic: 75 %B  
Temperature: 30 °C  
Detection: UV 228 nm, PDA

Injection Volume: 0.5 µL  
Sample Solvent: 75/25 ACN/ Water  
Data Rate: 100 Hz  
Response Time: 0.025 sec.  
Flow Cell: 1 µL  
LC System: Shimadzu Nexera X2

#### PEAK IDENTITIES:

1. CBDVA
2. CBDV
3. CBDA
4. CBGA
5. CBG
6. CBD
7. THCV
8. THCVa
9. CBN
10. 9-THC
11. 8-THC
12. CBC
13. THCA

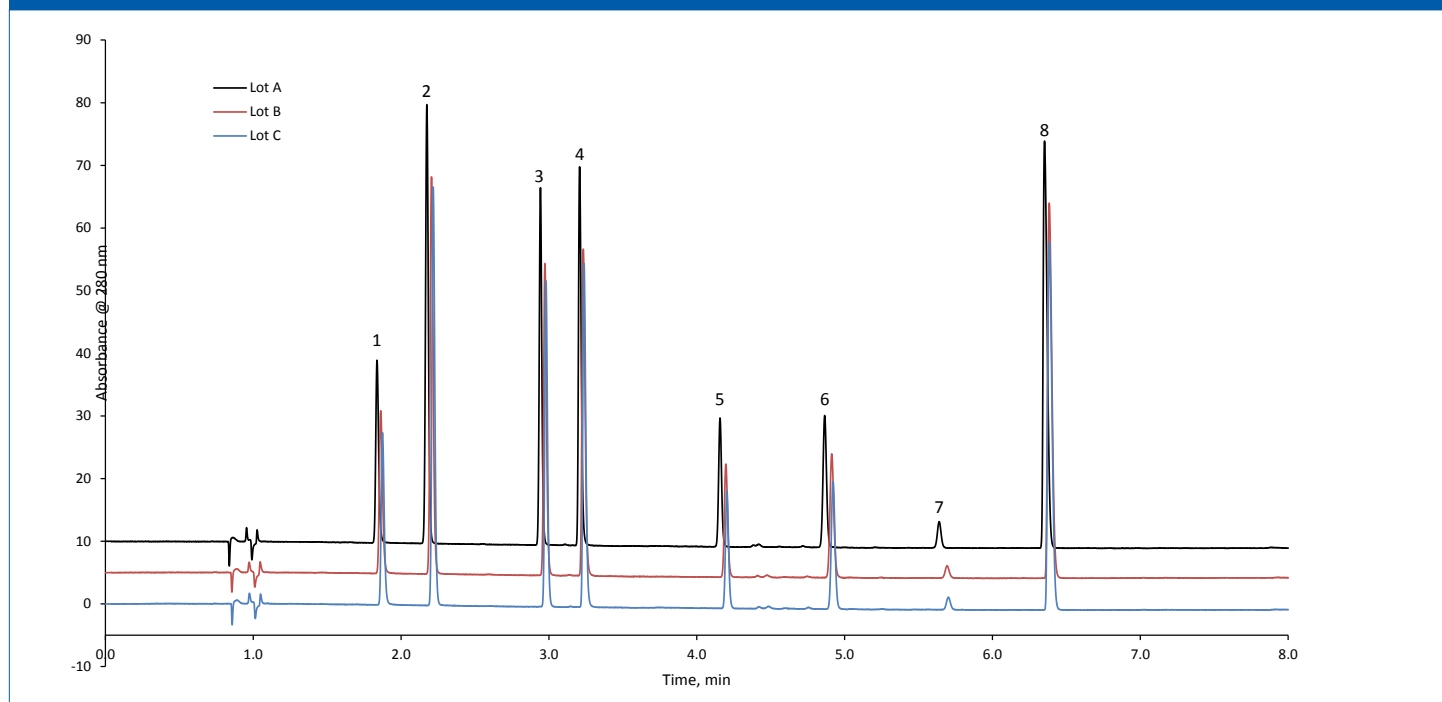


# STABILITY

The new HALO® 1.5 meets the same rigorous quality standards of all HALO® products. Multi lot testing on the new hardware design and a QA report on every column produced from our ISO certified facility results in reliability you can depend on, column to column, analysis to analysis for the lifetime of the method.

## EXCELLENT LOT TO LOT REPRODUCIBILITY WITH THE 1.5 MM ID HARDWARE

Separation of OTC cough and cold medicines using three different lots of the 1.5 mm ID column hardware shows confidence in reproducibility.

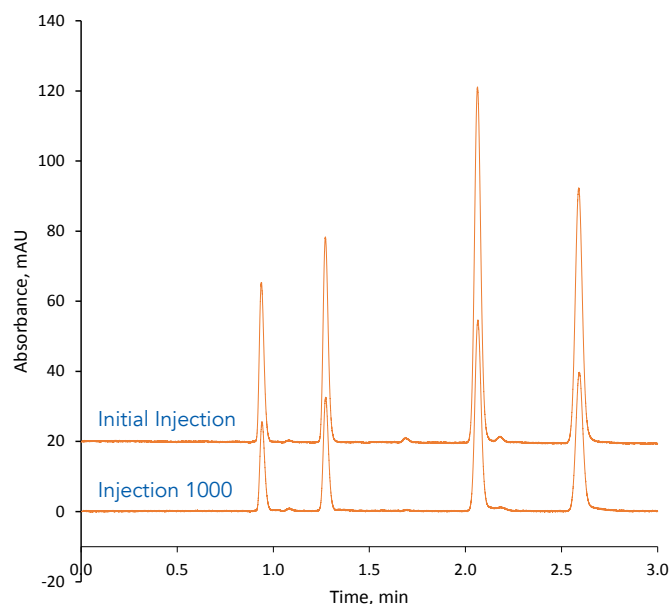


Test conditions for the above chromatogram are the same as p.3 top figure.



## STABILITY DEMONSTRATION WITH HALO 1000 Å DIPHENYL

The HALO 1000 Å Diphenyl in 1.5 mm ID column hardware was tested at 600 bar for 1000 injections. No loss in efficiency or retention was observed over the course of the experiment.

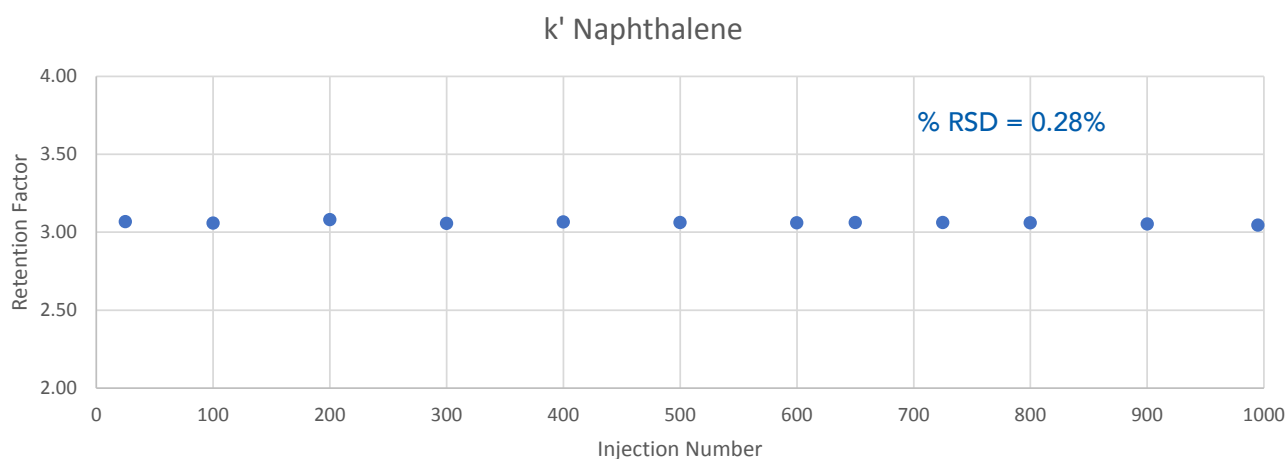


### TEST CONDITIONS:

Column: HALO 1000 Å Diphenyl, 2.7  $\mu$ m, 1.5 x 150 mm  
Mobile Phase A: Water  
B: Acetonitrile  
Isocratic: 25 %B  
Flow Rate: 0.4 mL/min  
Back Pressure: 600 bar  
Temperature: 30 °C  
Detection: 254 nm, PDA  
Injection Volume: 0.2  $\mu$ L  
Sample Solvent: 60/40 ACN/ Water  
Data Rate: 200 Hz  
Response Time: 0.005 sec.  
Flow Cell: 1  $\mu$ L  
LC System: Shimadzu Nexera X2

## 600 BAR STABILITY USING HALO 90 Å C18

A HALO 90 Å C18 1.5 mm ID column was run for 1000 injections to demonstrate the stability of the new 1.5 mm ID hardware. The retention factor of naphthalene was stable across all of the injections.



### TEST CONDITIONS:

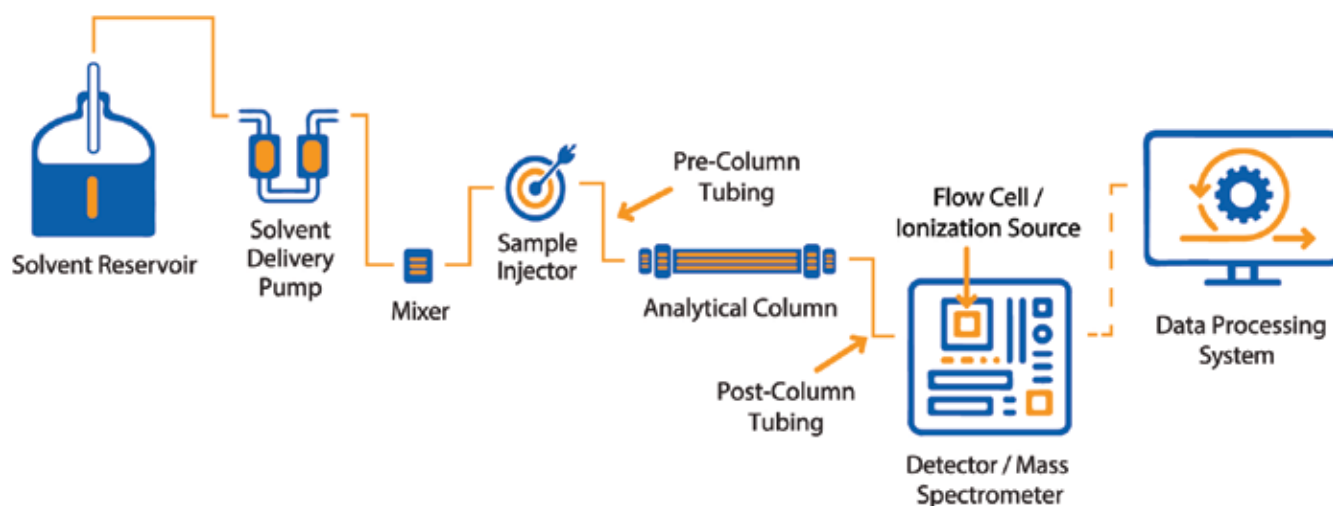
Column: HALO 90 Å C18, 2.7  $\mu$ m, 1.5 x 150 mm  
Mobile Phase A: Water  
B: Acetonitrile  
Isocratic: 60 %B  
Flow Rate: 0.6 mL/min  
Back Pressure: ~600 bar  
Temperature: 30 °C  
Detection: 254 nm, PDA

Injection Volume: 0.2  $\mu$ L  
Sample Solvent: 60/40 ACN/ Water  
Data Rate: 200 Hz  
Response Time: 0.005 sec.  
Flow Cell: 1  $\mu$ L  
LC System: Shimadzu Nexera X2

# SYSTEM OPTIMIZATION

Success with smaller ID columns requires attention to optimizing the LC system hardware for best performance. While manufacturers of UHPLC systems in general have already reduced system volumes, consideration should be taken to items like tubing and flow cells which lead to extracolumn dispersion.

Most critical when changing a gradient method from a current column to the new 1.5 mm ID column is the system dwell volume and extracolumn dispersion. The dispersion occurs post-column in the tubing leading to the detector and within the detector itself. Under isocratic conditions, the dispersion comes from both pre- and post-column tubing as well as injection volume and detector.

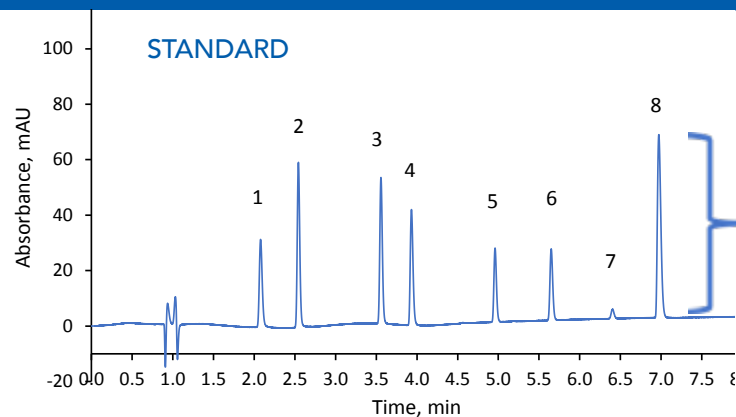
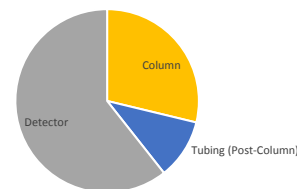


## EXAMPLE DEMONSTRATING REDUCTION OF UHPLC VOLUMES

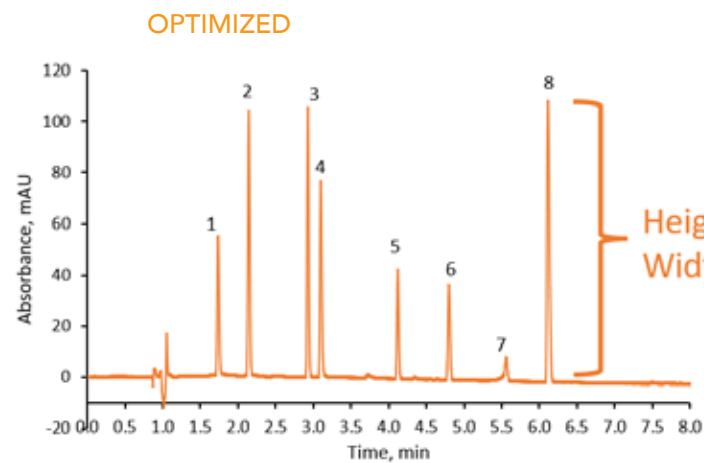
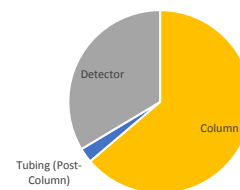
COMPONENT	STANDARD UHPLC SYSTEM	OPTIMIZED UHPLC SYSTEM
Mixer (μL)	100	20
Pre-Column Tubing Volume (μL)	0.1 mm x 800 mm 6.3	75 μm x 350 mm 1.5
Post-Column Tubing Volume (μL)	0.1 mm x 509 mm 4	60 μm x 707 mm 2
Flow Cell (PDA) Volume (μL)	1	1
Extracolumn Dispersion (μL <sup>2</sup> )	14	2



When the UHPLC is optimized, peak heights are taller and peak widths are smaller, leading to improved sensitivity. Notice how the pie wedges for the post-column tubing and the detector are reduced in size when the UHPLC system is optimized for this gradient separation.

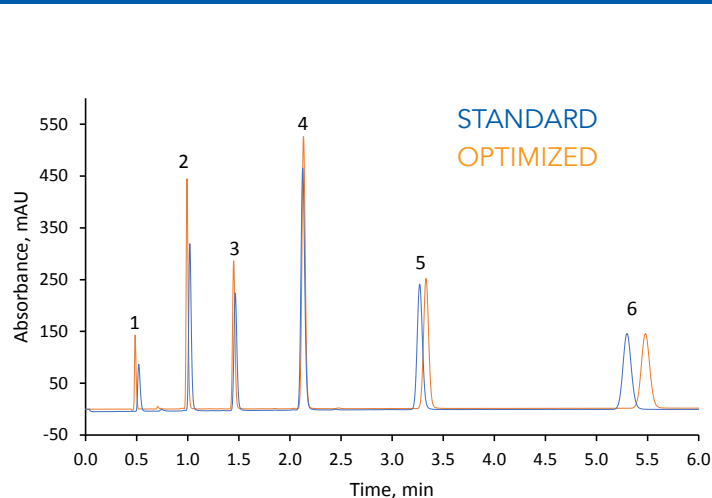
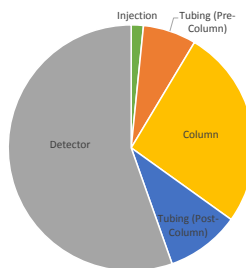
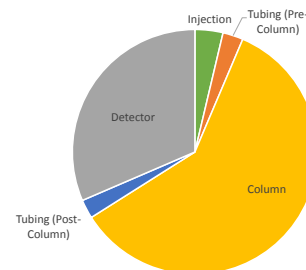
Standard Plumbing - Gradient  $k^* = 2$ 

Height = 66 mAU  
Width = 0.046 min

Optimized Plumbing - Gradient  $k^* = 2$ 

Height = 105 mAU  
Width = 0.037 min

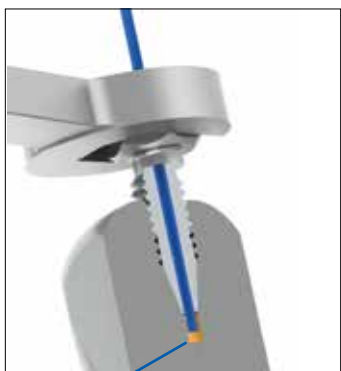
Using isocratic conditions, the extracolumn dispersion comes from both pre- and post-column tubing, the injection volume, and the detector. In this comparison the peaks are taller and the peak efficiencies are increased with the optimized UHPLC system.

Standard Plumbing - Isocratic  $k = 2$ Optimized Plumbing - Isocratic  $k = 2$ 

# ENSURE A PERFECT CONNECTION WITH MarvelXACT™

MarvelXACT™ connection systems have been designed to eliminate the risk of under- or over-tightening with a patented torque limiting mechanism. This unique feature emits a haptic “click” feedback when it reaches the optimum torque, assuring a perfect installation every time. MarvelXACT™ incorporates advanced MarvelX™ Sealing Technology to deliver precise face sealing (sealing at the port bottom), which eliminates additional internal volume, and minimizes carryover risk, peak tailing, and peak broadening.

## MarvelXACT™ VS. CONVENTIONAL CONED FITTINGS



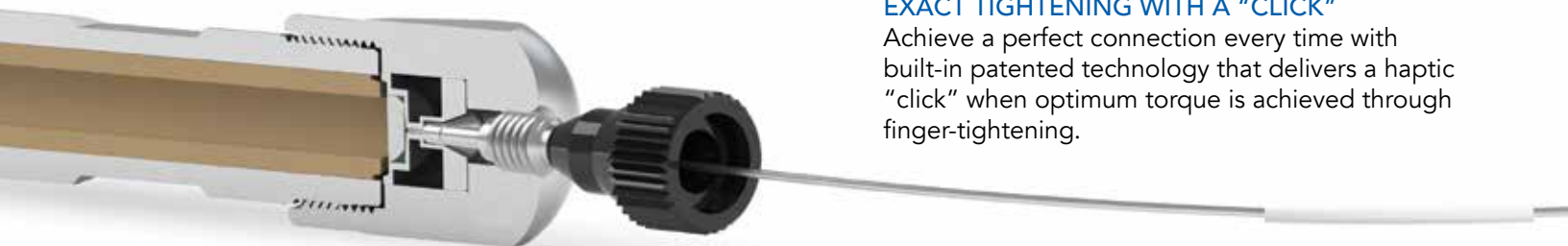
EXTRA INTERNAL VOLUME

**Conventional coned fittings** require a ferrule in conjunction with a fitting for proper sealing. They depend on tools, to improve sealing performance, which significantly increases probability of extra internal volume and poor chromatography results. The mechanical tightening increases wear leading to higher replacement costs.



ZERO DEAD VOLUME

**MarvelXACT™ fittings** do not depend on ferrules. They seal with hand tightening at the bottom of the port, which significantly reduces required torque and enables many more connects and disconnects reducing wear and increasing product life. An enhanced proprietary tip design also ensures zero dead volume (ZDV) and better chromatography results.



### EXACT TIGHTENING WITH A “CLICK”

Achieve a perfect connection every time with built-in patented technology that delivers a haptic “click” when optimum torque is achieved through finger-tightening.



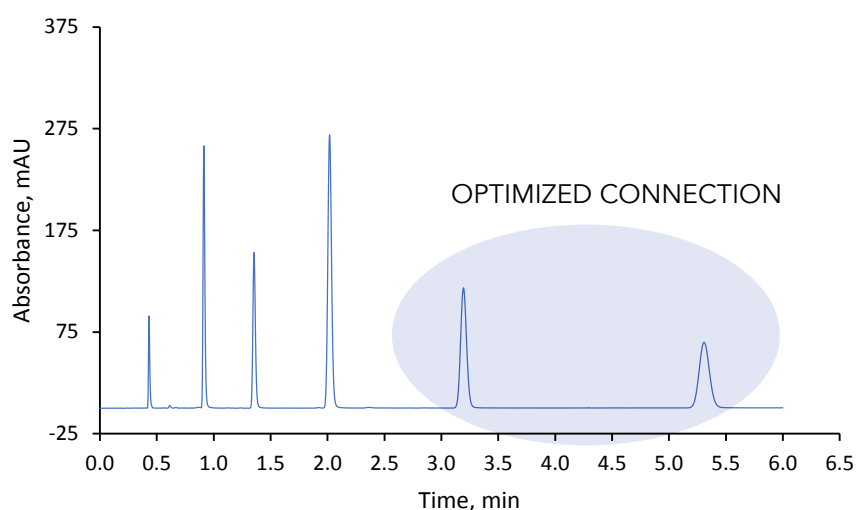
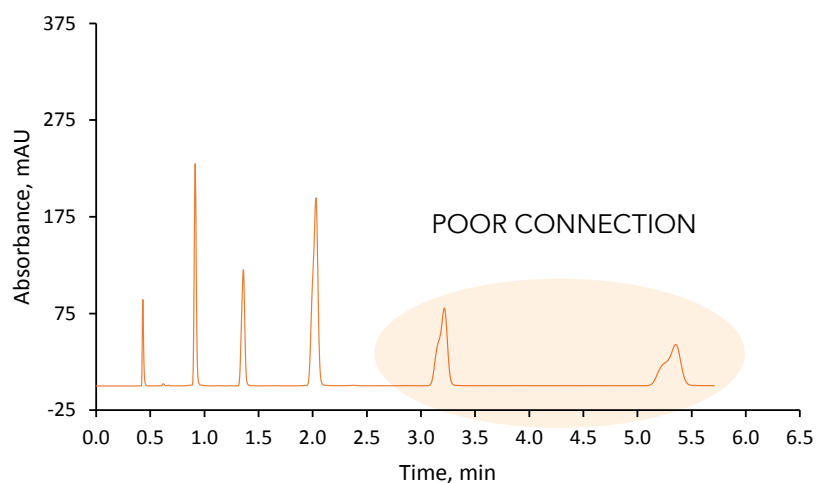
### FLEXIBLE TUBING

1/32" OD tubing prevents kinking and allows considerable flexibility to route throughout the instrument.



## CONNECTION CONSEQUENCES

When a poor connection is made to the injector, distorted peak shape and leaks may occur. In this example, the connecting tubing was not fully seated into the injector port which caused a slow leak and distorted peak shape, especially for the later eluting peaks.



### FINGER-TIGHT TO UHPLC

MarvelXACT™ is truly a finger-tight connection system that has a patented torque-limiting mechanism for exact tightening every time, and seals up to 19000 psi (~1310 barr) for routine use.

### ROBUST TIP

Enable robust structure, superior re-usability, and minimizes chances of tip damage from connecting and disconnecting.

### SMALL & ACCESSIBLE

Fittings are small enough to fit in tight spaces, yet allow for finger-tightening at UHPLC pressures.

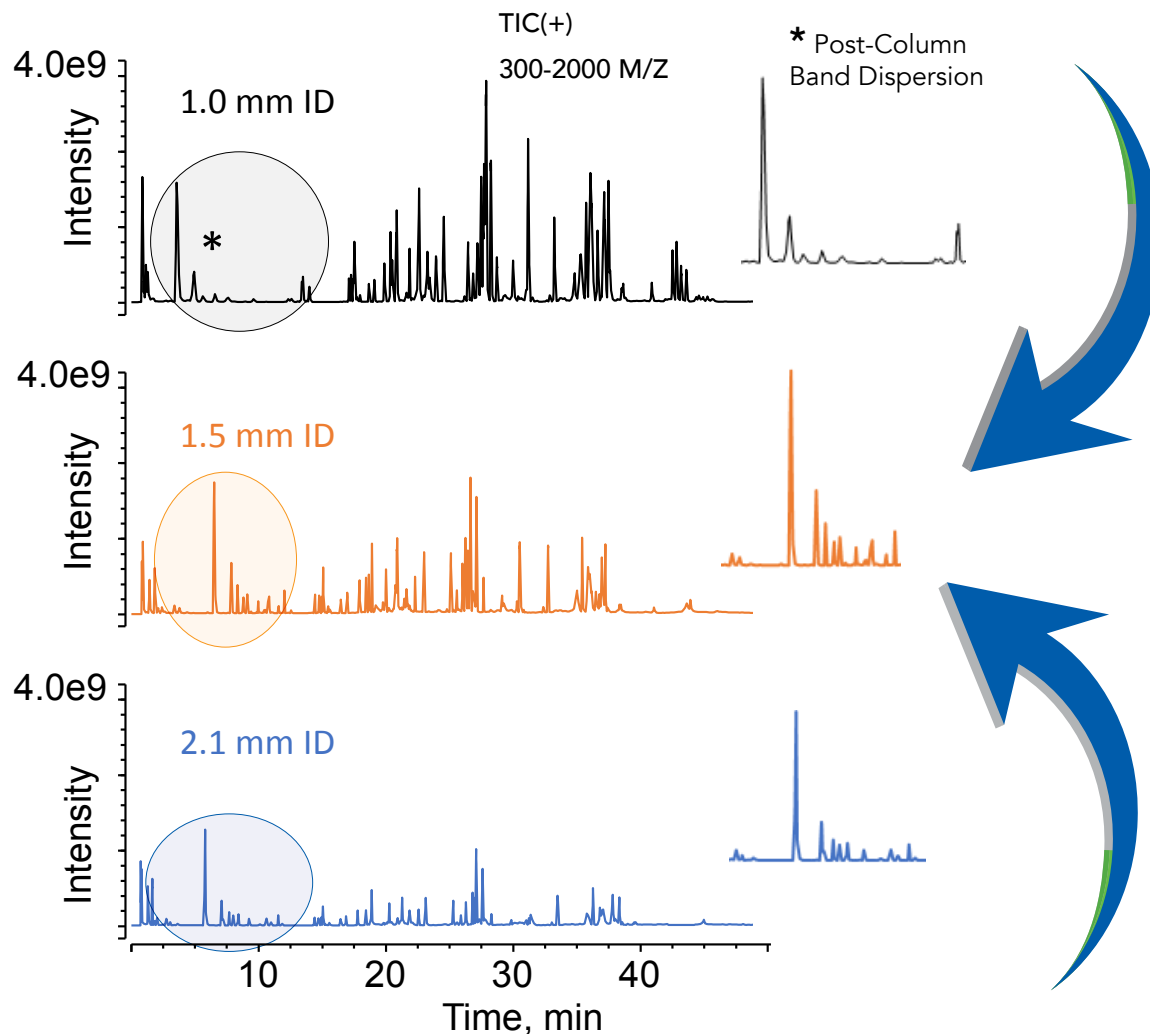




# EXTRACOLUMN DISPERSION

## IMPACT OF EXTRACOLUMN DISPERSION ON DIFFERENT ID COLUMNS

The 1.0 mm ID column shows broad peak shape due to the amount of extracolumn dispersion going from the column to the source of the MS. The 1.5 mm ID performs better than both the 2.1 mm ID (in terms of peak height) and the 1.0 mm ID (in terms of peak width).



### TEST CONDITIONS:

Column: HALO 160 Å ES-C18, 2.7  $\mu$ m, 1.5 x 150 mm  
Column: HALO 160 Å ES-C18, 2.7  $\mu$ m, 2.1 x 150 mm  
Column: HALO 160 Å ES-C18, 2.7  $\mu$ m, 1.0 x 150 mm  
Mobile Phase A: Water/0.1% DFA  
B: Acetonitrile/0.1% DFA  
Gradient: 2-50 %B in 60 min  
Flow Rate: 0.1 mL/min for 1.5 mm ID  
0.2 mL/min for 1.5 mm ID  
0.4 mL/min for 2.1 mm ID

Back Pressure: 265 bar (1.0 mm)  
310 bar (1.5 mm)  
444 bar (2.1 mm)

Temperature: 60 °C

Detection: ESI +

Injection Volume: 2  $\mu$ L of 1.25 mg/mL Trastuzumab tryptic digest

Sample Solvent: 1.5 M Guanidine HCl/0.5% Formic Acid

LC System: Shimadzu Nexera X2

MS System: ThermoFisher Q Exactive

### MS TEST CONDITIONS:

Spray Voltage (kV): 3.8

Capillary temperature: 320 °C

Sheath gas: 35

Aux gas: 10

RF lens: 50

# CONVERTING TO THE NEW 1.5

## WHY SHOULD WE CARE ABOUT EXTRACOLUMN DISPERSION?

The analyte bands or peaks naturally broaden as they move through the connecting tubing in a UHPLC system. The smaller the column ID, the more this broadening could impact the results of the column. If the true efficiency of the column is the goal, then the extracolumn dispersion must be reduced. The extracolumn dispersion comes from the injector, the pre-column tubing, the heat exchanger, the post-column tubing, and the detector. For isocratic separations, all of these impact the observed efficiency. For gradient separations, only the post-column tubing and the detector impact the observed efficiency. In order to maximize what efficiency the column is capable of delivering, the extracolumn volume needs to be reduced as much as possible by using shorter length, smaller ID tubing. However, changing to smaller ID tubing will increase the pressure of the system so a compromise must be made in order to still be able to run at the flow rates needed for optimum column performance.

## EQUATION FOR SCALING FLOW RATE

$$F_2 = F_1 \times \frac{(\pi R_2)^2}{(\pi R_1)^2} = F_1 \times \frac{(R_2)^2}{(R_1)^2} = F_1 \times \frac{(D_2)^2}{(D_1)^2}$$

Where F = flow rate

R = radius

D = diameter

1 = original column

2 = column being changed to

		COLUMN IDS				
		4.6	3.0	2.1	1.5	1.0
FLOW RATES (mL/min)		0.96	0.41	0.20	0.10	0.045
		1.44	0.61	0.30	0.15	0.068
		1.92	0.82	0.40	0.20	0.091
		2.40	1.02	0.50	0.26	0.113
		2.88	1.22	0.60	0.31	0.136

## EXTRACOLUMN DISPERSION REFERENCES

1. D.R. Stoll, K. Broeckhoven, LCGC North America. 39, Issue 4 (2021) 159–166.
2. G. Desmet, K. Broeckhoven, TrAC Trends Anal. Chem. 119 (2019) 115619.
3. K. Broeckhoven, J. De Vos, and G. Desmet, LCGC Europe 30 (2017) 618– 625.

# HOW TO SELECT THE BEST CONNECTORS FOR THE BEST 1.5 MM ID PERFORMANCE

- In general, use the shortest length and smallest ID tubing that will work for your system
- Are you running isocratic or gradient?
  - If isocratic, then pre-column tubing is most impactful - reduce length and ID of tubing before the column
  - If gradient, then post-column tubing is most impactful reduce the length and ID of tubing after the column
- Does your system have a heat exchanger?
  - If so, consider bypassing it as long as you are able to operate your method without it
- Is there a smaller volume flow cell available for your system?
  - If so, consider switching to it

## STEPS FOR SELECTING CONNECTING TUBING

1. Measure the length in mm from the injector to the column and from the column to the detector or MS source
2. Select ID tubing and length that will fit according to the table below being mindful of your system back pressure limits:

L(mm)	ID (μm)	volume (uL)	
150	25	0.07	Red
	50	0.29	Orange
	75	0.66	Green
	100	1.18	Green

L(mm)	ID (μm)	volume (uL)	
350	25	0.17	Red
	50	0.69	Red
	75	1.55	Green
	100	2.75	Green

L(mm)	ID (μm)	volume (uL)	
600	25	0.29	Red
	50	1.18	Red
	75	2.65	Orange
	100	4.71	Green

Green = minimal extra back pressure (<15 bar)

Orange = may generate too much back pressure (>40 bar)

Red = not recommended (>100 bar)



ISO 9001:2015 certified QMS

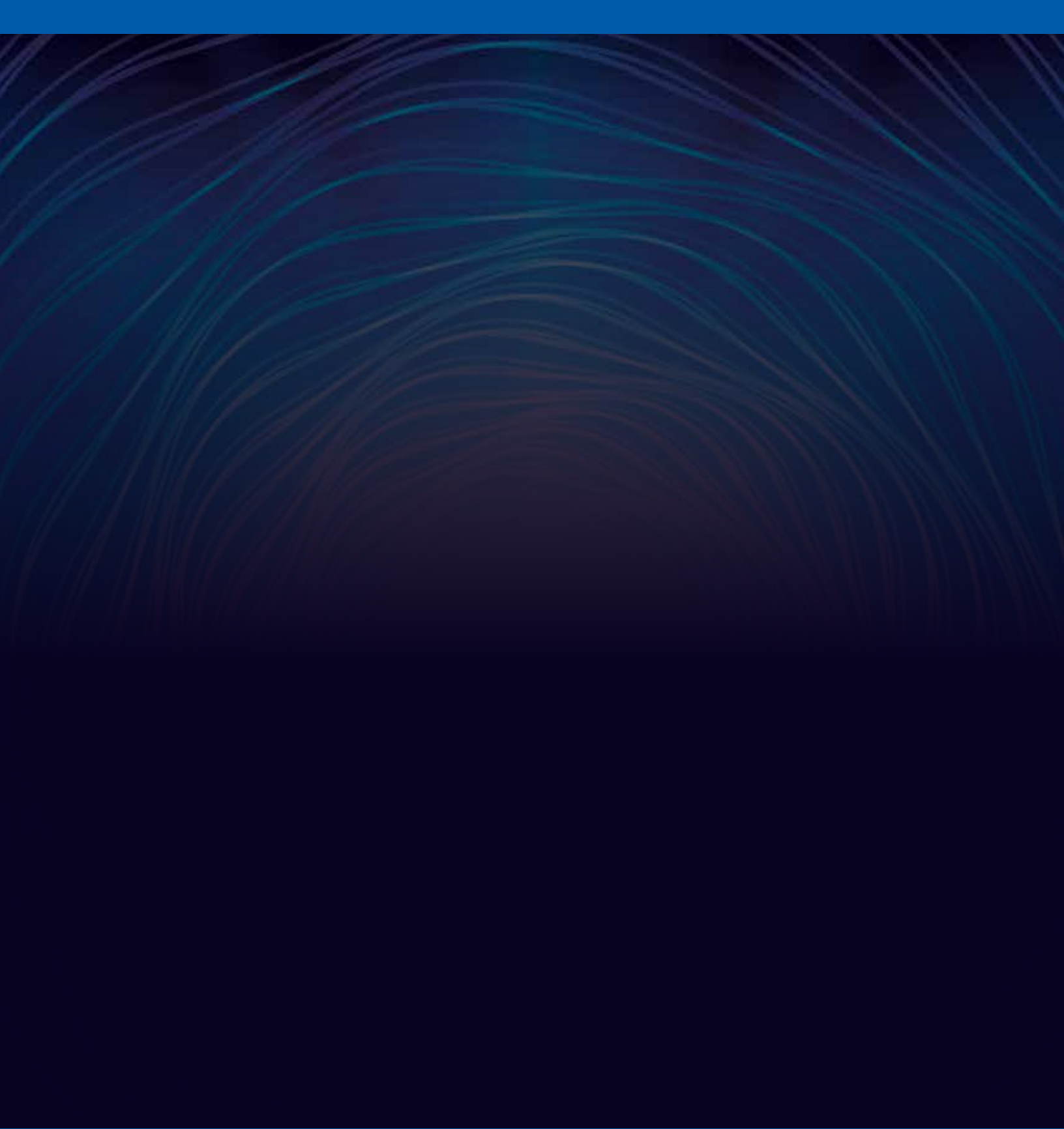




# HALO® 1.5 PRODUCT OFFERINGS

1.5 MM COLUMN SIZES AND PHASES	ANALYTICAL COLUMNS			
	BONDED PHASE	PORE SIZE	DESCRIPTION	PART NUMBER
	C18	90 Å	HALO 90 A C18, 2.7 µm, 1.5 x 50 mm	9281X-402
			HALO 90 A C18, 2.7 µm, 1.5 x 100 mm	9281X-602
			HALO 90 A C18, 2.7 µm, 1.5 x 150 mm	9281X-702
	ES-C18	160 Å	HALO 160 A ES-C18, 2.7 µm, 1.5 x 50 mm	9212X-402
			HALO 160 A ES-C18, 2.7 µm, 1.5 x 100 mm	9212X-602
			HALO 160 A ES-C18, 2.7 µm, 1.5 x 150 mm	9212X-702
	C4	1000 Å	HALO 1000 A C4, 2.7 µm, 1.5 x 50 mm	9271X-414
			HALO 1000 A C4, 2.7 µm, 1.5 x 100 mm	9271X-614
HALO 1000 A C4, 2.7 µm, 1.5 x 150 mm			9271X-714	
Diphenyl	1000 Å	HALO 1000 A Diphenyl, 2.7 µm, 1.5 x 50 mm	9271X-426	
		HALO 1000 A Diphenyl, 2.7 µm, 1.5 x 100 mm	9271X-626	
		HALO 1000 A Diphenyl, 2.7 µm, 1.5 x 150 mm	9271X-726	
CONNECTION TUBING OPTIONS				
	DESCRIPTION	VOLUME	PART NUMBER	
	AMT MarvelXACT™ PLS 25µm x 150mm	75 nl	PL7025150	
	AMT MarvelXACT™ PLS 25µm x 350mm	170 nl	PL7025350	
	AMT MarvelXACT™ PLS 25µm x 600mm	295 nl	PL7025600	
	AMT MarvelXACT™ PLS 50µm x 150mm	295 nl	PL7050150	
	AMT MarvelXACT™ PLS 50µm x 350mm	685 nl	PL7050350	
	AMT MarvelXACT™ PLS 50µm x 600mm	1178 nl	PL7050600	
	AMT MarvelXACT™ PLS 75µm x 150mm	665 nl	PL7075150	
	AMT MarvelXACT™ PLS 75µm x 350mm	1545 nl	PL7075350	
	AMT MarvelXACT™ PLS 75µm x 600mm	2650 nl	PL7075600	
	AMT MarvelXACT™ PLS 100µm x 150mm	1178 nl	PL7100150	
	AMT MarvelXACT™ PLS 100µm x 350mm	2750 nl	PL7100350	
	AMT MarvelXACT™ PLS 100µm x 600mm	4710 nl	PL7100600	
	AMT MarvelXACT™ PEEKsil™ 25µm ID x 150mm	75 nl	PS7025150	
	AMT MarvelXACT™ PEEKsil™ 25µm ID x 350mm	170 nl	PS7025350	
	AMT MarvelXACT™ PEEKsil™ 25µm ID x 600mm	295 nl	PS7025600	
	AMT MarvelXACT™ PEEKsil™ 50µm ID x 150mm	295 nl	PS7050150	
	AMT MarvelXACT™ PEEKsil™ 50µm ID x 350mm	685 nl	PS7050350	
	AMT MarvelXACT™ PEEKsil™ 50µm ID x 600mm	1178 nl	PS7050600	
	AMT MarvelXACT™ PEEKsil™ 75µm ID x 150mm	665 nl	PS7075150	
	AMT MarvelXACT™ PEEKsil™ 75µm ID x 350mm	1545 nl	PS7075350	
	AMT MarvelXACT™ PEEKsil™ 75µm ID x 600mm	2650 nl	PS7075600	
	AMT MarvelXACT™ PEEKsil™ 100µm ID x 150mm	1178 nl	PS7100150	
	AMT MarvelXACT™ PEEKsil™ 100µm ID x 350mm	2750 nl	PS7100350	
	AMT MarvelXACT™ PEEKsil™ 100µm ID x 600mm	4710 nl	PS7100600	

[illegible]



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# HALO®

**Manufactured by:**



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