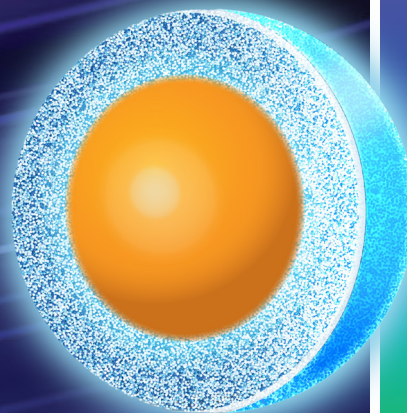


# HALO<sup>®</sup>

## ELEVATE C18

TAKING SEPARATIONS TO  
A HIGHER LEVEL



ELEVATE



# HALO<sup>®</sup> ELEVATE C18

## INTRODUCING HALO<sup>®</sup> ELEVATE C18

Built upon proven Fused-Core<sup>®</sup> particle technology for speed and efficiency, the HALO<sup>®</sup> Elevate C18 incorporates surface modified organo-silane technology for alkaline resistance resulting in excellent stability in high pH environments.

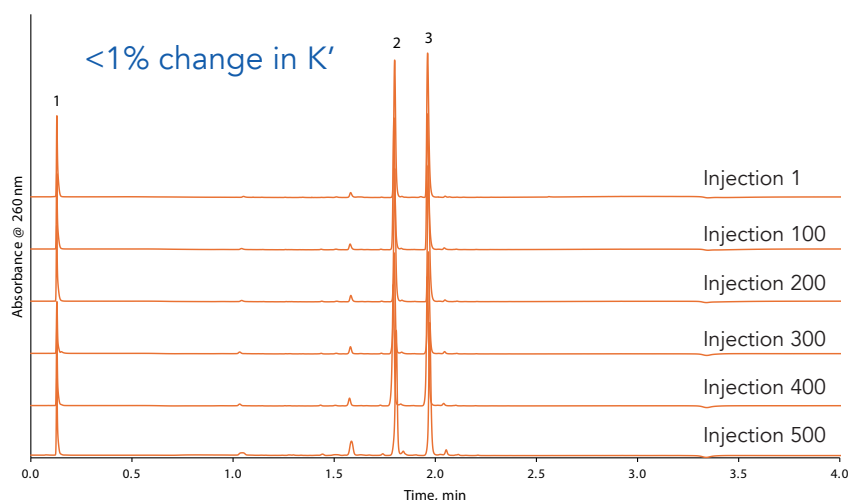
With a wide operational use range of pH 2-12, HALO<sup>®</sup> Elevate allows for robust method development and improved separations for basic compounds that may present problems such as poor peak shapes, inadequate retention or limited load tolerance at low pH. Ideal for use with high pH mobile phases.

### FEATURES OF HALO<sup>®</sup> ELEVATE C18

- Excellent stability for high pH, high temperature environments
- Flexible to work the full range of operating conditions for separation selectivity of acids, bases, neutrals and zwitterions
- Proven HALO<sup>®</sup> Fused-Core<sup>®</sup> technology for separation speed and chromatographic efficiency
- C18, USP L1 2.7  $\mu$ m 120 Å particle

## BETTER BY DESIGN

The stability of a HALO<sup>®</sup> Elevate C18 column was tested using 10 mM ammonium bicarbonate at pH 10 and 60 °C. Less than a 1% change in retention is achieved over 20,000 column volumes! HALO<sup>®</sup> Elevate C18 also demonstrates symmetrical peak shape with no increase in back pressure during the 500 injection stability test.



### PEAK IDENTITIES

1. Uracil
2. Acenaphthene
3. Amitriptyline

### TEST CONDITIONS

Column: HALO 120 Å ELV C18, 2.7  $\mu$ m, 2.1 x 50 mm  
Part Number: 92272-402  
Mobile Phase A: 95/5 10mM Ammonium Bicarbonate, pH:10/ ACN  
Mobile Phase B: Acetonitrile  
Flow Rate: 0.8 mL/min  
Back Pressure: 220 bar  
Temperature: 60 °C  
Gradient: 

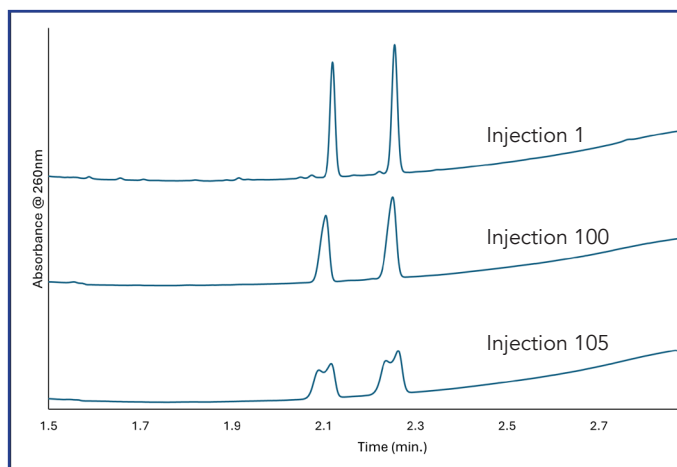
Time	%B
0.0	0
2.5	95
3.0	95
3.1	0
5.0	0

  
Detection: UV/PDA, 260 nm  
Injection Volume: 1.0  $\mu$ L  
LC System: Shimadzu Nexera X2

Compared to the new HALO® Elevate C18, competitor high pH columns failed in long term stability tests. Peak splitting, fronting, drift and degradation was observed during the 500 injection stability test.

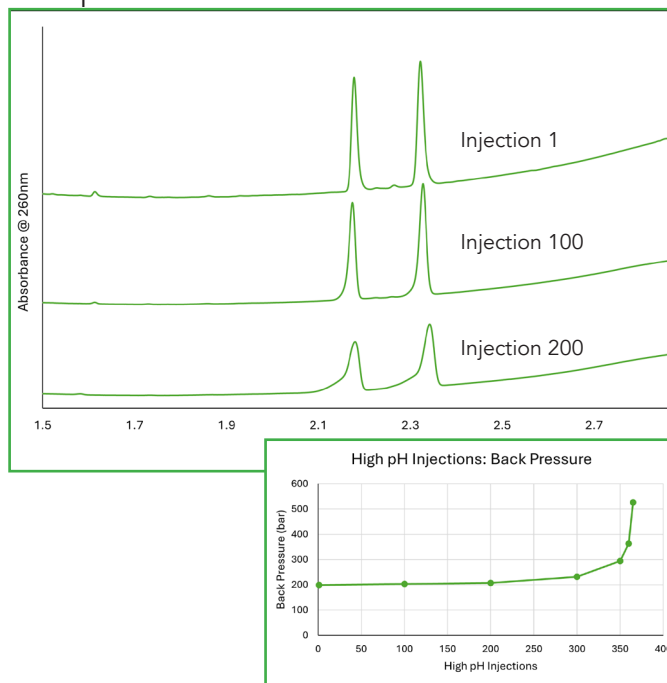
### Competitor A: FPP, 3 $\mu$ m

Split peaks beginning at injection 105



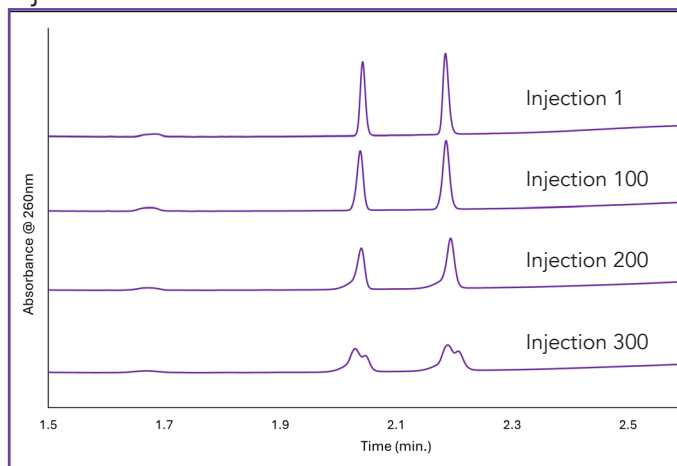
### Competitor B: FPP, 3 $\mu$ m

Peak fronting at 200 injections and increasing back pressure



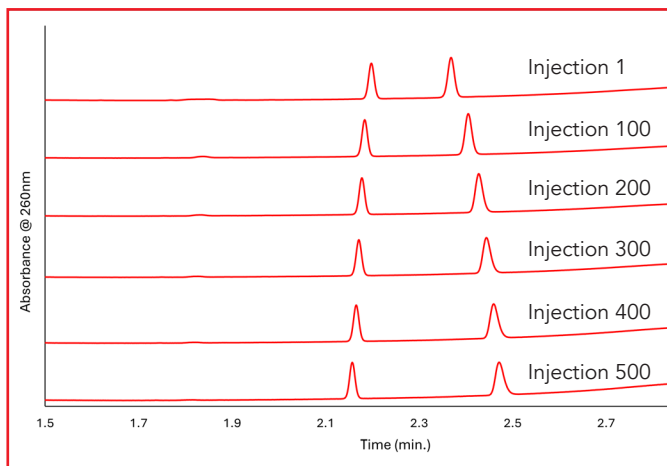
### Competitor C: SPP, 2.5 $\mu$ m

Fronting at injection 200 and peak splitting at injection 300



### Competitor D: FPP, 3 $\mu$ m

Retention and selectivity change

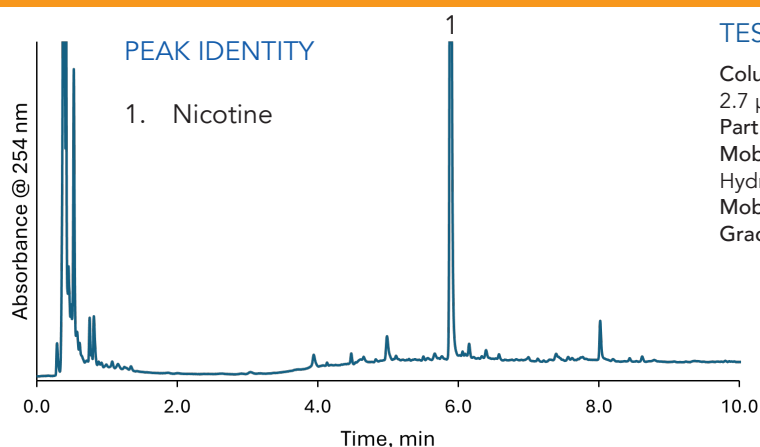


Test conditions and column dimensions used are the same as previous page.

# APPLICATIONS

## NICOTINE ANALYSIS

High pH mobile phases are ideal for analyzing nicotine due to the increase in retention and improved peak shape (compared to low pH conditions). A cigarette is analyzed using a HALO® Elevate column using a combination of ammonium hydroxide and acetonitrile (pH 10.15). With a pKa of 8, nicotine is commonly analyzed at an elevated pH of 10. In this sample preparation of a commercial cigarette, the active stimulant of nicotine is easily identified using the HALO Elevate® C18.



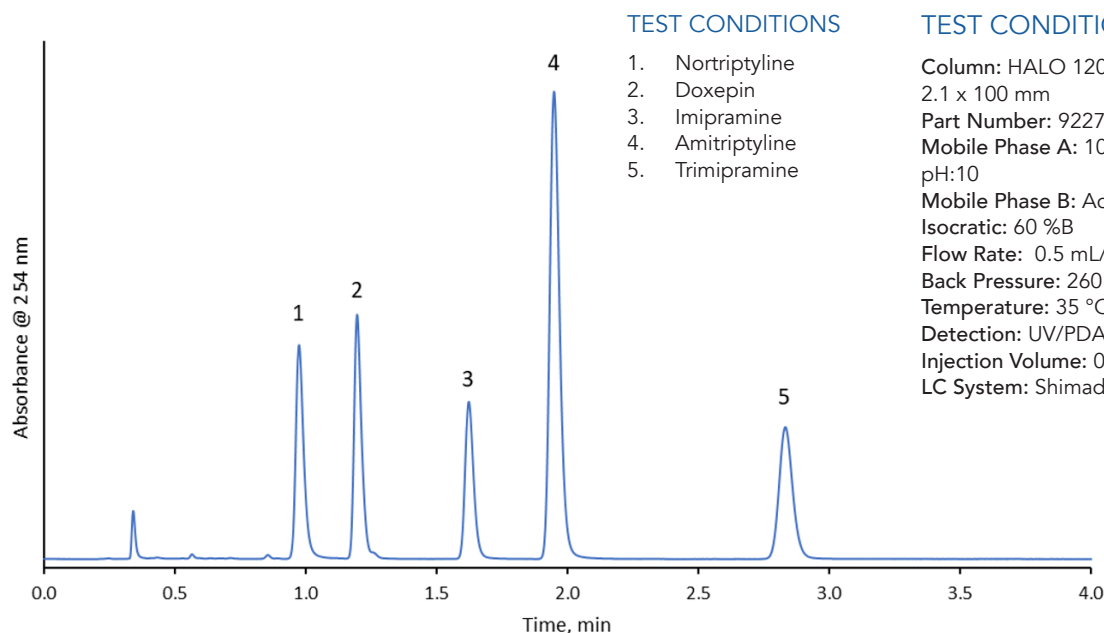
### TEST CONDITIONS

Column: HALO 120 Å ELV C18,  
2.7 µm, 2.1 x 100 mm  
Part Number: 92272-602  
Mobile Phase A: Ammonium  
Hydroxide, pH: 10.15  
Mobile Phase B: Acetonitrile  
Gradient: Time %B  
0.0 5  
2.0 5  
10.0 45  
11.0 45  
12.0 5

Flow Rate: 0.4 mL/min  
Back Pressure: 256 bar  
Temperature: 30 °C  
Injection: 0.5 µL  
Sample Solvent: 95/5 Water/  
ACN  
Wavelength: PDA, 254 nm  
Flow Cell: 1 µL  
Data Rate: 100 Hz  
Response Time: 0.05 sec.  
LC System: Shimadzu Nexera X2

## A SEPARATION OF ANTIDEPRESSANTS IN UNDER 3 MINUTES

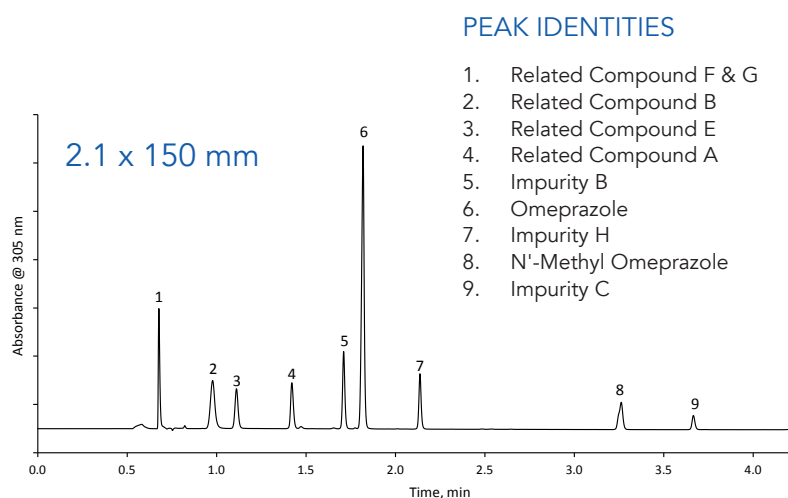
Tricyclic antidepressants (TCAs) are a class of drugs primarily used to manage depression. A separation of antidepressants is achieved under high pH conditions using a HALO® Elevate C18 column. Excellent peak shape and resolution is achieved in under 3 minutes demonstrating the advantage of Fused-Core® particle technology.



### TEST CONDITIONS

Column: HALO 120 Å ELV C18, 2.7 µm,  
2.1 x 100 mm  
Part Number: 92272-602  
Mobile Phase A: 10mM Ammonium Bicarbonate,  
pH:10  
Mobile Phase B: Acetonitrile  
Isocratic: 60 %B  
Flow Rate: 0.5 mL/min  
Back Pressure: 260 bar  
Temperature: 35 °C  
Detection: UV/PDA, 254 nm  
Injection Volume: 0.2 µL  
LC System: Shimadzu Nexera X2

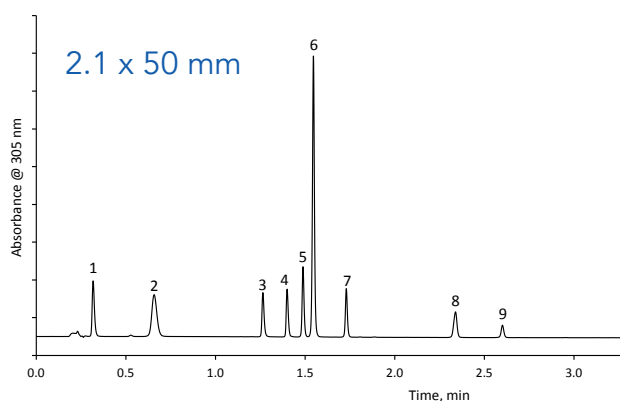
## METHOD IMPROVEMENTS FOR OMEPRAZOLE ANALYSIS USING HALO® ELEVATE



With a pKa of 9.3, omeprazole requires high pH for optimal separation. The current USP method utilizes a 4.6 x 150 mm ID column with a 25 minute separation time.

By using a 2.1 x 150 mm HALO® Elevate column at pH 10.6, the separation of omeprazole and its related compounds are all fully resolved within 3.75 minutes. This is an 88% faster analysis time from the USP method.

Using a 2.1 x 50 mm column the method can be further improved by another 27% in analysis time while still achieving baseline resolution for all components.



### TEST CONDITIONS (data written as "top/bottom for graphs respectively)

Column: HALO 120 Å ELV C18, 2.7 µm,  
2.1 x 150 mm / 2.1 x 50 mm  
Part Number: 92272-702/ 92272-402  
Mobile Phase A: Water + 0.1% NH<sub>4</sub>OH (pH - 10.6)  
Mobile Phase B: Acetonitrile  
Flow Rate: 0.4 mL/min  
Back Pressure: 311 bar/167 bar  
Temperature: 60 °C  
Injection: 1 µL  
Sample Solvent: USP Diluent  
Wavelength: PDA, 305 nm  
Flow Cell: 1 µL  
Data Rate: 40 Hz  
Response Time: 0.05 sec.  
LC System: Shimadzu Nexera X2

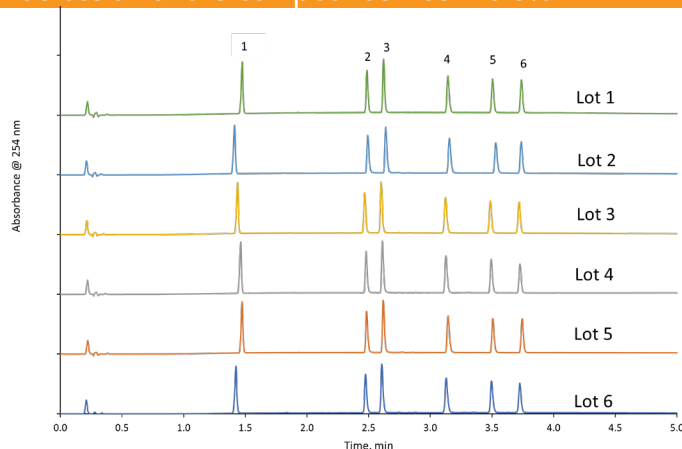
Gradient (top):	Time	%B
	0.0	13
	3.3	53
	3.8	53
	3.9	13
	9.0	13

Gradient (bottom):	Time	%B
	0.0	5
	3.0	55
	3.5	55
	3.6	5
	6.0	5

## QUALITY

Lot-to-lot reproducibility is a critical component in method validation. Six different lots of HALO® Elevate C18 were tested using a mix containing a neutral compound and 5 basic compounds. The average %RSDs across all of the compounds was < 0.6%.



### PEAK IDENTITIES

1. Butyl Paraben (neutral)
2. Doxylamine (base)
3. Chlorpheniramine (base)

4. Doxepin (base)
5. Amitriptyline (base)
6. Trimipramine (base)

### TEST CONDITIONS

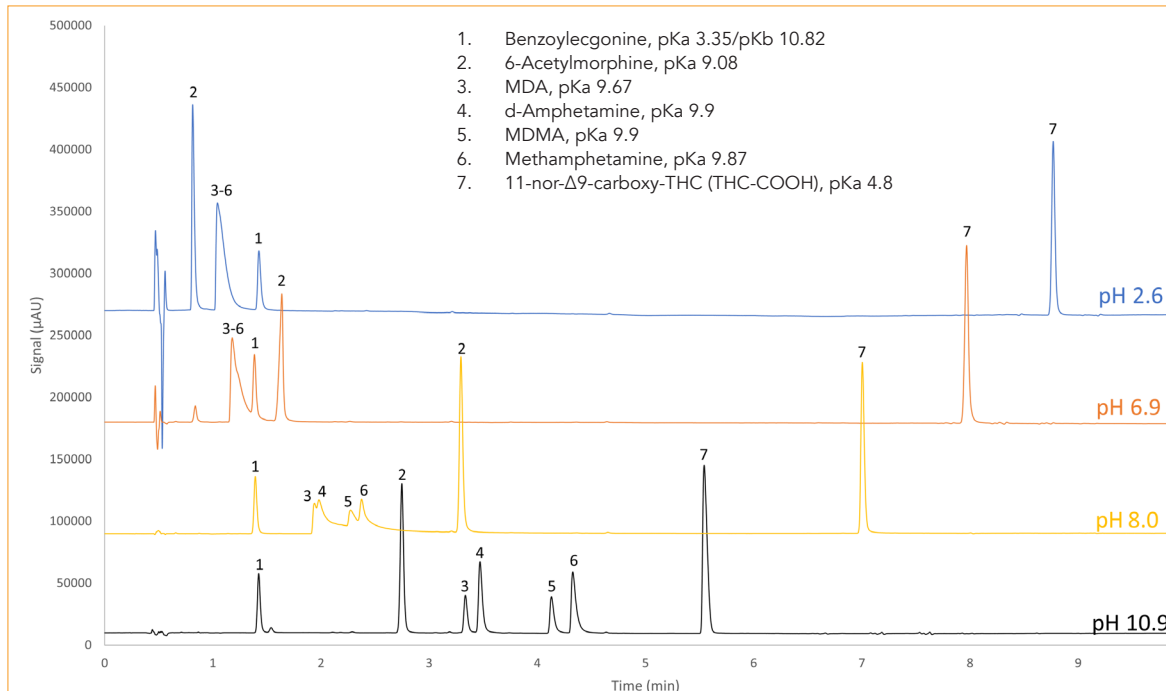
Columns: HALO 120 Å ELV C18, 2.7 µm,  
2.1 x 50 mm  
Part Number: 92272-402  
Mobile Phase A: 0.1% NH<sub>4</sub>OH, pH:10.7  
Mobile Phase B: Acetonitrile

Gradient:	Time	%B
	0.0	5
	4.0	95
	4.5	95
	5.0	5
	7.0	5

Flow Rate: 0.4 mL/min  
Back Pressure: 134 bar  
Temperature: 40 °C  
Injection Volume: 0.5 µL  
Sample Solvent: 65/35 0.1% NH<sub>4</sub>OH/ACN  
Detection: UV/PDA, 254 nm  
Flow Cell: 1 µL  
Data Rate: 40 Hz  
Response Time: 0.05 s  
LC System: Shimadzu Nexera X2

# SELECTIVITY ADVANTAGE

## LEVERAGING PH TO OPTIMIZE SEPARATIONS



A powerful tool for selectivity in method optimization can be the modulation of pH. In this example of common drugs of abuse, the wide pH versatility of the HALO® Elevate C18 was used in the separation to accommodate the varying pKa's to achieve an optimized method favoring the critical compounds of interest, which in this analysis are the amphetamines.

### TEST CONDITIONS

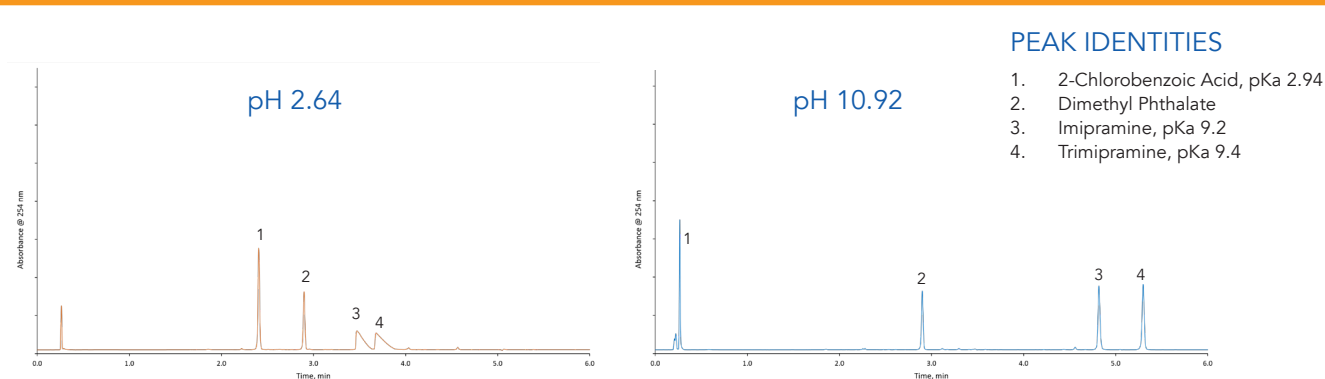
Columns: HALO 120 Å ELV, 2.7 μm,  
2.1 x 100 mm  
Part Number: 92272-602  
Mobile Phase A:  
Water + 0.1% Formic Acid, pH 2.6  
10mM Ammonium Formate, pH 6.9  
10mM Potassium Phosphate, pH 8.0  
Water + 0.1% Ammonium Hydroxide, pH 10.9  
Mobile Phase B: Methanol

Gradient: Time %B  
0.0 25  
3.0 50  
5.0 60  
10.0 95  
10.1 25  
15 25  
Flow Rate: 0.4 mL/min  
Back Pressure: 353 bar

Temperature: 40 °C  
Injection Volume: 5.0 μL  
Sample Solvent: 93:7 Water:Methanol  
Detection: UV/PDA, 214 nm  
Flow Cell: 1 μL  
Data Rate: 40 Hz  
Response Time: 0.05 seconds  
LC System: Shimadzu Nexera X2

## IMPACT OF PH ON RETENTION USING HALO® ELEVATE

Demonstration of ACID, BASE, NEUTRAL separation and effect of pH. Note that at an unbuffered low pH condition, the basic compounds exhibit tailing. Moving to high pH, the basic compound peak shape improves.



### PEAK IDENTITIES

1. 2-Chlorobenzoic Acid, pKa 2.94
2. Dimethyl Phthalate
3. Imipramine, pKa 9.2
4. Trimipramine, pKa 9.4

### TEST CONDITIONS

Columns: HALO 120 Å ELV, 2.7 μm,  
2.1 x 50 mm  
Part Number: 92272-402  
Mobile Phase A:  
H<sub>2</sub>O + 0.1% Formic Acid, pH 2.64  
H<sub>2</sub>O + 0.1% NH<sub>4</sub>OH, pH 10.92  
Mobile Phase B: Acetonitrile

Gradient: Time %B  
0.0 5  
5.5 85  
6.0 85  
6.1 5

Flow Rate: 0.4 mL/min  
Back Pressure: 185 bar  
Temperature: 30 °C  
Injection Volume: 1.0 μL  
Sample Solvent: 1:1 Water:Acetonitrile

Detection: UV/PDA, 254 nm  
Flow Cell: 1 μL  
Data Rate: 100 Hz  
Response Time: 0.025 s  
LC System: Shimadzu Nexera X2

# PRODUCT CHARACTERISTICS

**Ligand:** dimethyloctadecylsilane -  
surface modified  
**Particle Size:** 2.7  $\mu\text{m}$   
**Pore Size:** 120 Å

**USP Designation:** L1  
**Carbon Load:** 5.6%  
**Surface Area:** 75 m<sup>2</sup>/g  
**Endcapped:** YES

**Low pH Limit:** 2  
**High pH limit\*:** 12  
**Temp limit @ low pH:** 60 °C  
**Temp limit @ high pH\*:** 60 °C

## PART NUMBERS

### 2.7 $\mu\text{m}$ ANALYTICAL COLUMNS

Dimensions: ID x Length (in mm)	Part Number
1.5 x 50	9227X-402
1.5 x 100	9227X-602
1.5 x 150	9227X-702
2.1 x 30	92272-302
2.1 x 50	92272-402
2.1 x 100	92272-602
2.1 x 150	92272-702
2.1 x 250	92272-902
3.0 x 30	92273-302
3.0 x 50	92273-402
3.0 x 100	92273-602
3.0 x 150	92273-702
4.6 x 50	92274-402
4.6 x 100	92274-602
4.6 x 150	92274-702
4.6 x 250	92274-902

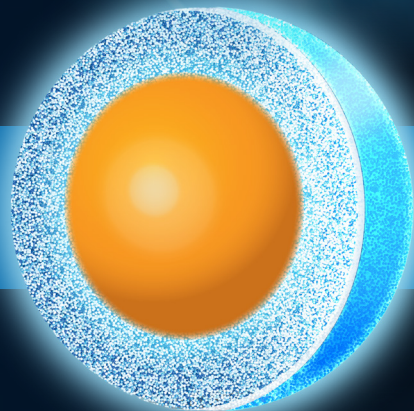
### 2.7 $\mu\text{m}$ GUARD COLUMNS (3 PK)

Dimensions: ID x Length (in mm)	Part Number
2.1 x 5	92272-102
3.0 x 5	92273-102
4.6 x 5	92274-102
Guard Column Holder	94900-001

\*Column lifetime will vary depending on the operating temperature and the type and concentration of buffers used. Operation at extreme specifications of temperature and pH may reduce column lifetime. Consult the column Care and Use document for more information.

**INNOVATION YOU CAN TRUST – PERFORMANCE YOU CAN RELY ON**

# HALO®



advancedmaterialstechnology

**halocolumns.com**

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