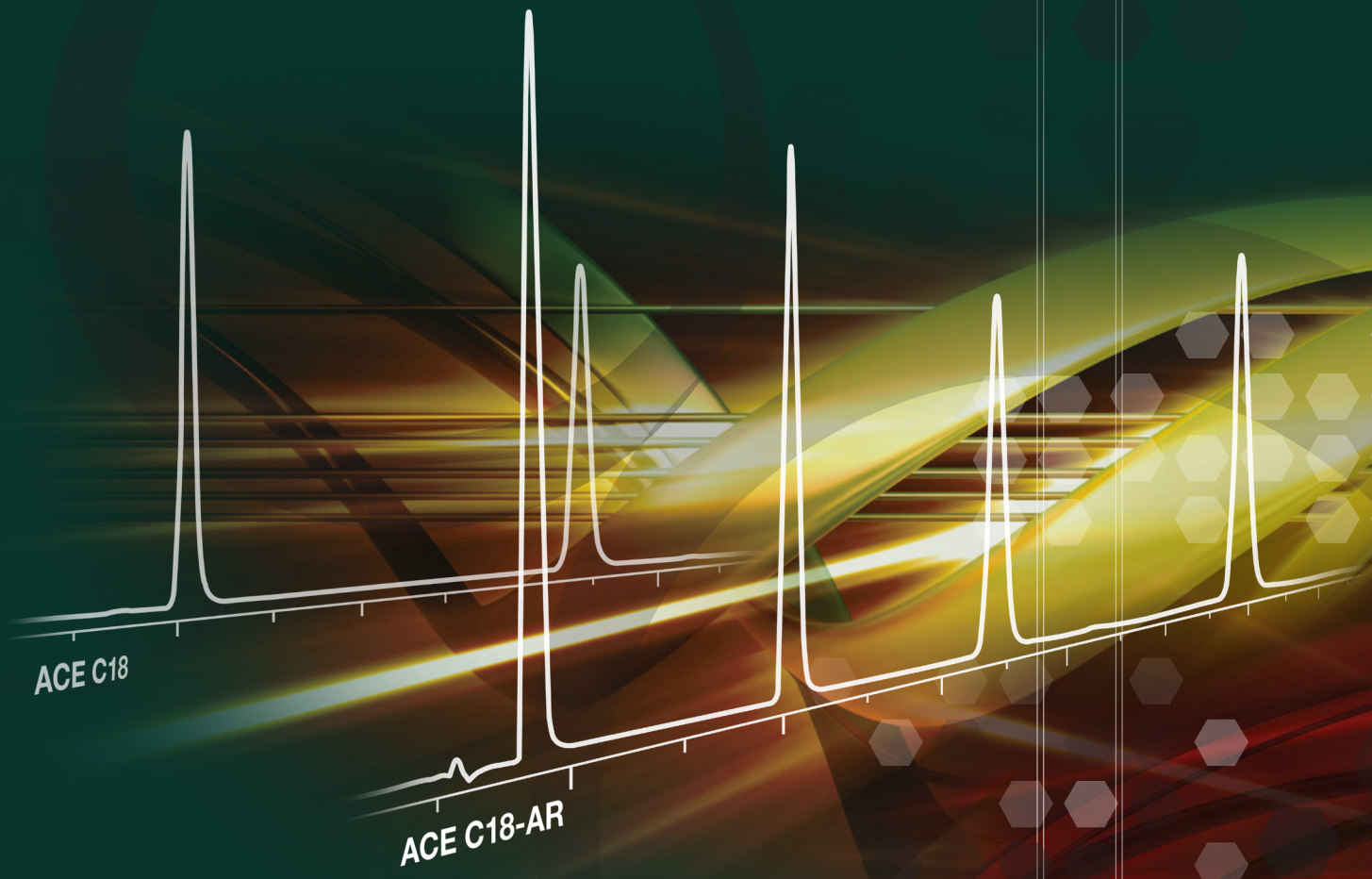
ACE® C18-AR

A C18 bonded phase with unique selectivity



- Guaranteed reproducibility
- Exceptional bonded phase stability
- Hydrophobic and aromatic “mixed mode” interaction

ACE®
HPLC Columns

Explore the Advantages of ACE C18-AR

- Provides alternate selectivity to "standard" C18 columns – additionally recommended for compounds with aromatic functionality
- Ultra inert, ultra high purity silica, for excellent peak shape and reproducibility
- Compatible with highly aqueous mobile phases to enable the retention and separation of polar compounds
- Exceptional bonded phase stability for elevated temperature applications
- Ultra low bleed phase ensures UV and LC/MS compatibility
- Available in high throughput column dimensions

Contents

Why do I need another new C18 phase?

The use of an ultra pure, ultra inert silica has many recognised benefits, including improved reproducibility, lifetime and chromatographic performance (particularly with basic molecules). However, since the ultra inert silica surface effectively no longer contributes to the separation, C18 columns manufactured with high purity silicas show near identical selectivity. It is therefore highly likely that a problem separation on one leading brand will not be significantly improved by changing to an alternate manufacturer's equivalent product.

For many years, experienced chromatographers have been seeking phases with the proven performance and reproducibility benefits shown by such leading C18 column brands, but which additionally provide the alternate selectivity required for their challenging applications.

How is ACE C18-AR different?

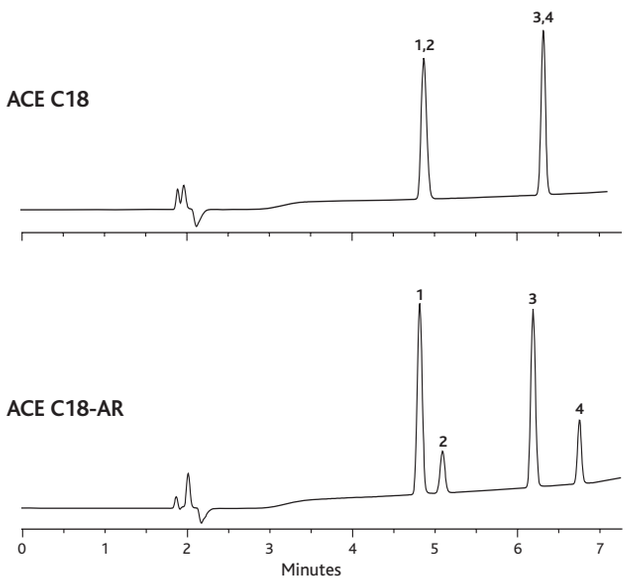
C18 bonded phases currently dominate the HPLC market, with recent surveys indicating that they are still responsible for 50-60% of all HPLC columns sold. However, in recent years the use of Phenyl bonded phases has grown significantly, due to the alternate selectivity they provide. It is estimated that Phenyl phases now account for 10-15% of HPLC column sales, making them the largest sub-category after C18 phases.

The ACE C18-AR phase utilises a specially developed ligand combining a C18 chain with integral phenyl functionality, thus combining the benefits of both C18 and Phenyl characteristics into a single phase. Based upon the same ultra inert, ultra pure, ultra reproducible silica platform as ACE C18, the unique ACE C18-AR phase provides an alternate selectivity to C18 columns.

"We required a C18 phase that provided different chromatography and improved resolution – ACE C18-AR delivered"

Senior Analyst, Leading Pharmaceutical Company

ACE C18-AR shows alternate selectivity to C18 bonded columns



Compounds:1) 4-acetamidophenol 2) 4-aminobenzoic acid 3) 4-hydroxybenzoic acid 4) caffeine
Column: 150 x 4.6mm, 3µm Flow Rate: 1.00ml/min Temperature: 40°C Detection: UV, 240nm

Mobile Phase: A. 0.1% v/v formic acid in H_2O
B. 0.1% v/v formic acid in MeCN

Gradient:

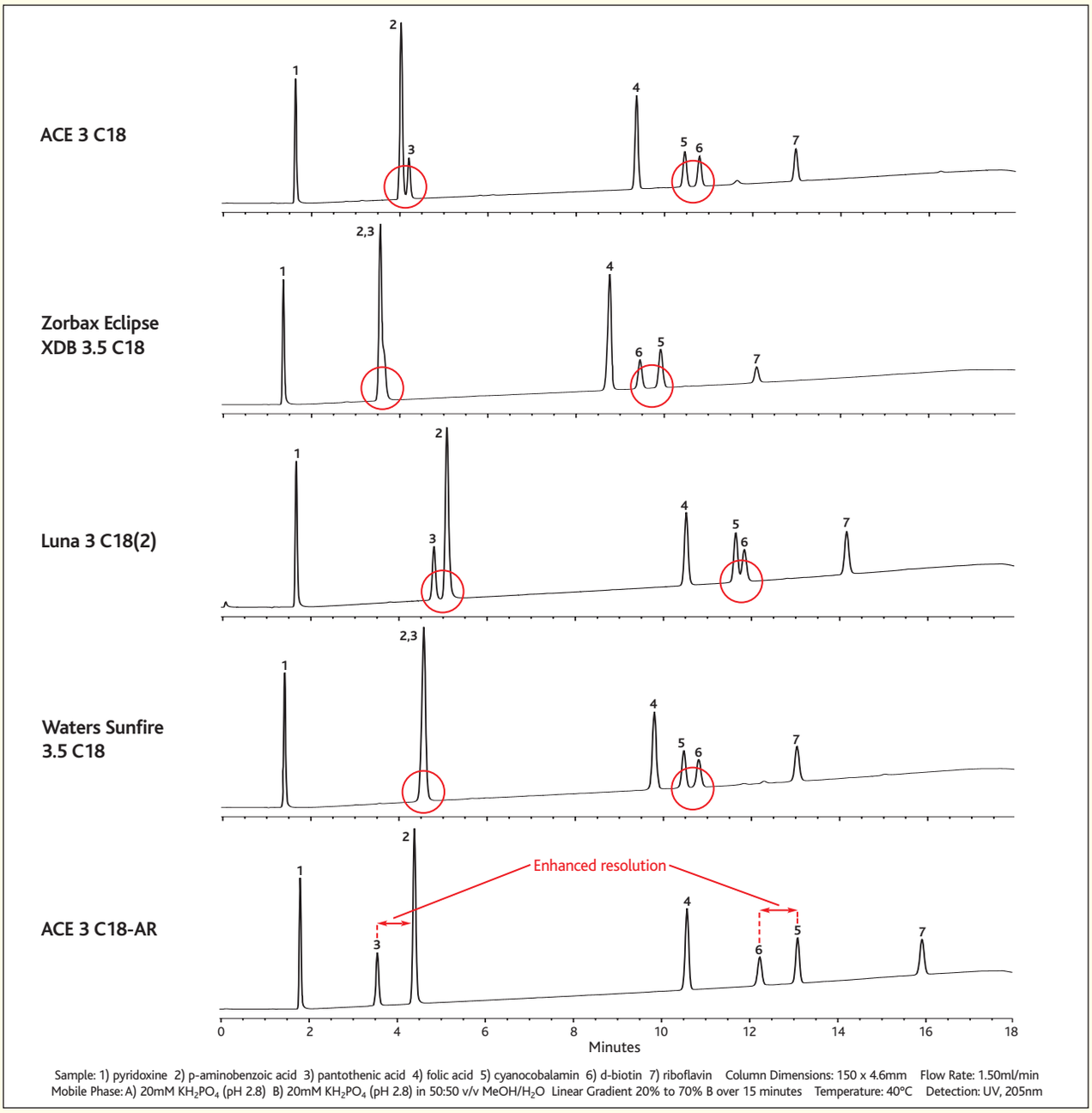
T(mins)	%B
0	5
9	35

When should I use ACE C18-AR?

Due to their similar hydrophobic characteristics, ACE C18-AR columns may be used for applications in which "standard" C18 columns would normally be considered. However, due to its integral phenyl functionality, ACE C18-AR is additionally recommended for separations that involve compounds containing aromatic functionality.

As the applications contained within this booklet demonstrate, ACE C18-AR can be used to improve separations that are proving problematic on C18 columns. The unique ACE C18-AR phase provides an alternate selectivity to C18 columns, but remains a valid selection for methods in which C18 bonded columns are specified. In many instances, the same evaluation conditions that prove unsuitable for the C18 column prove suitable for the C18-AR column, avoiding the need for lengthy method redevelopment.

Application #1 - Water Soluble Vitamins



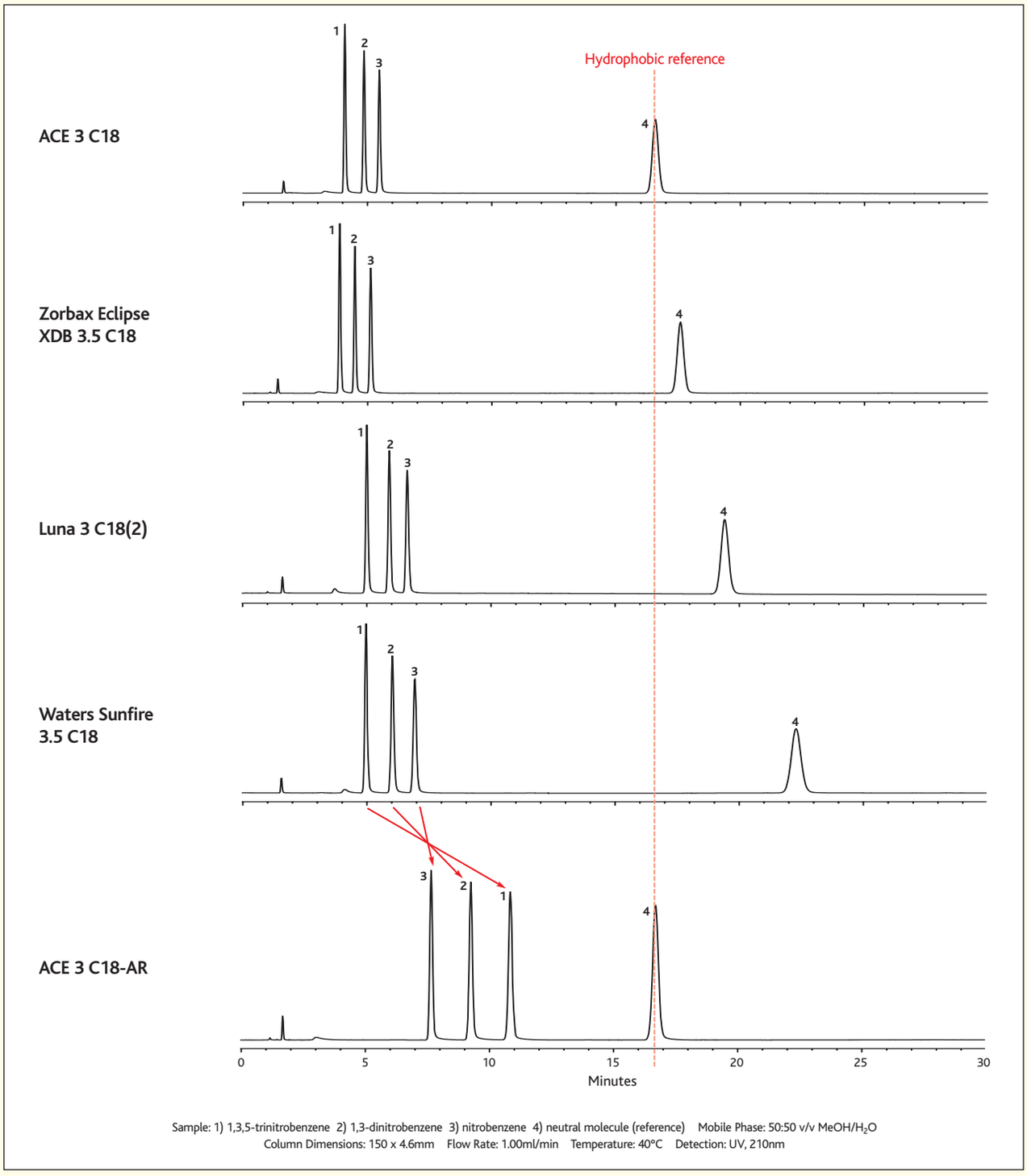
Sample: 1) pyridoxine 2) p-aminobenzoic acid 3) pantothenic acid 4) folic acid 5) cyanocobalamin 6) d-biotin 7) riboflavin Column Dimensions: 150 x 4.6mm Flow Rate: 1.50ml/min
Mobile Phase: A) 20mM KH_2PO_4 (pH 2.8) B) 20mM KH_2PO_4 (pH 2.8) in 50:50 v/v MeOH/H_2O Linear Gradient 20% to 70% B over 15 minutes Temperature: 40°C Detection: UV, 205nm

This test containing water soluble vitamins illustrates that leading C18 column brands provide similar selectivity. After optimisation of temperature and gradient, an acceptable separation is achieved on the ACE C18, with critical pair 2,3 just baseline resolved. To improve method robustness it may be preferable to try and further improve resolution. Since the evaluation conditions are already optimal, we now investigate whether changing to an alternate C18 column brand will improve the separation of our critical pairs (peaks 2,3 and 5,6). This approach is representative of a method development strategy currently performed in many laboratories.

As the above results demonstrate, both the Zorbax XDB C18 and Sunfire C18 columns no longer resolve critical pair 2,3, whereas the Luna C18(2) column shows slightly improved resolution of critical pair 2,3 but now critical pair 5,6 is only partially resolved.

However, the unique ACE C18-AR phase provides a completely different retention profile to those obtained with the leading C18 column brands. Resolution of both critical pairs is significantly improved and method robustness is no longer an issue. Indeed, further optimisation of both column dimensions and evaluation conditions (to reduce analysis time) is now possible.

Application #2 - Aromatic Nitrobenzenes

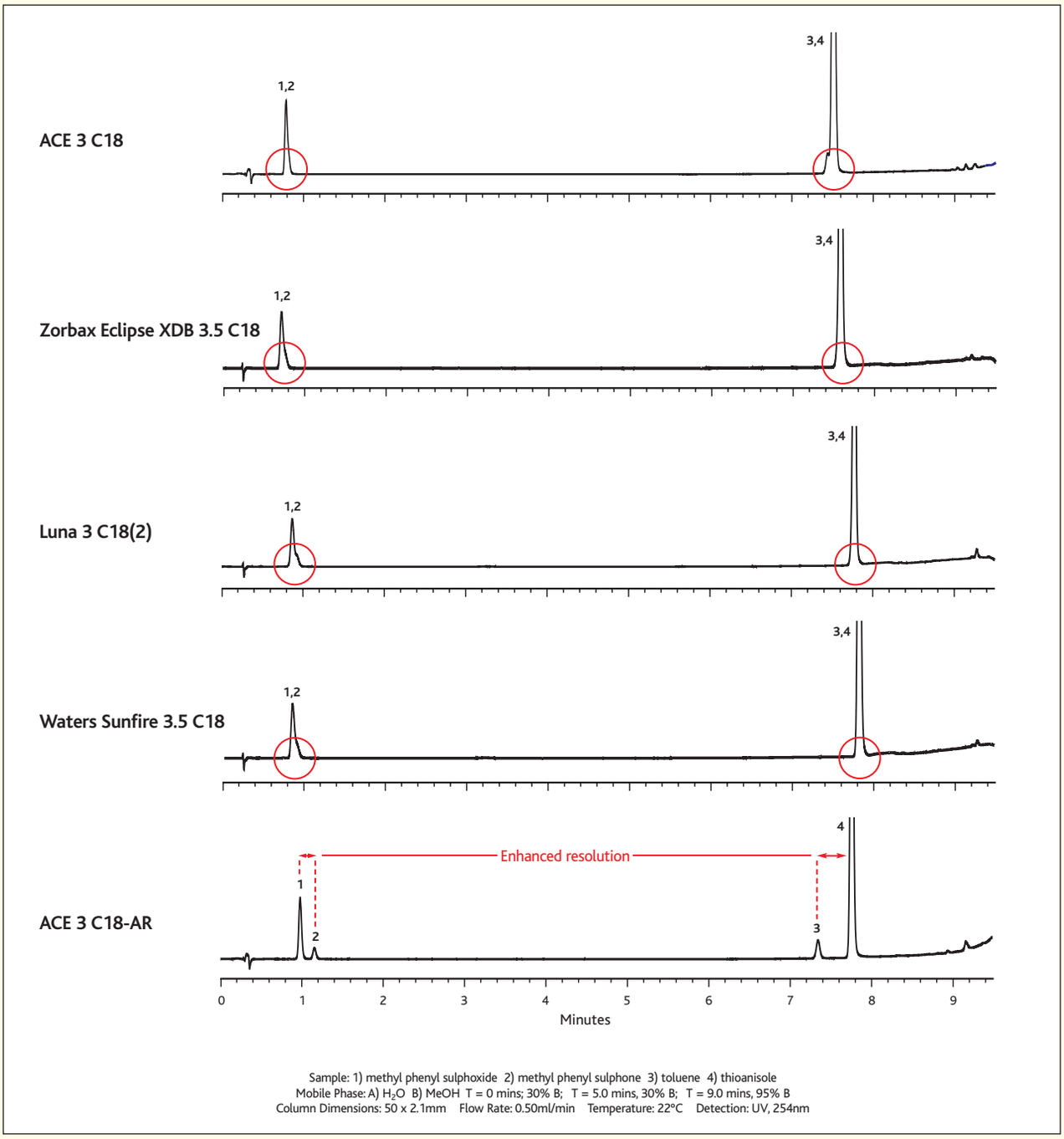


Sample: 1) 1,3,5-trinitrobenzene 2) 1,3-dinitrobenzene 3) nitrobenzene 4) neutral molecule (reference) Mobile Phase: 50:50 v/v MeOH/H_2O
Column Dimensions: 150 x 4.6mm Flow Rate: 1.00ml/min Temperature: 40°C Detection: UV, 210nm

This test containing aromatic nitrobenzene compounds performed under simple isocratic conditions again shows that the leading C18 column brands provide near identical selectivity. The differences in absolute retention (as illustrated by the neutral reference marker) are due to purely hydrophobic effects and related to parent silica characteristics (eg: surface area).

As the ACE C18-AR illustrates above, hydrophobic retention with a neutral marker is matched to its C18 equivalent, but selectivity towards aromatic nitrobenzene compounds is significantly enhanced - with increased retention and a complete reversal of elution order. This retention profile is completely different to that obtained with a standard C18 phase, and results from the integral phenyl functionality contained within the ACE C18-AR ligand.

Application #3 - Sulphur Compounds

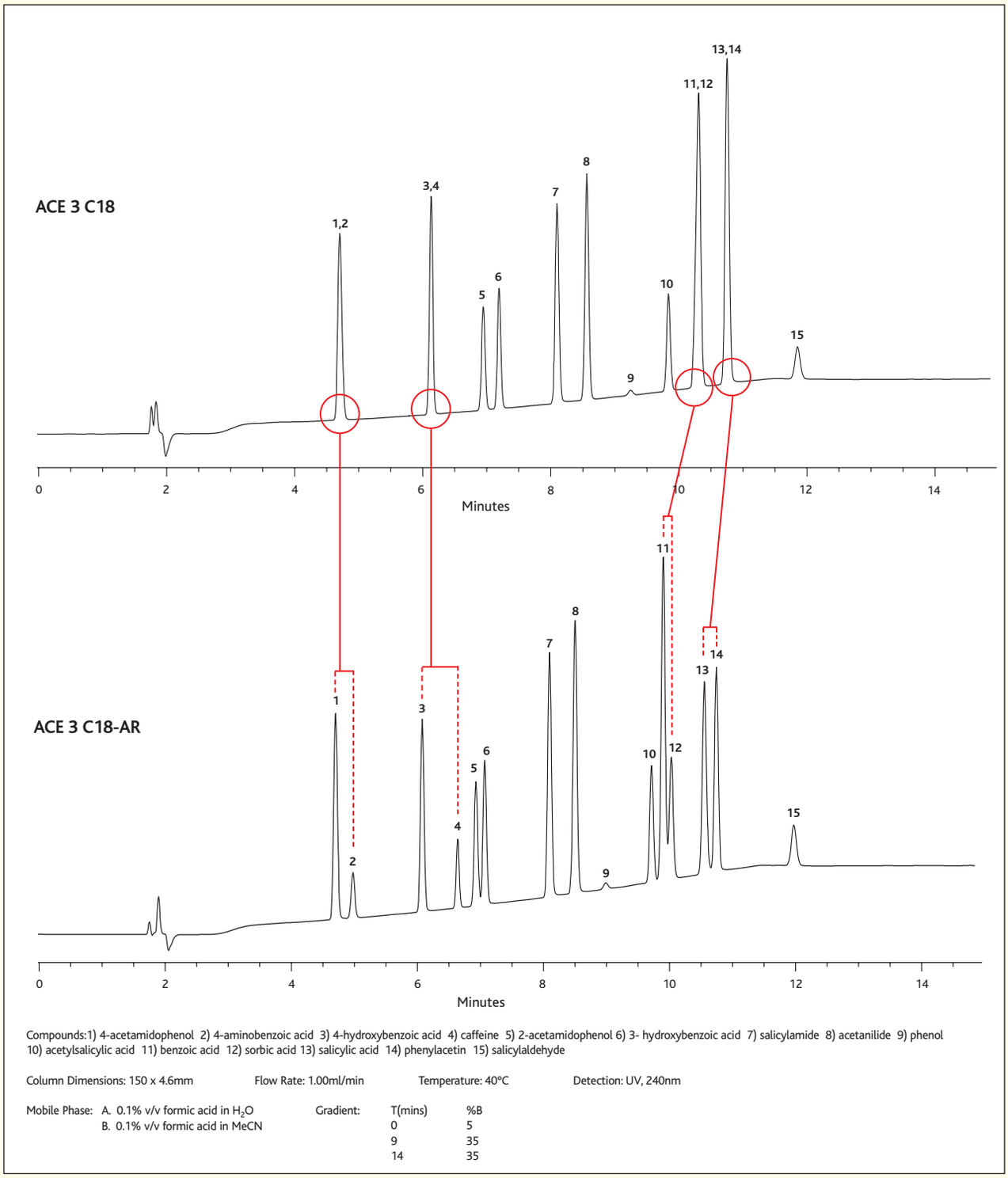


Sample: 1) methyl phenyl sulphoxide 2) methyl phenyl sulphone 3) toluene 4) thioanisole
Mobile Phase: A) H_2O B) MeOH T = 0 mins; 30% B; T = 5.0 mins, 30% B; T = 9.0 mins, 95% B
Column Dimensions: 50 x 2.1mm Flow Rate: 0.50ml/min Temperature: 22°C Detection: UV, 254nm

This difficult separation of sulphur compounds again shows that the leading C18 column brands provide essentially the same separation, with two pairs of co-eluting peaks obtained.

However, the C18-AR column again provides a completely different separation to the leading C18 column brands. The additional aromatic (π-π) interaction provided by the ACE C18-AR column enables both critical pairs 1,2 and 3,4 to be fully resolved.

Application #4 - Analgesics Separation



Compounds:1) 4-acetamidophenol 2) 4-aminobenzoic acid 3) 4-hydroxybenzoic acid 4) caffeine 5) 2-acetamidophenol 6) 3- hydroxybenzoic acid 7) salicylamide 8) acetanilide 9) phenol 10) acetylsalicylic acid 11) benzoic acid 12) sorbic acid 13) salicylic acid 14) phenylacetin 15) salicylaldehyde

Column Dimensions: 150 x 4.6mm Flow Rate: 1.00ml/min Temperature: 40°C Detection: UV, 240nm

Mobile Phase: A. 0.1% v/v formic acid in H_2O
B. 0.1% v/v formic acid in MeCN

Gradient:

T(mins)	%B
0	5
9	35
14	35

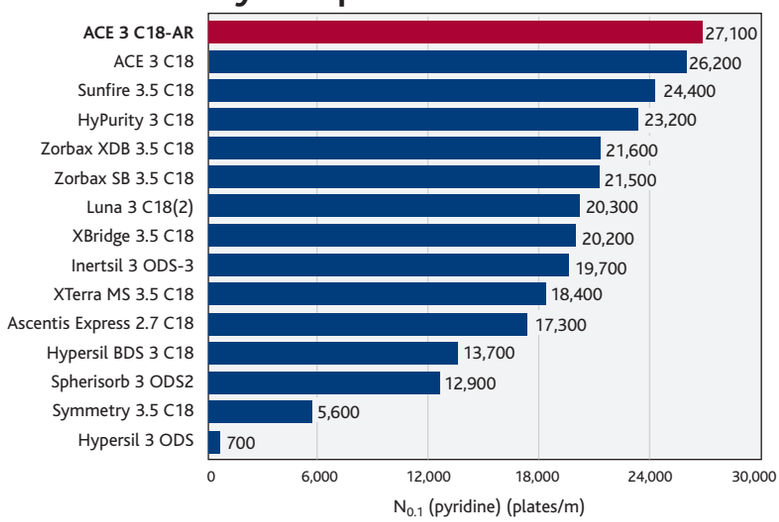
The above application shows the separation of analgesics on an ACE C18 column, with 4 pairs of co-eluting peaks observed. This separation is also consistent with those that can be expected with other leading C18 column brands, which exhibit very similar selectivity due to the same (predominantly hydrophobic) interaction.

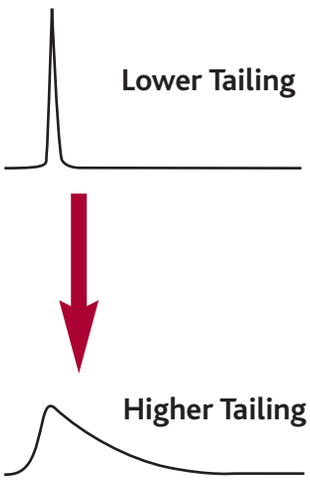
Based upon the same ultra inert, ultra high purity silica platform as ACE C18, the unique ACE C18-AR phase provides an alternate selectivity which enables resolution of all 15 components, including the 4 critical pairs previously identified. The same evaluation conditions that proved unsuitable for the ACE C18 were found to be suitable for the ACE C18-AR column, avoiding the need for lengthy method redevelopment.

Comparison of Column Inertness

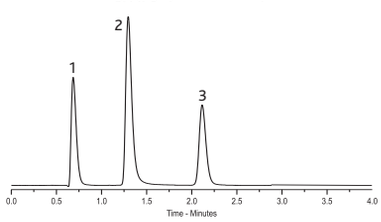
- Leading 3µm, small pore C18 column brands
- 50 x 2.1mm i.d. LC/MS compatible dimensions
- Basic molecule inertness test
- Peak efficiency and asymmetry investigation

Peak Efficiency Comparison

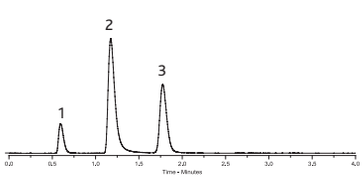




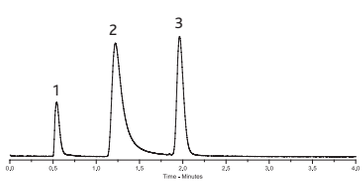
ACE 3 C18-AR
$N_{0.1}$(pyr) = 27,100pl/m



Waters XTerra MS 3.5 C18
$N_{0.1}$(pyr) = 18,400pl/m



Waters Symmetry 3.5 C18
$N_{0.1}$(pyr) = 5,600pl/m



Column Dimensions: 50 x 2.1mm Sample: 1) uracil 2) pyridine 3) phenol Mobile Phase: 40:60 v/v MeOH/H_2O Flow Rate: 0.20ml/min Temperature: 22°C Wavelength: 254nm

Conclusion:

Significant differences in efficiency, peak shape and selectivity are seen when analysing pyridine – a small highly basic molecule.

Increased tailing and retention are indicative of undesirable secondary interactions between pyridine and silanol groups on the stationary phase surface. These interactions can also result in poor column reproducibility.

ACE C18 columns have been previously independently tested and found to be the highest efficiency, most inert columns available. The new ACE C18-AR maintains this excellent performance.

ACE® Stationary Phases Virtually Eliminate the Negative Effects of Silanols on HPLC Separations

Further inertness test data is contained within the current ACE HPLC column catalogue. Additionally, a Comparison Guide to C18 Columns is also available, detailing material characteristics for over 50 HPLC column brands and comparing performance with a number of test probes. Please contact your local distributor to request your copies.

Compatible with Highly Aqueous Mobile Phases

Whilst primarily designed to show alternate selectivity to "standard" C18 columns, ACE C18-AR is also resistant to retention loss in 100% aqueous mobile phases, and may be used with fast gradients where the requirement for rapid re-equilibration and resistance to retention loss are essential.

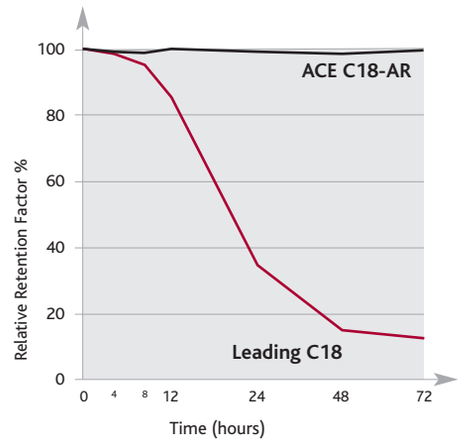
Maximum Reproducibility under High Aqueous Conditions

When separating very polar, water soluble compounds, highly aqueous (>95%) mobile phases are often required to achieve sufficient retention. However, operating a conventional C18 column under such conditions can lead to poor chromatographic reproducibility. Over time, peaks will elute with shorter and shorter retention times and resolution between peaks will deteriorate.

This retention loss was originally believed to be due to "Phase Collapse", whereby the bonded phase ligands become matted down and thus offer a reduced interaction with the sample. However, more recent studies suggest that "Pore De-Wetting" is actually occurring. The mobile phase is excluded from the pores under highly aqueous conditions and the retention loss is due to a loss of accessible surface area.

The integral phenyl functionality of the ACE C18-AR protects against pore de-wetting and subsequent retention loss, resulting in highly reproducible chromatography even under highly aqueous conditions.

Reproducible Chromatography with 100% Aqueous Mobile Phase

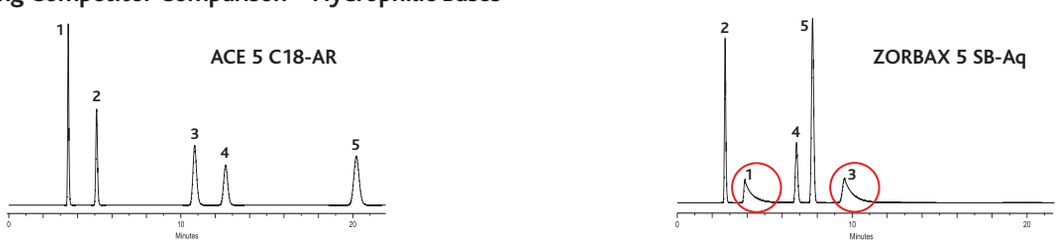


Ultra Inert Silica for Excellent Chromatography

Many columns designed for use under high aqueous conditions are compromised by the low purity silica employed and exhibit poor peak shape with polar basic molecules. This results in poor chromatography and ultimately leads to poor column reproducibility.

ACE C18-AR columns are manufactured from the same ultra inert, high purity silica as all ACE phases – ensuring excellent chromatography and excellent reproducibility are obtained.

Leading Competitor Comparison – Hydrophilic Bases



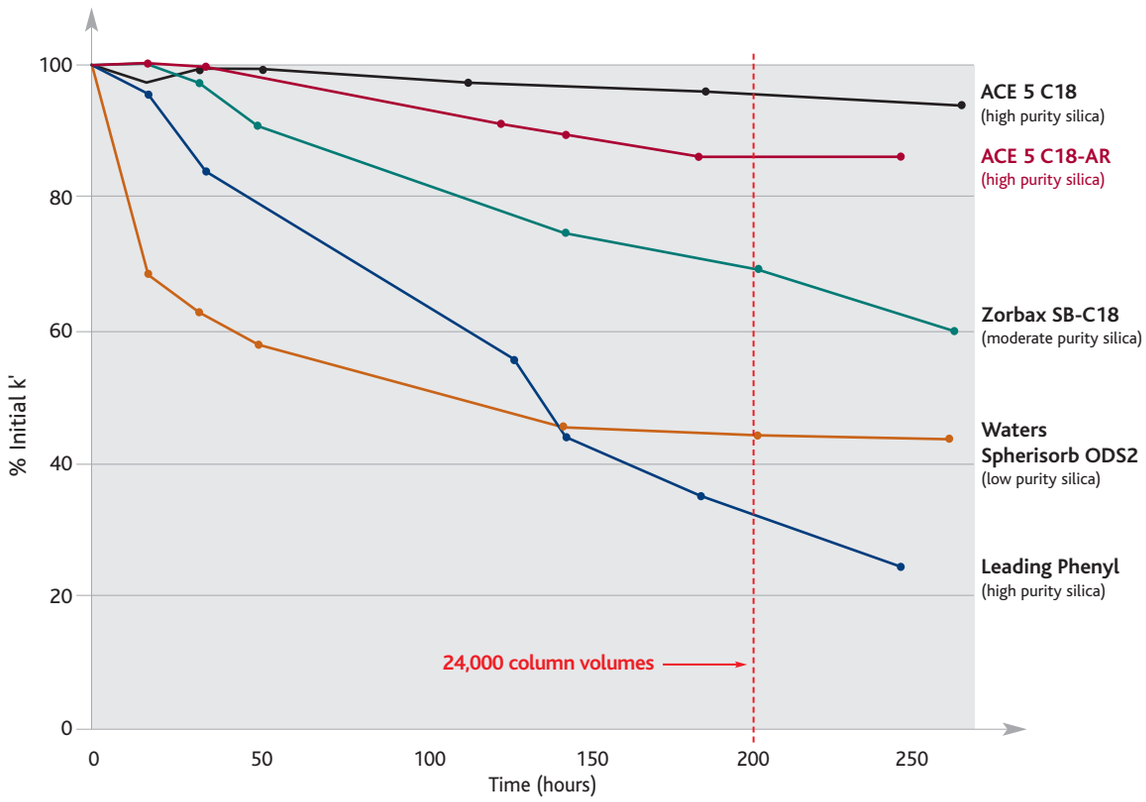
Sample: 1) nicotine 2) benzylamine 3) procainamide 4) salbutamol 5) phenol Mobile Phase: 3.3:96.7 MeOH/20mM KH_2PO_4 (pH 2.7) Dimensions: 150 x 4.6mm i.d. Flow Rate: 1.0ml/min, Temperature: 60°C, Wavelength: 210nm

The Zorbax SB-Aq column shows a dramatic loss of performance for peaks 1 and 3, whereas the ultra inert ACE C18-AR column maintains excellent peak shape with hydrophilic bases.

Temperature and pH Stability

At low pH, column deterioration is caused by hydrolysis of the bonded phase, with a decrease in retention observed. The nature of the bonded phase, the purity of the silica surface and bonding density are all critical parameters. The use of a lower purity silica, a shorter ligand and a lower bonding density are all factors that will contribute to accelerated ligand cleavage and reduced column lifetime.

Accelerated Column Stability Study - 80°C at pH 1.9



Acidic Exposure Conditions: Mobile Phase: 5:95 MeOH/0.1% TFA in H_2O (pH 1.9) Column Dimensions: 50 x 2.1mm
Flow Rate: 0.20ml/min
Temperature: 80°C

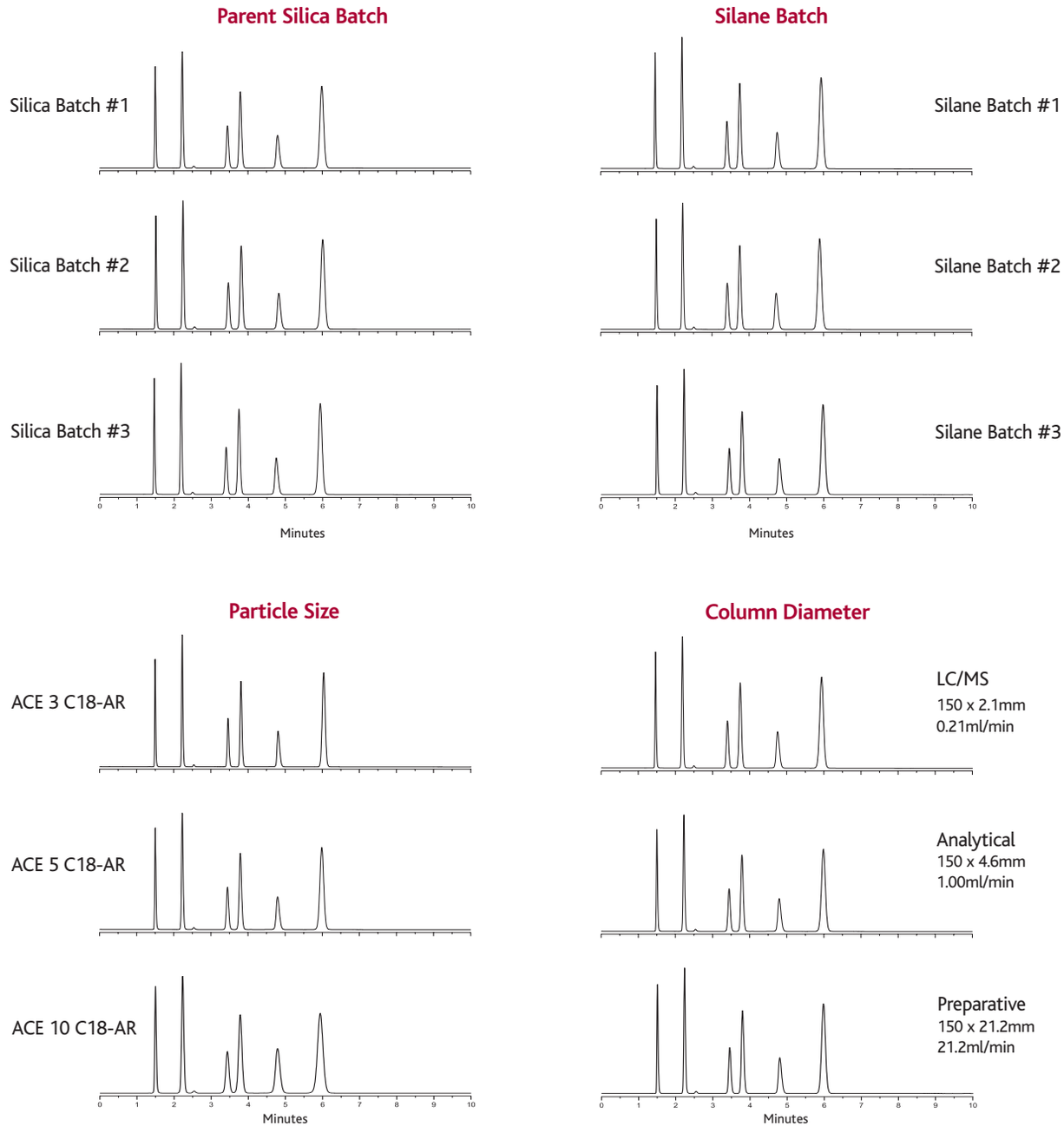
Using conditions designed to accelerate column degradation, the ACE C18-AR phase shows little retention loss, with lifetime equivalent to the highly robust ACE C18 phase. Both phases are manufactured from the same ultra pure silica, and out-last the Zorbax SB C18, a phase previously recognised to provide excellent stability for high temperature and low pH applications.

As expected, a C18 bonded column based upon a low purity silica (Waters Spherisorb ODS2) shows a greatly reduced lifetime under these accelerated conditions.

Of particular note is the result comparing the lifetime of a leading phenyl column to the ACE C18-AR. Despite the use of an ultra pure silica, the lifetime of the phenyl column is diminished compared with the ACE C18-AR, suggesting that the ACE C18-AR may be suitable for applications in which phenyl columns are seen to exhibit reduced lifetime.

Guaranteed Reproducibility and Fully Scalable

Of equal importance to alternate selectivity is excellent reproducibility. Variations between different batches of stationary phase are the most common cause of customer concern. ACE stationary phases virtually eliminate the unpredictable negative effects of silanols on HPLC separations by maintaining a rigid control of the complete manufacturing process and establishing tight specifications for purity, selectivity, retention, efficiency and asymmetry. Therefore, as demonstrated in the figure below absolute batch-to-batch and column-to-column reproducibility are guaranteed for all ACE C18-AR columns.



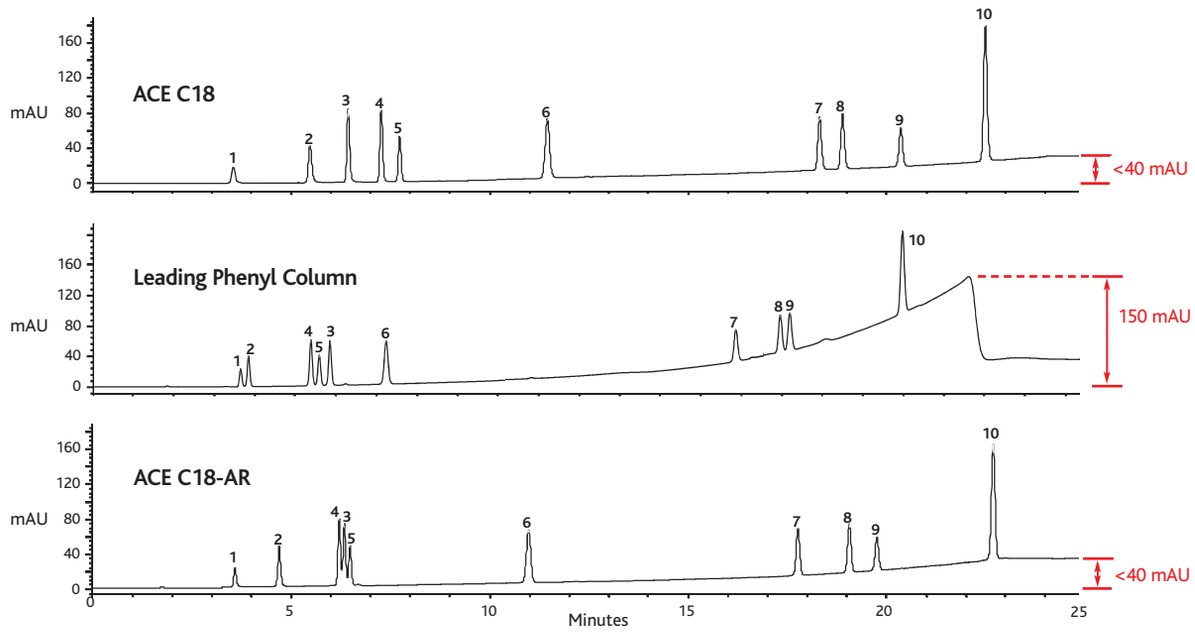
Column: ACE 5 C18-AR, 150 x 4.6mm (unless specified otherwise)
Sample: 1) uracil 2) 4-hydroxybenzoic acid 3) acetylsalicylic acid 4) benzoic acid 5) 2-hydroxybenzoic acid 6) ethyl paraben
Mobile Phase: 35:65 MeCN/0.1%TFA in H_2O Temperature: 22°C Wavelength: 254nm Flow 1.00ml/min (unless specified otherwise)

The availability of 3µm, 5µm and 10µm particle sizes combined with a range of column dimensions from capillary through to preparative scale ensures that methods can be reproducibly scaled up or down. The chromatograms above demonstrate the excellent reproducibility achieved when silica batch and silane batch are changed, and the reproducible scalability obtained when changing particle size and column diameter.

Low Bleed for UV and LC/MS Compatibility

Many phases exhibit bleed of the bonded phase, which is most clearly seen under gradient conditions when baseline stability is affected. Whilst most ultra pure C18 phases can be expected to give low column bleed, careful selection of an alternate selectivity bonded phase is required to ensure that column bleed does not cause unforeseen problems when analysing at low UV wavelengths or by LC/MS.

ACE C18-AR Exhibits Low Column Bleed for UV



Column Dimensions: 150 x 4.6mm Flow Rate: 1.00ml/min Temperature: 60°C Detection: UV, 214nm

Compounds: 1) nicotine 2) benzylamine 3) procainamide 4) terbutaline 5) salbutamol 6) phenol 7) internal standard A 8) internal standard B 9) diphenhydramine 10) nortriptyline

Mobile Phase: A. 20mM KH_2PO_4 in H_2O (pH 2.7) B. 35:65 (v/v) 20mM KH_2PO_4 in H_2O (pH 2.7) / MeOH

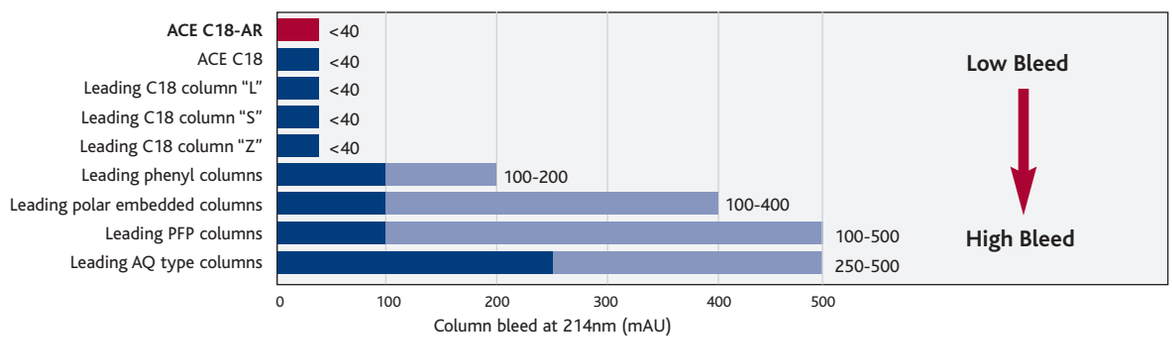
Gradient:

T(mins)	%B
0	5
20	95
25	95
26	5

This example compares the low bleed characteristics of an ultra pure ACE C18 column (top) with the moderate bleed typical of phenyl columns (middle). The ACE C18-AR column (bottom) shows bleed levels comparable to the ACE C18 despite containing an integral phenyl functionality which provides the alternate selectivity.

Comparison of UV Bleed

Evaluation of Leading C18 Brands and Popular Alternate Bonded Phases



Further analysis of a wider range of columns under the same conditions confirms that leading high purity C18 column brands show similarly low levels of column bleed. However, the evaluation of alternate bonded phases traditionally recommended to change selectivity (ie; phenyl, polar embedded, PFP and AQ type surface chemistries) reveal that all these non-C18 columns show significantly higher bleed.

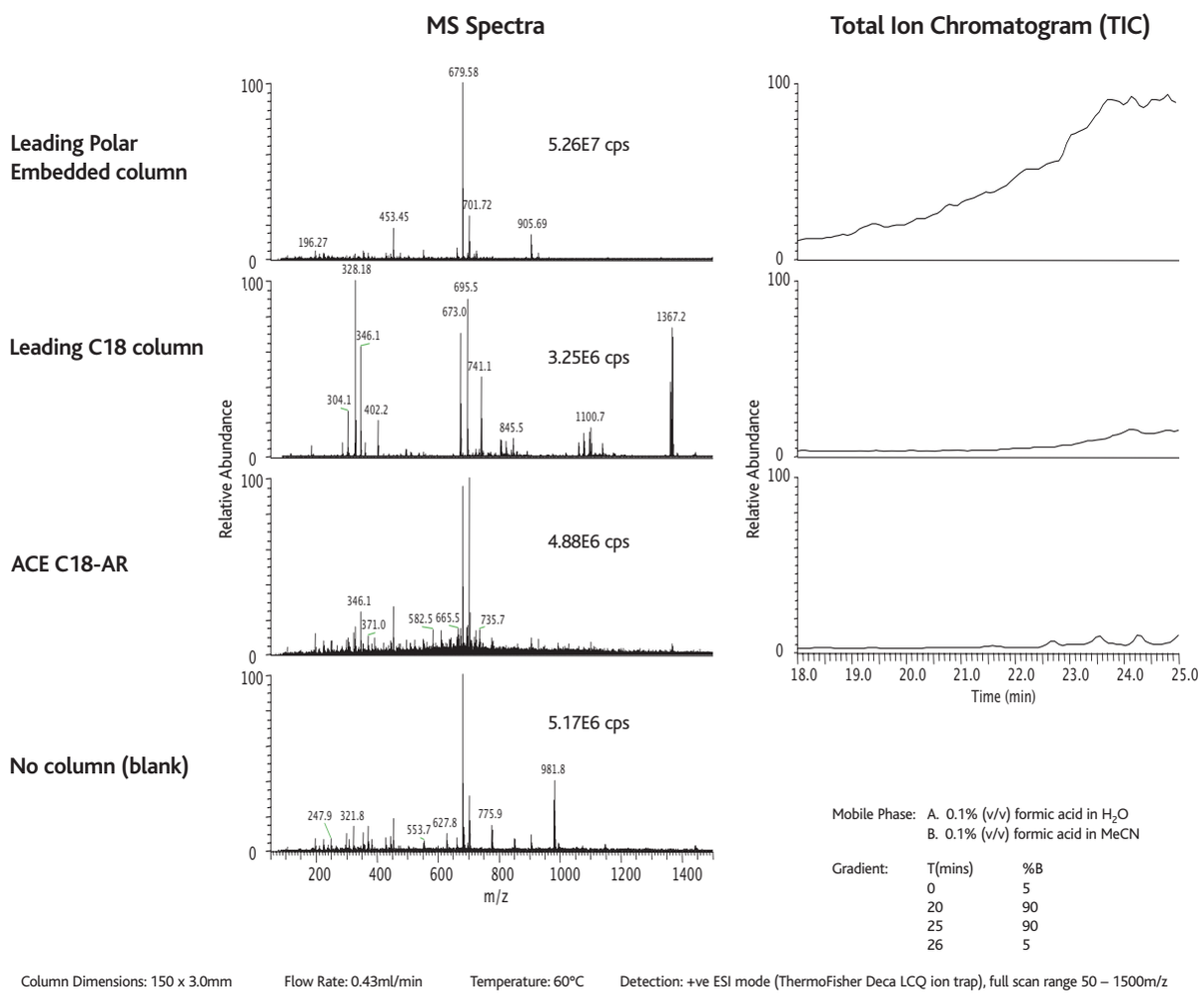
The ACE C18-AR combines a low bleed level (typical of the leading C18 column brands) with an alternate selectivity, thus providing the analyst with a valuable method development tool.

Low Bleed for UV and LC/MS Compatibility (cont'd)

When detecting by MS, the use of non-C18 phases has traditionally presented additional challenges to the analyst. In extreme instances, column bleed may swamp the detector signal and mask the analyte of interest.

In the following example, column bleed is monitored in the 18-25 minute segment of the gradient run, at which point the % organic increases to its maximum level and column bleed is therefore also highest. The MS Spectra (left series) provides an m/z breakdown of the bleed detected during this 18-25 minute window, whereas the Total Ion Chromatogram (right series) illustrates the bleed obtained during this same 18-25 minute time period.

ACE C18-AR Exhibits Low Column Bleed for LC/MS



The TIC trace and MS spectra for the polar embedded column (previously seen to show significant bleed by UV detection) again shows a high level of column bleed when analysing by LC/MS. The MS spectra from a blank run (performed with no column attached) enables the background system bleed to be quantified. Both the ACE C18-AR column and leading C18 column exhibit bleed levels similar to the blank run, denoting that negligible column bleed is occurring.

Conclusion:

The ACE C18-AR phase may be used to provide a different selectivity to leading C18 columns without encountering the column bleed issues associated with many alternate (ie: non-C18) bonded phases.

Material Characteristics

PHASE	FUNCTIONAL GROUP	ENDCAPPED	PARTICLE SIZE (µm)	PORE SIZE (Å)	SURFACE AREA (m^2/g)	CARBON LOAD (%)	MAXIMUM pH RANGE
C18-AR	Proprietary octadecyl with embedded phenyl functionality	Yes	3, 5, 10	100	300	15.5	1.5-10.0[a]
C18	Octadecyl	Yes	3, 5, 10	100	300	15.5	1.5-10.0[a]

[a] For optimum column lifetime, a pH range of 2-8 is recommended. To increase column lifetime at high pH, organic buffers, low buffer concentrations, high % organic solvent and low temperatures must be considered. Further information is contained within "A Guide to HPLC and LC-MS Buffer Selection" by John Dolan – contact your distributor to request your FREE copy.

ACE 3µm Columns (Contact your distributor for the full range of ACE 3µm phases available)

ACE 3µm C18-AR

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
1.0mm	-	ACE-119-0301	ACE-119-3501	ACE-119-0501	ACE-119-7501	ACE-119-1001	ACE-119-1201	ACE-119-1501	ACE-119-2501[a]	ACE-119-0101GD[1]
2.1mm	ACE-119-0202[6]	ACE-119-0302	ACE-119-3502	ACE-119-0502	ACE-119-7502	ACE-119-1002	ACE-119-1202	ACE-119-1502	ACE-119-2502[a]	ACE-119-0102GD[2]
3.0mm	ACE-119-0203[6]	ACE-119-0303	ACE-119-3503	ACE-119-0503	ACE-119-7503	ACE-119-1003	ACE-119-1203	ACE-119-1503	ACE-119-2503[a]	ACE-119-0103GD[3]
4.0mm	-	-	ACE-119-3504	ACE-119-0504	ACE-119-7504	ACE-119-1004	ACE-119-1204	ACE-119-1504	ACE-119-2504[a]	ACE-119-0103GD[3]
4.6mm	ACE-119-0246[6]	ACE-119-0346	ACE-119-3546	ACE-119-0546	ACE-119-7546	ACE-119-1046	ACE-119-1246	ACE-119-1546	ACE-119-2546[a]	ACE-119-0103GD[3]

ACE 3µm C18

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
1.0mm	-	ACE-111-0301	ACE-111-3501	ACE-111-0501	ACE-111-7501	ACE-111-1001	ACE-111-1201	ACE-111-1501	ACE-111-2501[a]	ACE-111-0101GD[1]
2.1mm	ACE-111-0202[6]	ACE-111-0302	ACE-111-3502	ACE-111-0502	ACE-111-7502	ACE-111-1002	ACE-111-1202	ACE-111-1502	ACE-111-2502[a]	ACE-111-0102GD[2]
3.0mm	ACE-111-0203[6]	ACE-111-0303	ACE-111-3503	ACE-111-0503	ACE-111-7503	ACE-111-1003	ACE-111-1203	ACE-111-1503	ACE-111-2503[a]	ACE-111-0103GD[3]
4.0mm	-	-	ACE-111-3504	ACE-111-0504	ACE-111-7504	ACE-111-1004	ACE-111-1204	ACE-111-1504	ACE-111-2504[a]	ACE-111-0103GD[3]
4.6mm	ACE-111-0246[6]	ACE-111-0346	ACE-111-3546	ACE-111-0546	ACE-111-7546	ACE-111-1046	ACE-111-1246	ACE-111-1546	ACE-111-2546[a]	ACE-111-0103GD[3]

[a] Consider operating pressure limitations for maximum column lifetime

ACE 5µm Columns (Contact your distributor for the full range of ACE 5µm phases available)

ACE 5µm C18-AR

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
1.0mm	-	ACE-129-0301	ACE-129-3501	ACE-129-0501	ACE-129-7501	ACE-129-1001	ACE-129-1201	ACE-129-1501	ACE-129-2501	ACE-129-0101GD[1]
2.1mm	ACE-129-0202[6]	ACE-129-0302	ACE-129-3502	ACE-129-0502	ACE-129-7502	ACE-129-1002	ACE-129-1202	ACE-129-1502	ACE-129-2502	ACE-129-0102GD[2]
3.0mm	ACE-129-0203[6]	ACE-129-0303	ACE-129-3503	ACE-129-0503	ACE-129-7503	ACE-129-1003	ACE-129-1203	ACE-129-1503	ACE-129-2503	ACE-129-0103GD[3]
4.0mm	-	-	ACE-129-3504	ACE-129-0504	ACE-129-7504	ACE-129-1004	ACE-129-1204	ACE-129-1504	ACE-129-2504	ACE-129-0103GD[3]
4.6mm	ACE-129-0246[6]	ACE-129-0346	ACE-129-3546	ACE-129-0546	ACE-129-7546	ACE-129-1046	ACE-129-1246	ACE-129-1546	ACE-129-2546	ACE-129-0103GD[3]
7.75mm	-	-	-	ACE-129-0508	ACE-129-7508	ACE-129-1008	ACE-129-1208	ACE-129-1508	ACE-129-2508	ACE-129-0110GD[4]
10.0mm	-	-	-	ACE-129-0510	ACE-129-7510	ACE-129-1010	ACE-129-1210	ACE-129-1510	ACE-129-2510	ACE-129-0110GD[4]
21.2mm	-	-	-	ACE-129-0520	ACE-129-7520	ACE-129-1020	ACE-129-1220	ACE-129-1520	ACE-129-2520	ACE-129-0110GD[4]
30.0mm	-	-	-	ACE-129-0530	ACE-129-7530	ACE-129-1030	-	ACE-129-1530	ACE-129-2530	ACE-129-0220GD[5]

ACE 5µm C18

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
1.0mm	-	ACE-121-0301	ACE-121-3501	ACE-121-0501	ACE-121-7501	ACE-121-1001	ACE-121-1201	ACE-121-1501	ACE-121-2501	ACE-121-0101GD[1]
2.1mm	ACE-121-0202[6]	ACE-121-0302	ACE-121-3502	ACE-121-0502	ACE-121-7502	ACE-121-1002	ACE-121-1202	ACE-121-1502	ACE-121-2502	ACE-121-0102GD[2]
3.0mm	ACE-121-0203[6]	ACE-121-0303	ACE-121-3503	ACE-121-0503	ACE-121-7503	ACE-121-1003	ACE-121-1203	ACE-121-1503	ACE-121-2503	ACE-121-0103GD[3]
4.0mm	-	-	ACE-121-3504	ACE-121-0504	ACE-121-7504	ACE-121-1004	ACE-121-1204	ACE-121-1504	ACE-121-2504	ACE-121-0103GD[3]
4.6mm	ACE-121-0246[6]	ACE-121-0346	ACE-121-3546	ACE-121-0546	ACE-121-7546	ACE-121-1046	ACE-121-1246	ACE-121-1546	ACE-121-2546	ACE-121-0103GD[3]
7.75mm	-	-	-	ACE-121-0508	ACE-121-7508	ACE-121-1008	ACE-121-1208	ACE-121-1508	ACE-121-2508	ACE-121-0110GD[4]
10.0mm	-	-	-	ACE-121-0510	ACE-121-7510	ACE-121-1010	ACE-121-1210	ACE-121-1510	ACE-121-2510	ACE-121-0110GD[4]
21.2mm	-	-	-	ACE-121-0520	ACE-121-7520	ACE-121-1020	ACE-121-1220	ACE-121-1520	ACE-121-2520	ACE-121-0110GD[4]
30.0mm	-	-	-	ACE-121-0530	ACE-121-7530	ACE-121-1030	-	ACE-121-1530	ACE-121-2530	ACE-121-0220GD[5]

[1] 5 pack - use with cartridge holder H0001 and column coupler C0001
[2] 5 pack - use with integral microbore cartridge holder H0004 (not 20mm column length)
[3] 5 pack - use with integral analytical cartridge holder H0005 (not 20mm column length)
[4] 3 pack - use with semi-prep cartridge holder H0002 and column coupler C0001
[5] 1 pack - use with prep cartridge holder H0006 and column coupler C0002
[6] When using guards, cartridge holder H0001 and column coupler C0001 required

ACE 10µm Columns (Contact your distributor for the full range of ACE 10µm phases available)

ACE 10µm C18-AR

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
4.6mm	ACE-139-0246[6]	ACE-139-0346	ACE-139-3546	ACE-139-0546	ACE-139-7546	ACE-139-1046	ACE-139-1246	ACE-139-1546	ACE-139-2546	ACE-139-0103GD[3]
7.75mm	-	-	-	ACE-139-0508	ACE-139-7508	ACE-139-1008	ACE-139-1208	ACE-139-1508	ACE-139-2508	ACE-139-0110GD[4]
10.0mm	-	-	-	ACE-139-0510	ACE-139-7510	ACE-139-1010	ACE-139-1210	ACE-139-1510	ACE-139-2510	ACE-139-0110GD[4]
21.2mm	-	-	-	ACE-139-0520	ACE-139-7520	ACE-139-1020	ACE-139-1220	ACE-139-1520	ACE-139-2520	ACE-139-0110GD[4]
30.0mm	-	-	-	ACE-139-0530	ACE-139-7530	ACE-139-1030	-	ACE-139–1530	ACE-139-2530	ACE-139-0220GD[5]
50.0mm	-	-	-	enquire	enquire	enquire	enquire	enquire	enquire	enquire

ACE 10µm C18

COLUMN DIAMETER	COLUMN LENGTH									GUARD CARTRIDGE
	20 mm	30 mm	35 mm	50 mm	75 mm	100 mm	125 mm	150 mm	250 mm	
4.6mm	ACE-131-0246[6]	ACE-131-0346	ACE-131-3546	ACE-131-0546	ACE-131-7546	ACE-131-1046	ACE-131-1246	ACE-131-1546	ACE-131-2546	ACE-131-0103GD[3]
7.75mm	-	-	-	ACE-131-0508	ACE-131-7508	ACE-131-1008	ACE-131-1208	ACE-131-1508	ACE-131-2508	ACE-131-0110GD[4]
10.0mm	-	-	-	ACE-131-0510	ACE-131-7510	ACE-131-1010	ACE-131-1210	ACE-131-1510	ACE-131-2510	ACE-131-0110GD[4]
21.2mm	-	-	-	ACE-131-0520	ACE-131-7520	ACE-131-1020	ACE-131-1220	ACE-131-1520	ACE-131-2520	ACE-131-0110GD[4]
30.0mm	-	-	-	ACE-131-0530	ACE-131-7530	ACE-131-1030	-	ACE-131–1530	ACE-131-2530	ACE-131-0220GD[5]
50.0mm	-	-	-	enquire	enquire	enquire	enquire	enquire	enquire	enquire

[3] 5 pack - use with integral analytical cartridge holder H0005 (not 20mm column length)
[4] 3 pack - use with semi-prep cartridge holder H0002 and column coupler C0001
[5] 1 pack - use with prep cartridge holder H0006 and column coupler C0002
[6] When using guards, cartridge holder H0001 and column coupler C0001 required

Method Validation Kits

ACE phases are widely recognized to offer outstanding reproducibility. To aid method validation, a convenient kit containing three columns of the same bonded phase and dimensions, packed with three different batches of silica is available. Method Development Kits are available for all phases and column dimensions, with the most common kits shown below.

2.1mm METHOD VALIDATION KITS (three different batches of the same phase)	50 X 2.1mm	150 X 2.1mm	250 X 2.1mm
ACE 3 C18-AR Method Validation Kit ACE 5 C18-AR Method Validation Kit	ACE-119-0502-MVK ACE-129-0502-MVK	ACE-119-1502-MVK ACE-129-1502-MVK	ACE-119-2502-MVK[a] ACE-129-2502-MVK
ACE 3 C18 Method Validation Kit ACE 5 C18 Method Validation Kit	ACE-111-0502-MVK ACE-121-0502-MVK	ACE-111-1502-MVK ACE-121-1502-MVK	ACE-111-2502-MVK[a] ACE-121-2502-MVK

3.0mm METHOD VALIDATION KITS (three different batches of the same phase)	50 X 3.0mm	150 X 3.0mm	250 X 3.0mm
ACE 3 C18-AR Method Validation Kit ACE 5 C18-AR Method Validation Kit	ACE-119-0503-MVK ACE-129-0503-MVK	ACE-119-1503-MVK ACE-129-1503-MVK	ACE-119-2503-MVK[a] ACE-129-2503-MVK
ACE 3 C18 Method Validation Kit ACE 5 C18 Method Validation Kit	ACE-111-0503-MVK ACE-121-0503-MVK	ACE-111-1503-MVK ACE-121-1503-MVK	ACE-111-2503-MVK[a] ACE-121-2503-MVK

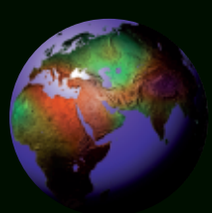
4.6mm METHOD VALIDATION KITS (three different batches of the same phase)	50 X 4.6mm	150 X 4.6mm	250 X 4.6mm
ACE 3 C18-AR Method Validation Kit ACE 5 C18-AR Method Validation Kit	ACE-119-0546-MVK ACE-129-0546-MVK	ACE-119-1546-MVK ACE-129-1546-MVK	ACE-119-2546-MVK[a] ACE-129-2546-MVK
ACE 3 C18 Method Validation Kit ACE 5 C18 Method Validation Kit	ACE-111-0546-MVK ACE-121-0546-MVK	ACE-111-1546-MVK ACE-121-1546-MVK	ACE-111-2546-MVK[a] ACE-121-2546-MVK

[a] Consider operating pressure limitations for maximum column lifetime

Free HPLC Technical Guides and Slide Chart

To receive your FREE copies of these guides or the HPLC Column slide chart contact your local distributor or email: info@ace-hplc.com

ACE® products are available through our international network of distributors



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