

MODcol® Multipacker® Systems and DAC Spring® Columns

Technical Note

**purification
technologies**

MODcol® Spring® Columns and MultiPacker® Instruments

MODcol® Dynamic Axial Compression (DAC) Spring® Columns are the product of choice for chromatographers who require high performance, robustness, and long lasting columns. This highly versatile DAC technology is self-contained in a small and portable package, providing a highly advanced and flexible technology for preparative and semi-preparative chromatography columns.

MODcol® Dynamic Axial Compression Spring® columns are the only mobile DAC columns on the market. They can be used without being mounted in the Multipacker® instrument with full DAC functionality. Spring® columns are available in 25mm, 50mm and 101mm i.d. and 2 lengths, which enable packed bed lengths from 5–300mm.

Dynamic Axial Compression has been used for many years in process chromatography to provide long lasting columns with excellent performance. This technology was developed to address the loss of efficiency and peak symmetry that can result when many samples and large amounts of mobile phase are passed through columns with fixed low-density beds. Under these conditions the initial packing of the media particles in the column bed can be disturbed, resulting in the formation of a void at the column inlet or in a channelling through the packed bed. This compromises efficiency and peak symmetry. Such voids and channeling can be eliminated by using a DAC system that continually forces a piston against the media bed at the column inlet.

Traditional DAC systems drive the piston with a hydraulic mechanism. The mechanical complexity of the hydraulic components can make it much more expensive than traditional columns. Until recently, use of DAC systems was limited to large permanent installations or expensive preparative systems where the column is an integrated part of the packing unit and can not be used independently after the packing process is finished. For the few alternative systems available for which the column can be separated from the packing unit, the DAC principle is lost when the column is separated from the packer and reduced to static axial compression (SAC) only.

25mm and 50mm Spring® Columns



Multipacker® Instrument for 25mm and 50mm Columns



Unlike other systems, the DAC mechanism remains inside the Spring® column even when removed from the packing unit.

Use a single Multipacker® unit to pack multiple columns

The MultiPacker® Instrument is a convenient tool to self pack preparative dynamic axial compression (DAC) Spring® Columns for HPLC.

With the revolutionary Dynamic Axial Compression Spring® Columns, the advantages of the DAC technology for preparative and semi-preparative chromatography are available at an affordable cost and with an ease of use that is comparable to classical fixed bed columns.

The Spring® Column Principle

The MODcol® DAC Spring® Column technology compensates for voids formed by bed settling, extending column lifetime and improving column performance without an external power source. This patented technology uses a spring-driven internal compression mechanism, instead of the traditional external hydraulic system, which keeps the piston in direct contact with the packed bed.

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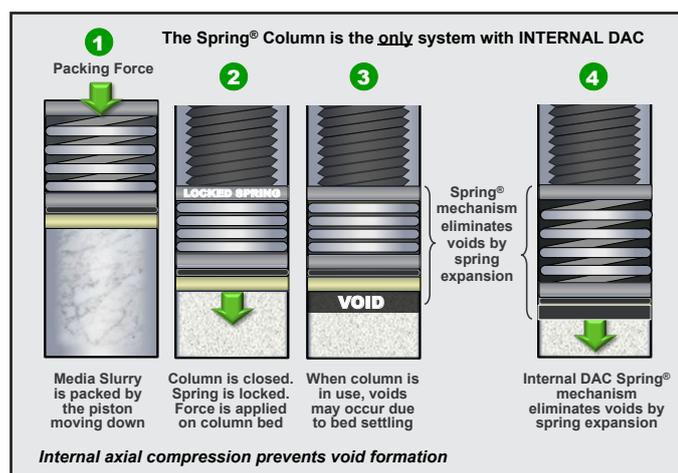
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GRACE

Mobile, internal dynamic axial compression



The proprietary and patented Spring[®] column mechanism provides constant pressure on the packed bed. This prevents void formation that occurs when the bed settles after packing. The ease of use, gentle packing mechanism, and the constant pressure on the packed bed make it possible for a single user to pack even sensitive large pore media for protein and peptide separations and experience superior performance.

The Spring[®] mechanism in the column regulates the pressure level and compensates for the bed consolidation that is often observed under high flow conditions. The Spring[®] mechanism continually forces the piston onto the media bed so that, as the volume occupied by the media gradually decreases, the piston advances to eliminate void formation before it develops.

The MODcol[®] Spring[®] column is able to maintain its performance for *thousands of injections* and *thousands of hours* of operation, well beyond the normal lifetime expectation for traditional columns.

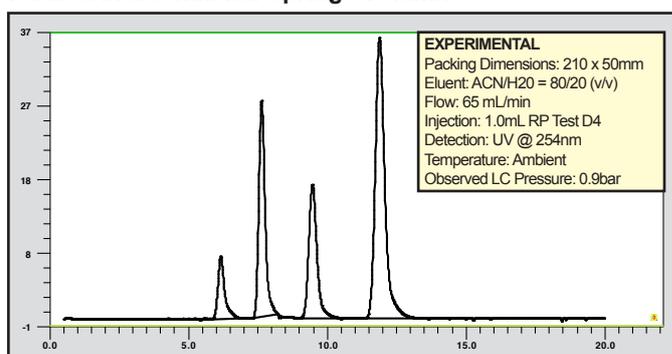
The Spring[®] Column's reliable performance reduces process down-time associated with premature column failure. For those who prefer to experience Spring[®] column technology with all of its advantages, but don't want to be bothered with column packing, Grace also offers prepacked Spring[®] columns and repack services.

MODcol[®] Spring[®] columns stand out on the market today as ready-to-use Dynamic Axial Compression Columns. If you do not require frequent repacking of your column hardware — why worry about the packing process when you can directly access a portable and effective DAC column by calling Grace or your local Grace distributor?

Spring[®] Columns offer Performance and Reproducibility

Spring[®] columns provide excellent efficiency, outstanding reproducibility and extended lifetimes in 25mm, 50mm and 101mm internal diameter versions. The ability to pack any bed length between 50 and 300mm and the advantages of the spring-driven DAC mechanism provide a high performance, adaptive solution for both product development and demanding process chromatography environments.

Efficiency Test of Vydac[®] 150HC Media Packed in a 50mm i.d. Spring[®] Column



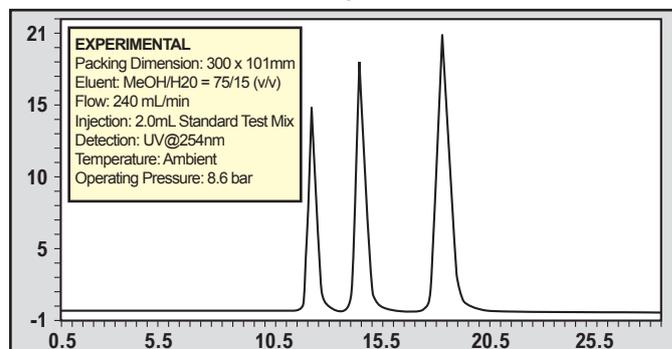
Signal	No.	Substance	Ret. Time	Height	Peak Area	Plate Count	Asymmetry
UV	1	Uracil	4.85min	8.55	129.41	2073	1.571
	2	Phenol	5.98min	29.14	438.40	3053	1.409
	3	DEET	7.19min	219.16	331.97	3492	1.259
	4	Toluene	9.17min	38.78	822.94	4154	1.250

PACKING CONDITIONS
Hardware: MODcol[®] Spring[®] Column 50 x 400mm
Frit Type: 2µm/60µm Double Density
Packing Device: MODcol[®] MultiPacker[™]
Media Type: Vydac[®] 150HC (C18 150HC 20µm)
Media Lot: LC150C18052809
Media Weight: 200g
Average Particle Size: (d₅₀) 29.5µm
Packing Density: 0.49g/mL
Slurry Solvent: 600mL IPA/H₂O - 80/20 (v/v)
Packing Pressure: 55 bar (system: 2/3bar)
Packing Speed: system max.

EFFICIENCY
N (Toluene) = 19,781
h (Toluene) = 1.7

This above chromatogram shows the excellent performance parameters and peak shape of a 50mm x 400mm i.d. Spring[®] column packed with Vydac[®] 150HC media. The column maintains performance at 55 bar. The Spring[®] column hardware can withstand a wide range of mechanical packing pressures and still maintain a high level of efficiency.

Efficiency Test of Vydac[®] 218TPB1520 Media Packed in a 101mm i.d. Spring[®] Column



Peak Table

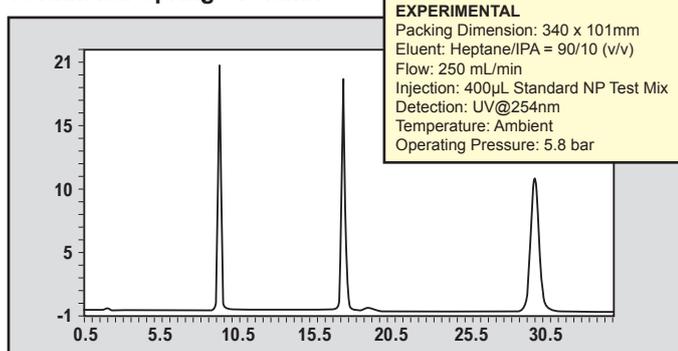
Signal	No.	Substance	Ret. Time	Height	Peak Area	Plate Count	Asymmetry
UV	1	Toluene	12.33min	20.33	525.94	5062	1.275
	2	Naphthalene	14.57min	25.00	826.91	4389	1.275
	3	Biphenyl	18.43min	27.77	1235.82	3914	1.294

PACKING CONDITIONS
Hardware: MODcol[®] Spring[®] column, 101 x 700mm (CE)
Frit Type: 1µm/60µm Double Density (sintered metal)
Packing Device: MODcol[®] Multipacker[™] (Mod. 2006)
Media Type: Vydac[®] 218TPB1520
Media Lot: E070901-1-2
Media Weight: 1300g
Slurry Solvent : 4600mL IPA/H₂O = 80/20 (v/v)
Packing Pressure: 30 bar (system : 70 bar)
Packing Speed: medium (approx. 2mm/sec)

EFFICIENCY [plates/meter]
Toluene: 16873 p/m
Naphthalene: 14630 p/m
Biphenyl: 13047 p/m

This above chromatogram shows the excellent performance parameters and peak shape of a 101mm x 300mm i.d. Spring[®] column packed with Vydac[®] 218TPB 1520 media. The Spring[®] column technique is preferred for packing sensitive media as well as rigid silica based separation media. Due to the smooth and gentle packing procedure you can get superior performance and longer lifetime for your columns. By having a fully mobile dynamic axial compression (DAC) column you can pack an additional column in the Multipacker[®] instrument while using the first one in DAC mode on a common HPLC system.

Efficiency Test of Davisil® 710N2OH Media Packed in a 101mm i.d. Spring® Column



Peak Table

Signal	No.	Substance	Ret. Time	Height	Peak Area	Plate Count	Asymmetry
UV	1	Toluene	9.33min	20.71	210.75	15576	1.250
	2	2-Chlorophenol	17.38min	19.43	398.86	14212	1.152
	3	4-Nitrophenol	29.81min	11.48	469.65	11569	1.119

PACKING CONDITIONS
 Hardware: MODcol® Spring® column, 101 x 700mm
 Frit Type: 5µm Double Density
 Packing Device: MODcol® Multipacker™ (Mod. 2006)
 Media Type: Davisil® 710N2OH (10-14µm)
 Media Weight: 1315g
 Slurry Solvent : 4000mL Isopropanol
 Packing Pressure: 43 bar (system : 65 bar)
 Packing Speed: 0.2cm/sec.

EFFICIENCY [plates/meter]
 Toluene: 45812 p/m
 2-Chlorophenol: 41800 p/m
 4-Nitrophenol: 34027 p/m

Especially with irregular silica based separation media like Grace's Davisil® grades, the Spring® column technology shows excellent results and superior performance parameters. The chromatogram shows a separation on a 101mm x 340mm i.d. Spring® column packed with irregular Davisil® 710N2OH. With the combination of a high purity irregular silica and the unique Spring® column technology you can get separation results close to those currently achieved with more costly spherical silicas only. An additional benefit is that you have a fully mobile column with an internal DAC mechanism up to 101mm i.d. dimensions.

The Flexibility of the Spring® Column Design Makes It Suitable for Any Media

Spring® columns can be optimized for media with 5µm or larger particles based on silica or polymer beads. This is made possible by a wide selection of springs having different force constants. Each is able to exercise just the right pressure for a particular type of media and flow rate. Spring® Columns can be purchased with an integral water jacket, making them ideal for use with separations that require careful temperature control.

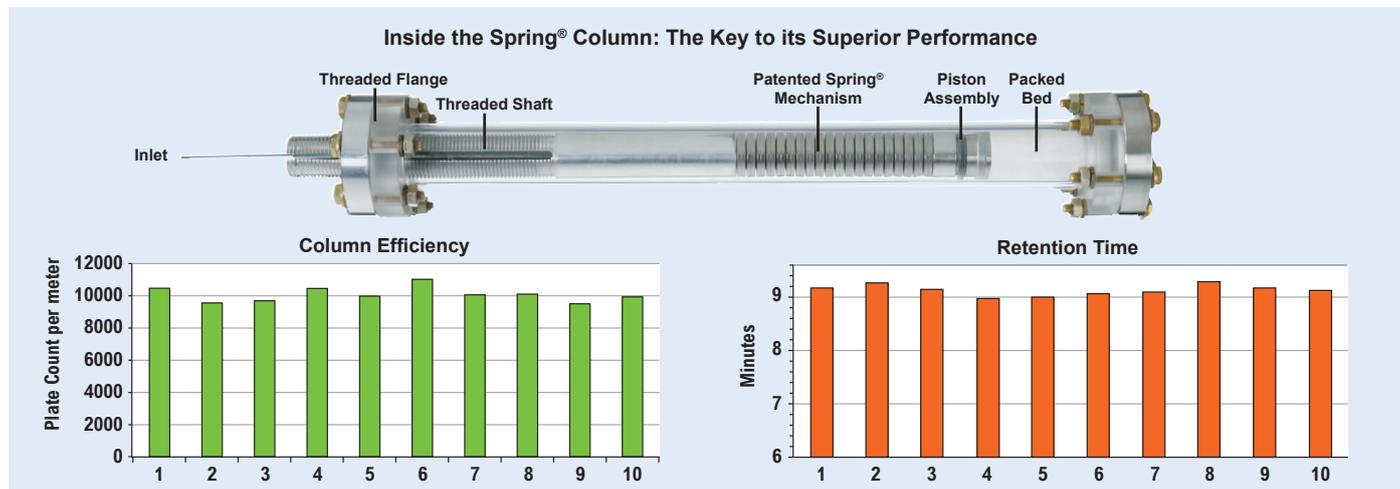
MultiPacker® Packing Stations for Spring® Columns

When combined with the MultiPacker® instrument, the Spring® column provides the ultimate solution for in-house column packing. Both MultiPacker® Instruments allow users to pack and unpack MODcol® Spring® columns quickly, conveniently, and easily in minutes. Because of this, the user is able to reconfigure the Spring® column and repack as needed to address needs in real time.

The MultiPacker® instrument and Spring® column concept is extremely versatile because the packing system is physically separated from the column and its internal DAC subsystem. This means that many columns can be packed and maintained with just one MultiPacker® instrument — and just one MultiPacker® instrument is required to pack both 25mm and 50mm i.d. columns or 50mm and 101mm i.d. columns.

Because of its design, the Spring® column is an economical solution and a simple calculation can show that the Spring® column, when repacked with the MultiPacker® instrument, can be less expensive than traditional columns, even when those are being repacked by the manufacturer.

Another powerful dimension to the flexibility of the MultiPacker® instrument and Spring® column combination is the immediate ability to address unexpected problems or packing needs in-house. The ability to pack a column on demand on-site enables several distinct advantages for a facility that does not already have this capability. Having control over the timing and production of LC columns is an extremely attractive feature for scientists who prefer the "hands on" control of performing the column packing themselves. This gives the chromatographer an extremely powerful and easy-to-use tool for developing in-house solutions. The ability to immediately respond and address unexpected problems can pay for the cost of the system itself. MultiPacker® instruments and Spring® columns are an ideal and flexible system for use with process development, prep and process scale purifications, and also simulated moving bed (SMB) applications.



A patented, internal spring mechanism provides constant pressure onto the packed bed even after it is removed from the packing unit. This enables column mobility without losing the advantages of DAC. The gentle packing mechanism and the permanent, constant pressure on the packed bed result in higher performance of the column. Additionally, this higher performance can be maintained for a longer period of time to help reduce the overall costs of associated with purification.

MODcol® MultiPacker® Instruments — Safer Packing

Because it employs a pneumatic packing mechanism, the MultiPacker® instrument for 25mm and 50mm i.d. Spring® columns uses no electrical power, making it safe for use with many types of solvents and a good choice for hazardous environments. The same applies to the 50mm and 101mm model. However, it features an air-driven hydraulic mechanism.

Other typical hydraulic packing systems on the market do not feature the damping devices provided in the MultiPacker® instrument. Therefore media (especially sensitive large pore media) can suffer from pressure peaks created by the hydraulic pumps. Pressure peaks cause particle breakage, leading to high back pressures, loss of efficiency, and poor peak shape. Also, the packing speed and the packing pressure of traditional systems may not be independently controlled, as is possible with MultiPacker® systems.

The MultiPacker® instrument for 25mm and 50mm Spring® columns overcomes this problem by using a pneumatic rather than hydraulic packing mechanism, combined with a hydraulic damping circuit. This combination allows a very smooth packing operation without any pressure peaks, and with the packing speed being completely independent from the chosen packing pressure.



The 25mm and 50mm MODcol® MultiPacker® instrument packs 25mm i.d. and 50mm i.d. Spring® columns

The MODcol® MultiPacker® instrument for 25mm and 50mm i.d. columns has a high safety standard and can be used in explosion-hazard areas. The ease of use results in nearly operator independent reproducible column packing. This makes the MODcol® MultiPacker® instrument the ideal choice for column self packing needs in the pharmaceutical industry.

The MultiPacker® instrument for 50mm i.d. and 101mm i.d. Spring® columns can also control the packing speed independently from the packing pressure. To help avoid pressure peaks that could harm the media, this air-driven hydraulic system features a sophisticated damping circuit which allows smooth and gentle packing of nearly all available chromatography media.

Both MultiPacker® instruments are easy to use, require very little training, and are virtually maintenance-free. They are both approved by TÜV Rheinland according to the EU machinery directive, are fully CE-certified, and come with an ATEX® exclusion that states their suitability to be safely operated in explosion-hazard areas.

Preparation for column packing is simple and straightforward; the packing process itself is very simple and can typically be performed in only a few minutes. Unpacking of the hardware and the cleaning process for the parts before re-packing are also easy to do.



The 50mm and 101mm MODcol® MultiPacker® instrument packs 50mm and 101mm i.d. Spring® columns

The MODcol® MultiPacker® instrument for 50mm and 101mm i.d. Spring® columns has same principle and performance as the 25-50mm unit. Both instruments have state of the art safety features and are designed to work in modern pharmaceutical lab and production environments. They are nearly maintenance free and easy to handle with very little training required.