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# The MODcol® Multipacker® and Spring® Column Technology

*A State-of-the-Art Hardware Solution for Prep-LC*

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# Dr. Maisch - Preparative Chromatography Products

## High Variety of Prep Column Technology

Standard Flanged
Manual adjustable Piston
Patented Auto-adjust Piston
Patented Long-Life

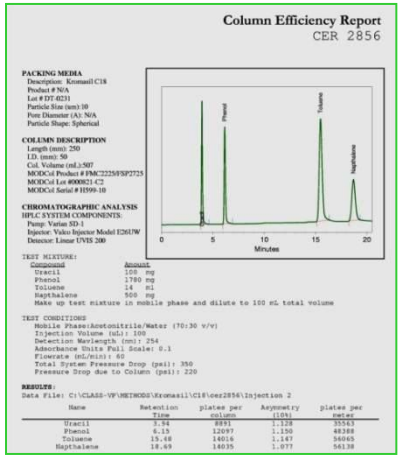
## Spring® Columns 25 – 150 mm I.D.


Dynamic Axial Compression
Extended lifetime vs. traditional fixed bed columns
Portable, versatile, robust
Less media consumption
Easy packing and re-packing with proprietary Multipacker instrument

## MultiPacker® Packing Stations


Fast and easy self-packing for SPRING Columns
State-of-the-Art Safety and Performance
Reproducible, efficient, flexible and user-friendly
Less media consumption

## Packing Services




Column packing procedures and experience with over 100 types of media
Certificate of Analysis provided with every column

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# Modcol Multipacker

2002 model
by Modcol Corporation

2018 model
by Dr. Maisch HPLC


1982: foundation of Modcol Corporation by Yehuda Shalon

Acquisition by Grace in 2003

Acquisition by Dr. Maisch in 2016

Upgraded in terms of
- Functionality
- Versatility
- Safety

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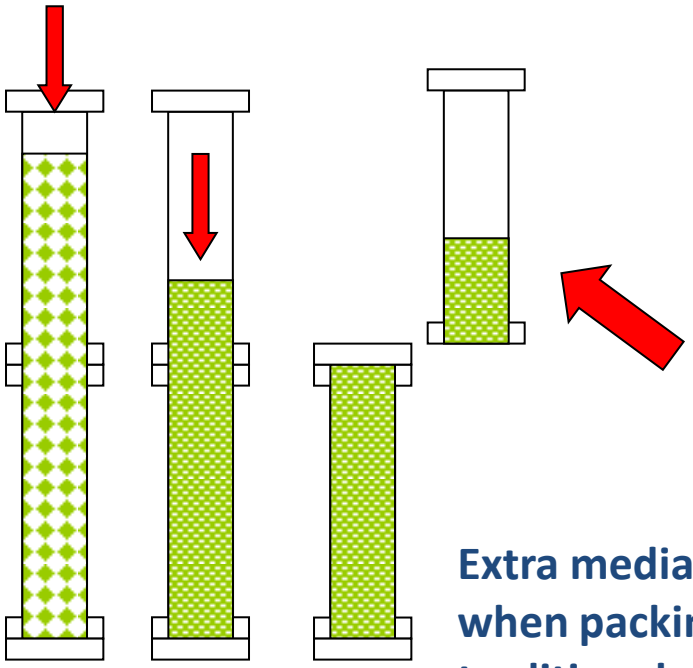
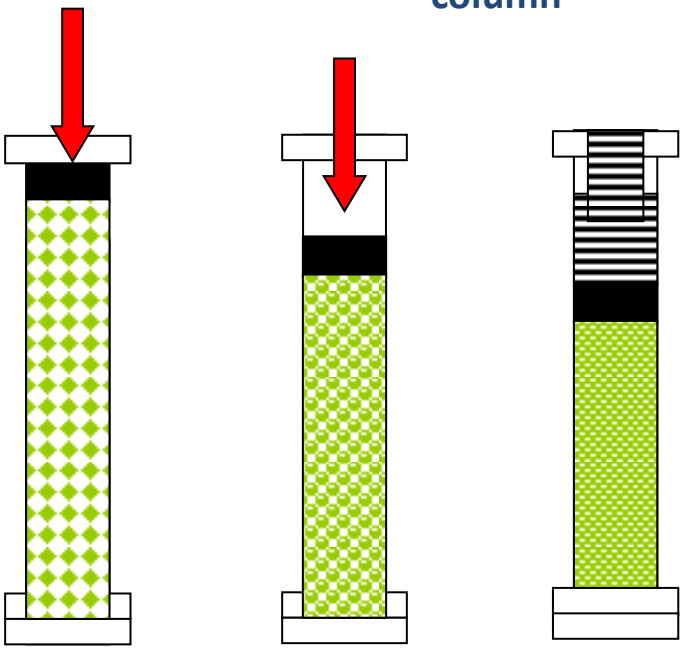
# Fixed Bed Column Packing vs. Axial Compression Column Packing

No extra media is used when packing an axial compression column



Extra media is used when packing a traditional column

Traditional fixed bed



Axial Compression

**Save up to 20% Media**

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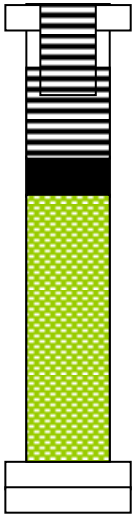
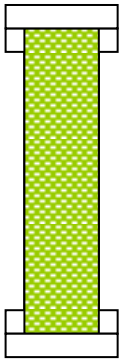
# Influence on Column Pressure Release



Mechanical pressure by the force on the Piston:
full pressure to the bed over the complete length



Pressure caused by flow:
there is a pressure drop along the column,
half pressure in the middle, close to zero at the end

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# Advantages of the Axial Compression Technology

## Performance Advantages

- Packing Columns at a Lower Pressure
  - Less Mechanical Damage to Media
  - Superior Results with “Delicate” Media
- Higher Stability of Packing Bed ⇒ Extended Column Lifetime
- Manual or Automatic Void Elimination (SAC & DAC Types)

## Economic Advantages

- Using Less Media per Column vs. the Classical Fixed Bed Principle ⇒ Save Money with Every Column Re-Pack
- Easy Self-Packing Possibility ⇒ Minimize Downtime & Startup at R&D / Process Development / Manufacturing Facilities
- Faster Product Delivery & Quicker Return on Investment

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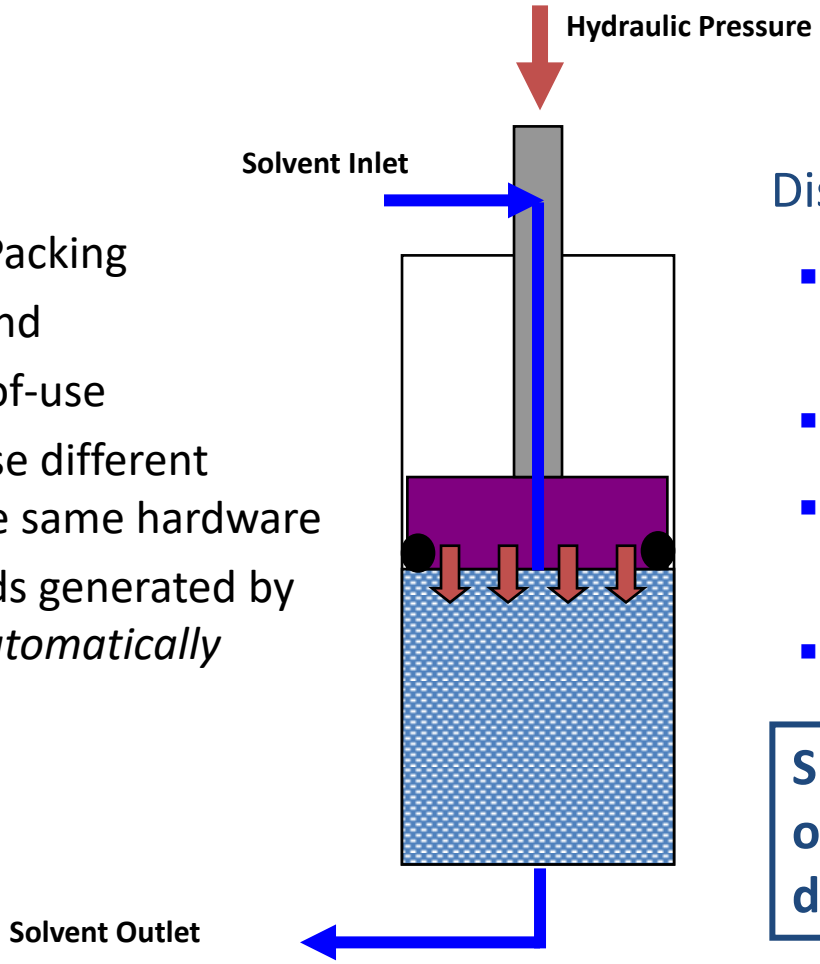
# Dynamic Axial Compression System (DAC)

## Advantages

- Packing & Re-Packing
  - On demand
  - At point-of-use
- Flexibility to use different media with the same hardware
- Eliminates voids generated by bed settling *automatically*




## Disadvantages

- Increased capital cost (more complex equipment)
- Large size excludes mobility
- Column is an integral part of the packing unit
- Critical failure tolerance

**Spring® Columns overcome these disadvantages !!!**

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# What is the MODcol® DAC Principle ?

- A light, small and cost-effective DAC System that is fully contained within the Spring® Column Body
- Dynamic Axial Compression through a purely mechanical and fault-tolerant system based on Bell Washer Springs
- A patented DAC - System that provides High-End and Long-Lived Chromatographic Performance
- The only true DAC Column that works independent from an outside compression device
- Multiple Spring® Column dimensions can be maintained with only one Packing System

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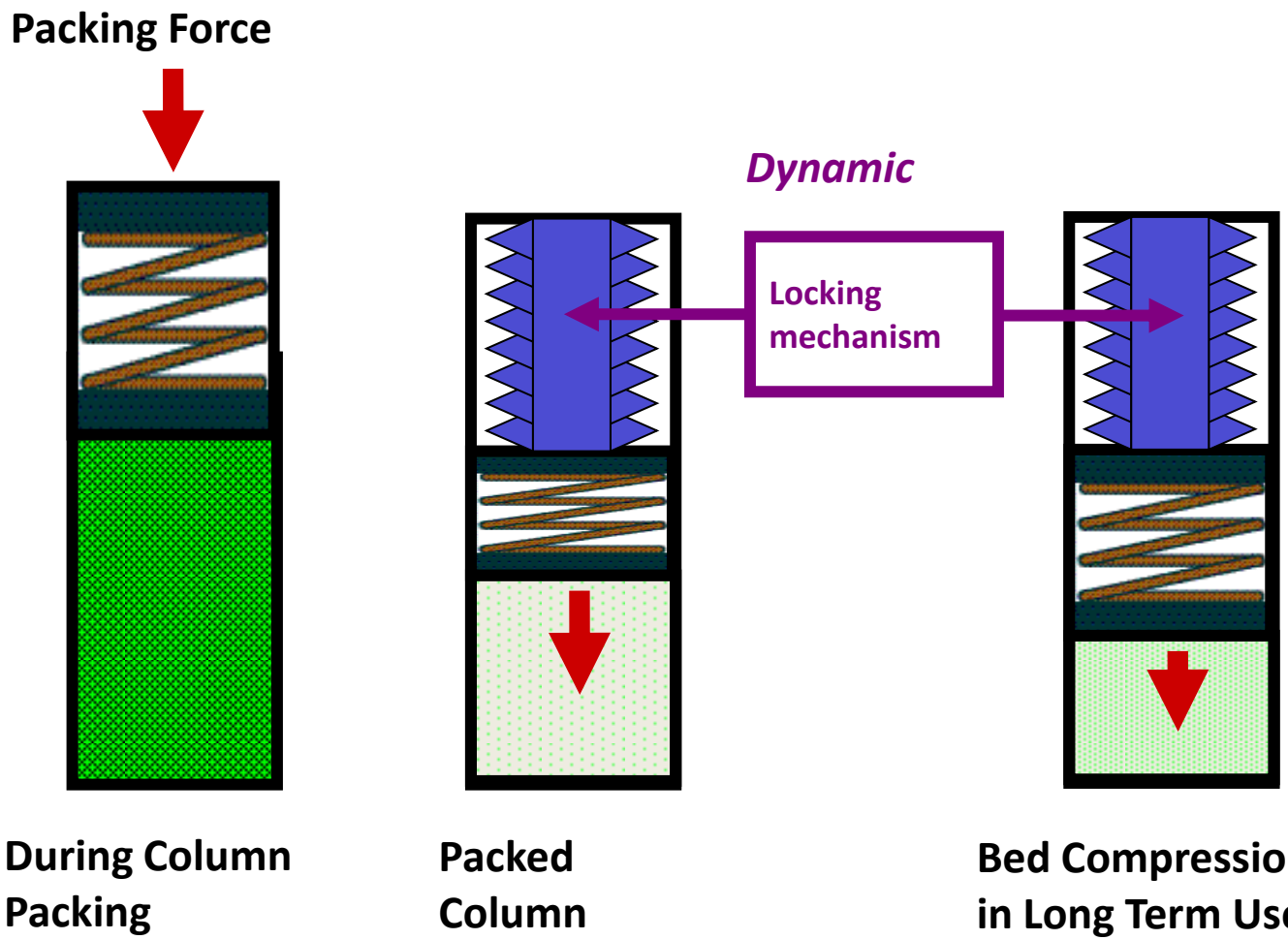
# The MODcol® Spring® Column Principle



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# The MODcol® Spring® Column


- Compensates for Voids
- Provides a Longer Column Lifetime
- Features Convenience and Mobility
- Is Easy & Quick to Pack and Un-Pack
- Allows Maximum Efficiencies
- Enables Higher Pass Rates
- Offers Cost-Effectiveness

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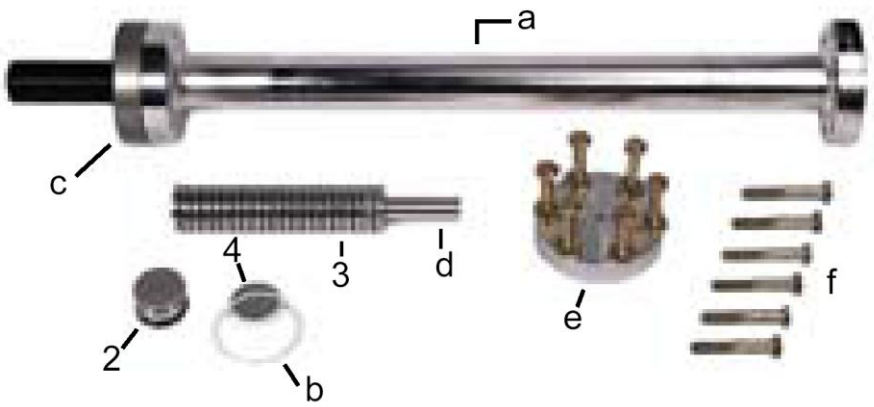
# MODcol® SPRING® Column Components




***How to Order Spring™ Column Hardware for Use with Multipacker® Instruments***

Spring™ Columns can be ordered as a complete kit, as seen on page 163, or customized selecting the options that best suit your needs. Components for customization can be found on page 164. Spring™ Columns are offered in two lengths, 40cm and 70cm. A 40cm column body can accommodate up to a 15cm length packed bed and the 70cm column body can accommodate up to a 30cm length packed bed.

Each complete Spring™ Column assembly consists of five components. For customized columns, one of each component below needs to be ordered:

1. The Base Spring™ Column Parts Kit includes:
   a. Column Body
   b. All Seals and O-rings
   c. Locking Mechanism
   d. Guide Tube
   e. Endplate
   f. Assembly Hardware
   g. Packing Spacers (for 70cm length columns)—not pictured
2. A Ready-to-Use Piston Assembly consisting of the piston body, piston frit, PTFE sleeve and O-ring. The piston assembly can be ordered with a 1µm, 2µm, or 5µm frit porosity.
3. A Spring Kit. Choose the appropriate pressure range for your needs. Spring force must exceed the operating pressure of the column in order to maintain axial compression force.
4. An Outlet Frit. Choose 1µm, 2µm, or 5µm frit porosity. For 101mm i.d. columns, the outlet frit is identical to the piston assembly (#2).
5. Tubing and Connectors. Choose tubing with an outer diameter and bore that suits your needs.

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# The MODcol® Springs

| Single Stacked:<br>Packing Pressure ≤ 80 bar (1160 PSI) | | Double Stacked:<br>Packing Pressure > 80 bar (1160 PSI) | |
|---|---|---|---|
|  |  |  |  |

1 Set Steel Springs, 40 pcs: AS2002-050A20; Spring Kit (Steal) for 50mm ID
1 Set SS Springs, 32 pcs: AS2002-050A03; Spring Kit (SS) for 50mm ID

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# MODcol® Spring® Column Hardware

- 25mm, 30 mm, 40 mm, 50mm, 70 mm, 101 mm and 150 mm I.D.
- Fully compliant to PED 97/23/EC (AD 2000, DIN EN 287-1)
- 40cm, (50 cm) and 70cm hardware length
- Standard bed height from 5cm to 35cm
- For any particle size, starting from 5µm
- For any silica- and polymer-based media
- Heating / Cooling Jacket (Optional)
- Pressure Limit 138 bar / 2000 psi
- Supplied with CE Certificate and Conformity Report by TÜV
- F.D.A. Reg. 21 CFR 177.1550

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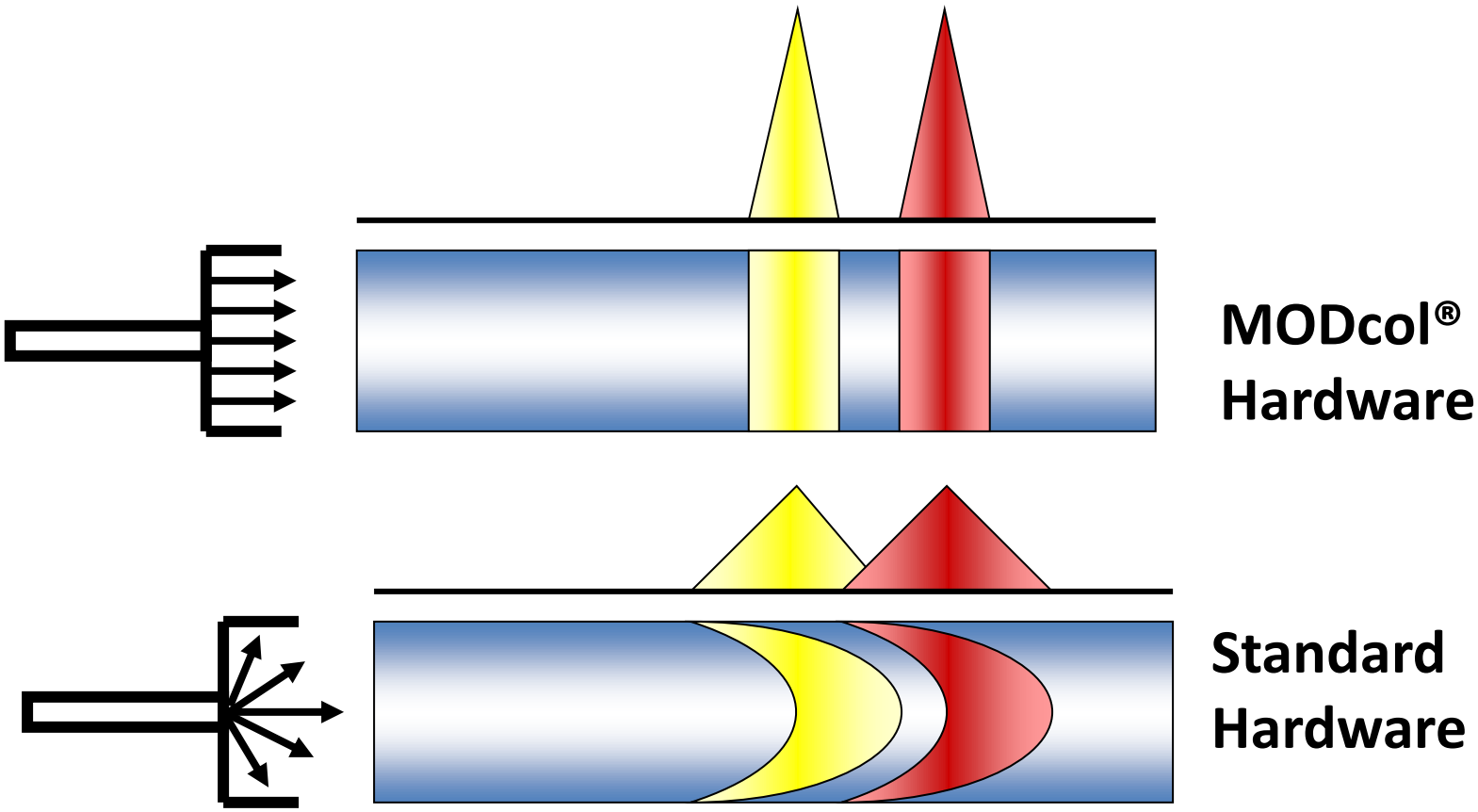
# Importance of the Flow Distribution



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# The MODcol® Spring® Column Flow Distribution

## Pistons & Flange Plates with Radial Slot Profile

**Specifically designed channel system with variable depth slots for equal flow distribution of sample and mobile phase to the periphery of the column**

## Double-Density Disperser Frits

**Combining a 60µm distribution layer with a 2µm or 5µm bed support layer in one frit allows an enhanced sample distribution while minimizing the back pressure of the frit**

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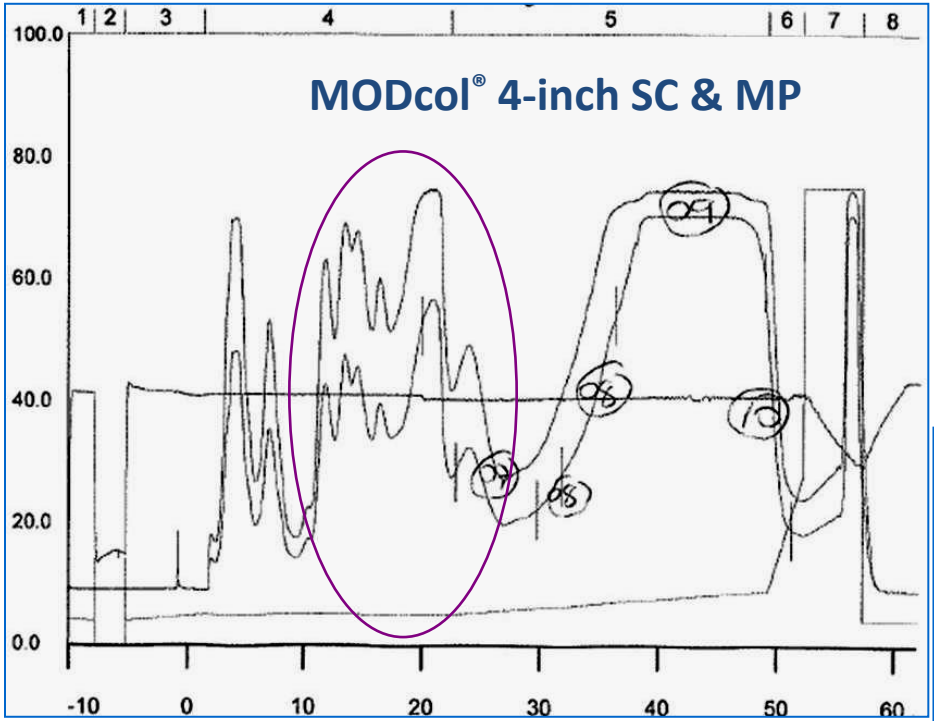


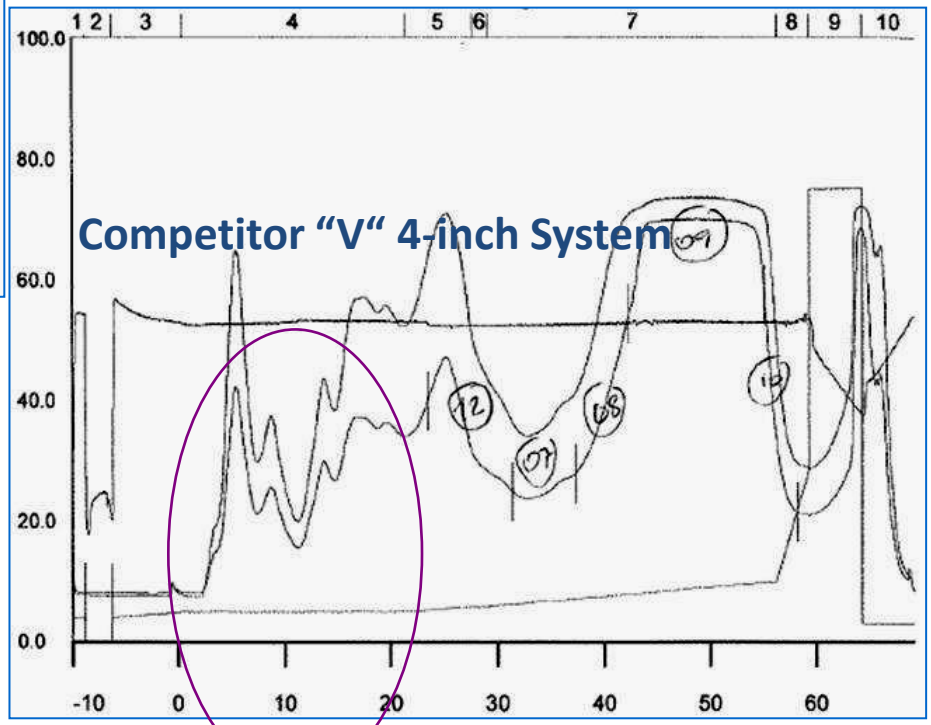

## *MODcol® vs. Competitor "V"*

## *- A Customer´s Field Report -*

***Columns*** **: 250 x 101mm, C18, 120 Å, 10µm**

***Injections*** **: 60g crude in 200ml**

***Solvent*** **: ACN / $H_2O$ (Gradient)**




"Comparing the chromatograms it is very clear that the MODcol® column resulted in sharper and more resolved peaks and thus in a better purification of the desired substance. In many cases improved resolution may not only lead to higher purity, but also higher load and throughput. It was also observed that the MODcol® column had a smaller dead volume and lower back pressure compared to the "V" column. These results demonstrate that implementing MODcol® in our lab is a wise decision."

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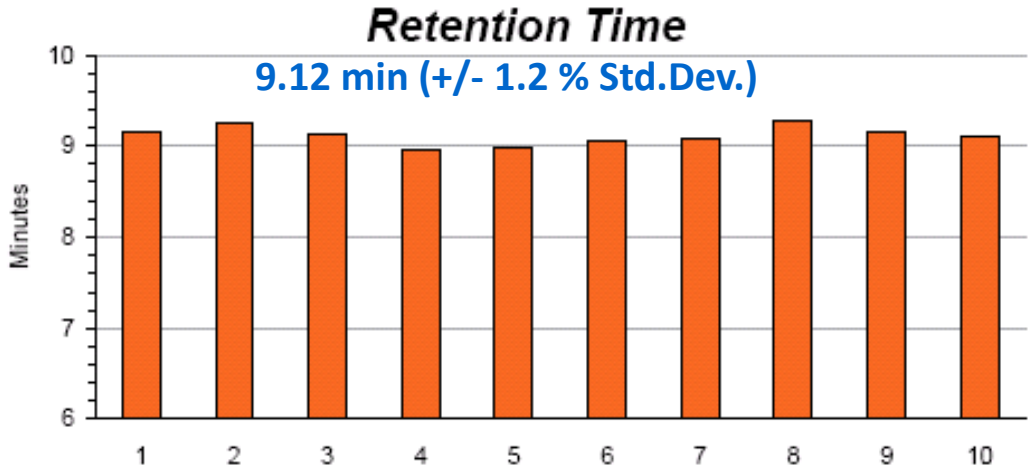
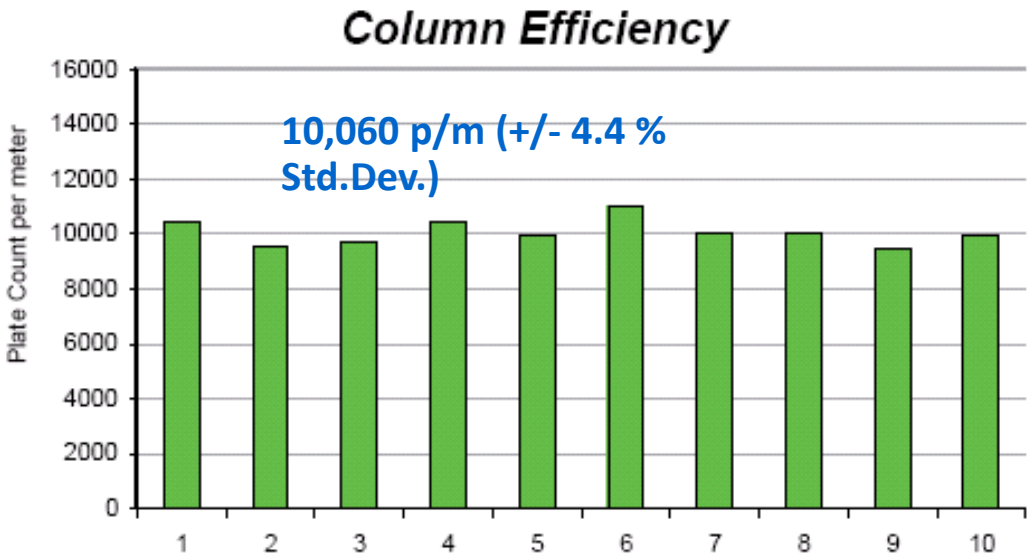
# Spring® Column Reproducibility




**Vydac 15-20µm, 300Å, C18 (218TPB1520)**
**50mm I.D. Spring® Column**

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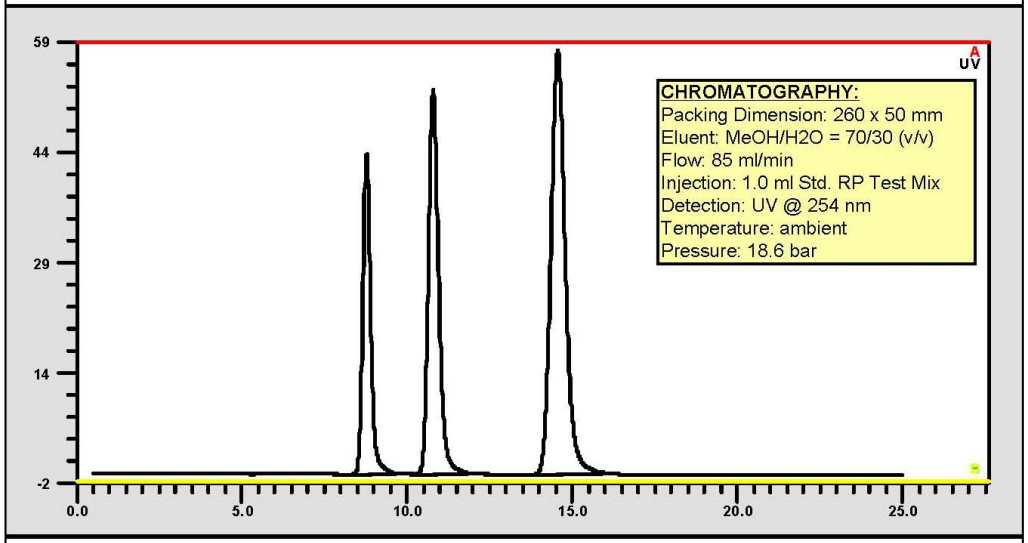
# Vydac 218TBP1015 packed in a MODcol® Spring® Column (260 x 50mm)

**Chromatogramm**




**Peak Tabelle**

| Kanal | Nr | Name | Ret. Zeit | Höhe | Abs. Fläche | Bodenzahl | Asymmetrie |
|---|---|---|---|---|---|---|---|
| UV | 1 | Toluene | 8.77 Min | 43.83 | 733.27 | 6063 | 1.269 |
| | 2 | Naphthalene | 10.78 Min | 52.67 | 1149.92 | 5277 | 1.303 |
| | 3 | Biphenyl | 14.55 Min | 58.12 | 1770.30 | 5026 | 1.255 |

**Vydac 218TPB1015**

**(10-15µm , 300 Å)**

**Efficiency : 20,296 p/m**

**Asymmetry : 1.3 (10 %P)**

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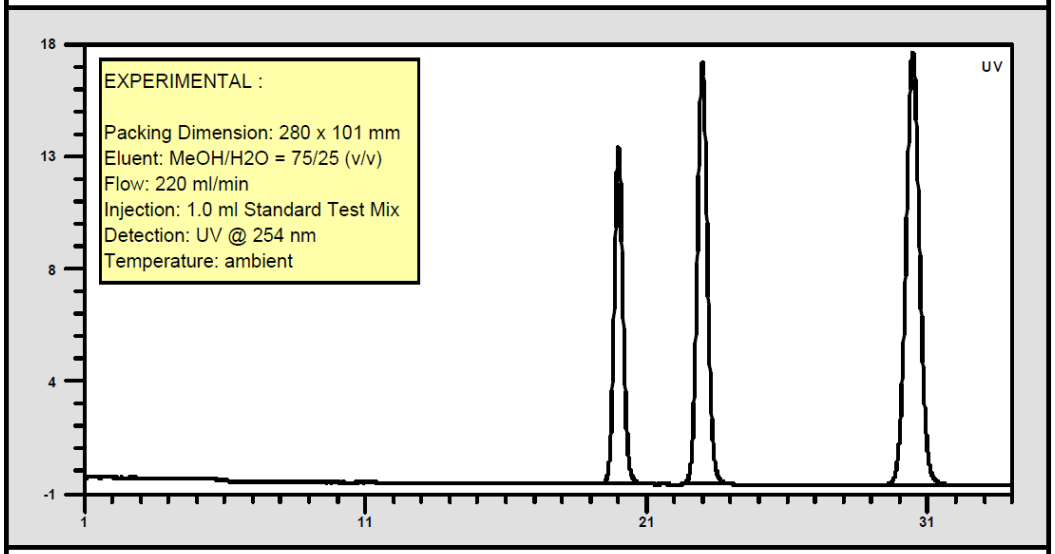
# Kromasil C8 packed in a MODcol® Spring® Column (280 x 101mm)

**Chromatogram**




**Peak Table**

| Channel | No | Name | Ret. Time | Height | Abs. Area | Plate No. | Asymmetry |
|---|---|---|---|---|---|---|---|
| UV | 1 | Toluene | 19.81 | 13.74 | 309.71 | 16876 | 1.135 |
| | 2 | Naphthalene | 22.83 | 17.26 | 448.36 | 16588 | 1.116 |
| | 3 | Biphenyl | 30.44 | 17.68 | 610.43 | 16944 | 1.051 |

EFFICIENCY [plates / meter]:

Toluene: 60,271 p/m
Naphthalene: 59,242 p/m
Biphenyl: 60,514 p/m

PACKING CONDITIONS :

Hardware: MODcol Spring Column 101 x 700mm
Frit Type: 5µm Double Density
Packing Device: MODcol 4" Multipacker (Mod. 2006)
Media Type: Kromasil C8 10µm
Media Weight: 1,400 g
Slurry Solvent: 4,000 ml Ethanol
Packing Pressure: 100 bar
Packing Speed: System Max.

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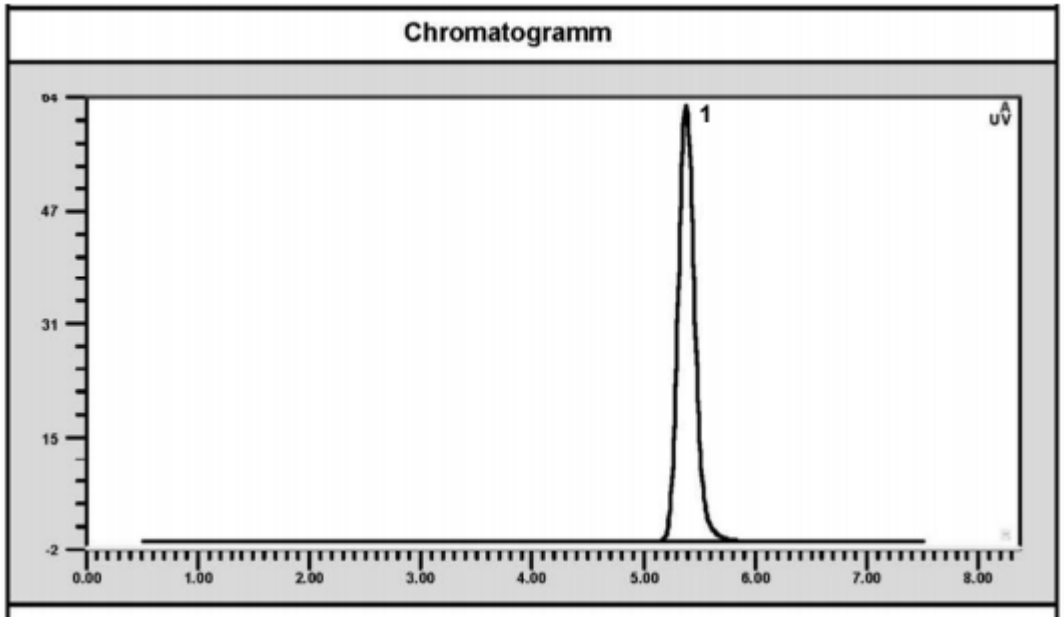
# Agilent PLRP-S, 300 A, 15 – 20 µm packed in a MODcol® Spring® Column (240 mm x 50 mm)




**Agilent PLRP-S**

**(15 – 20 µm , 300 Å)**

**Efficiency : 19,767 p/m**

**Asymmetry : 1.2 (10 %P)**

**TEST MIXTURE:**

| Solute | Concentration [mg/ml] |
|---|---|
| Acetone | 100 |

**TEST CONDITIONS:**

Mobile Phase Composition: Acetonitrile / Water – 80 / 20 (v/v)
Flow Rate (ml / min): 85
Injection Volume (µL): 1000
Detection Wavelength (nm): 254
Column Pressure Drop (bar): 4
Temperature : ambient

**Column: 50mm i.d. MODcol® Spring® column, 240mm bed length**
**Media: 140g of AGILENT PLRP-S, 300A, 15-20µm media**
Slurry Solvent: 1000 ml Acetonitrile / Water – 80 / 20 (v/v)
Packing pressure: 50 bar
Packing Speed : medium (approx. 5 mm/sec)

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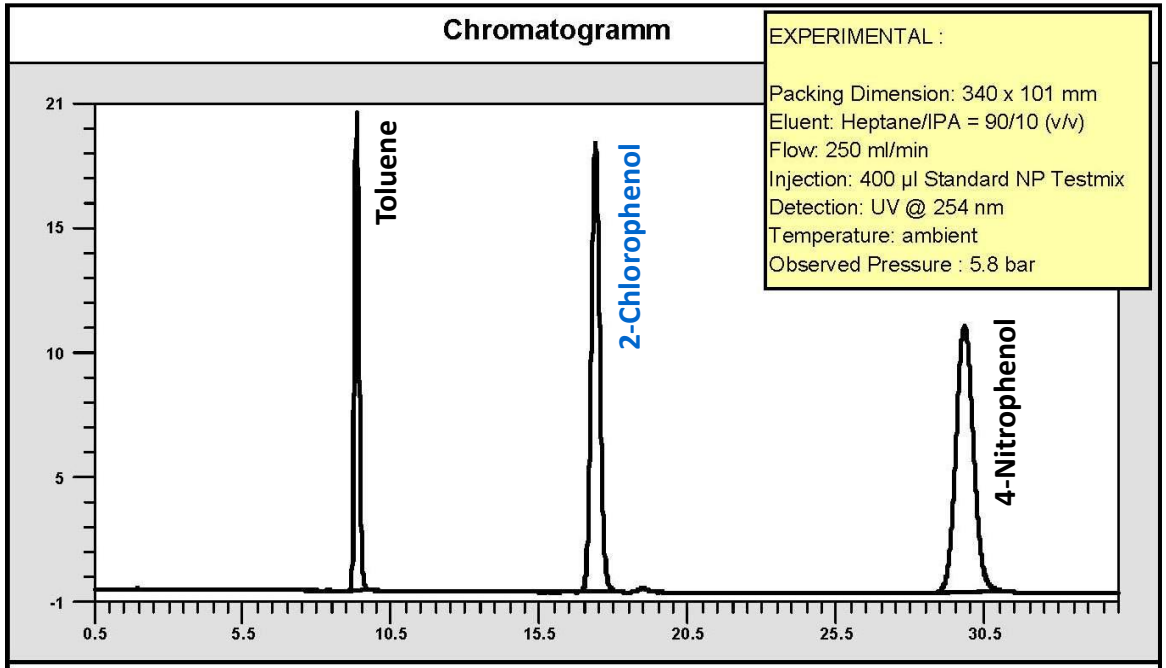
# Davisil 710N Diol, 10 – 14 µm, in a MODcol® Spring® Column (340 x 101mm)




**Peak Tabelle**

| Kanal | Nr | Name | Ret. Zeit | Höhe | Abs. Fläche | Bodenzahl | Asymmetrie |
|---|---|---|---|---|---|---|---|
| UV | 1 | Toluene | 9.33 Min | 20.71 | 210.75 | 15576 | 1.250 |
| | 2 | 2-Chlorophenol | 17.38 Min | 19.43 | 398.86 | 14212 | 1.152 |
| | 3 | 4-Nitrophenol | 29.81 Min | 11.48 | 469.65 | 11569 | 1.119 |

**Davisil® 710N Diol**

**(10-14µm , 60 Å)**

**Efficiency : 41,800 p/m**

**Asymmetry : 1.2 (10 %P)**

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# Small MODcol ® Multipacker

for

## 25, 30, 40, 50 and 70 mm ID

Spring®Columns

- Hardware length 40 or 70 cm
- New 50 cm length for ID >/= 70 mm (bed lengths 50 – 325 mm)

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# MODcol® MultiPacker®

## packing 25 - 70 mm I.D.
## Spring® Column Hardware

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# Illustration: Packer & Hardware

- *Packed 25 x 700mm Spring Column Hardware*
- *Empty 50 x 400mm Spring Column Body*

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# Pneumatic Packing Principle with Hydraulic Dampening System

- High quality, maintenance-free air cylinder.
- High performance air filter elements for noise reduction and fast depressurization.
- Heavy duty hydraulic pistons with dual seals and self-guiding stainless steel cylinder rods.
- Independent control of packing pressure & speed.

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# Piston Up/Down Control


Heavy duty switching valve allows easy and reliable control of the pneumatic piston's movement.

# System Status Indicators


*Green Indicator* shows when the system is pressurized and ready for column packing.


*Orange Indicator* shows when the packing adapter has stopped and has been secured so that the safety door can be opened without danger.

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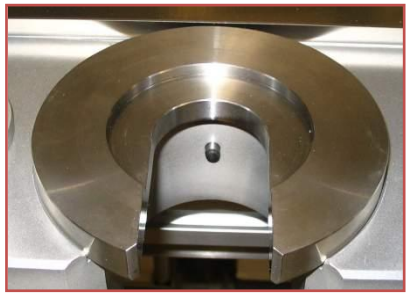
# Universal Column Bracket

automatic recognition of column I.D.

*Automatic Pressure Range Control*

This sensor automatically recognises the column hardware ID and the correct pressure cycle is chosen accordingly, thus eliminating the selection of inadequate packing pressure range by mistake.



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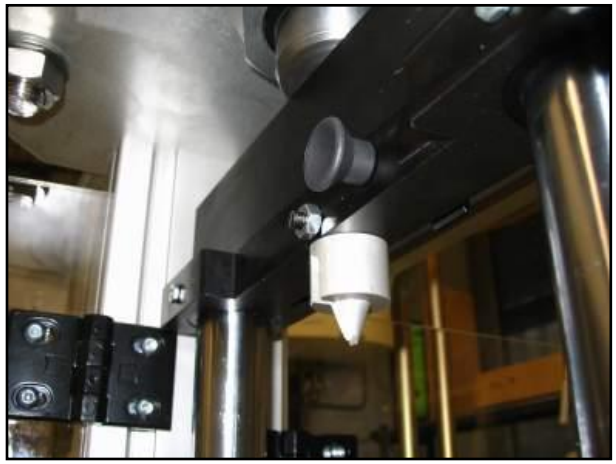
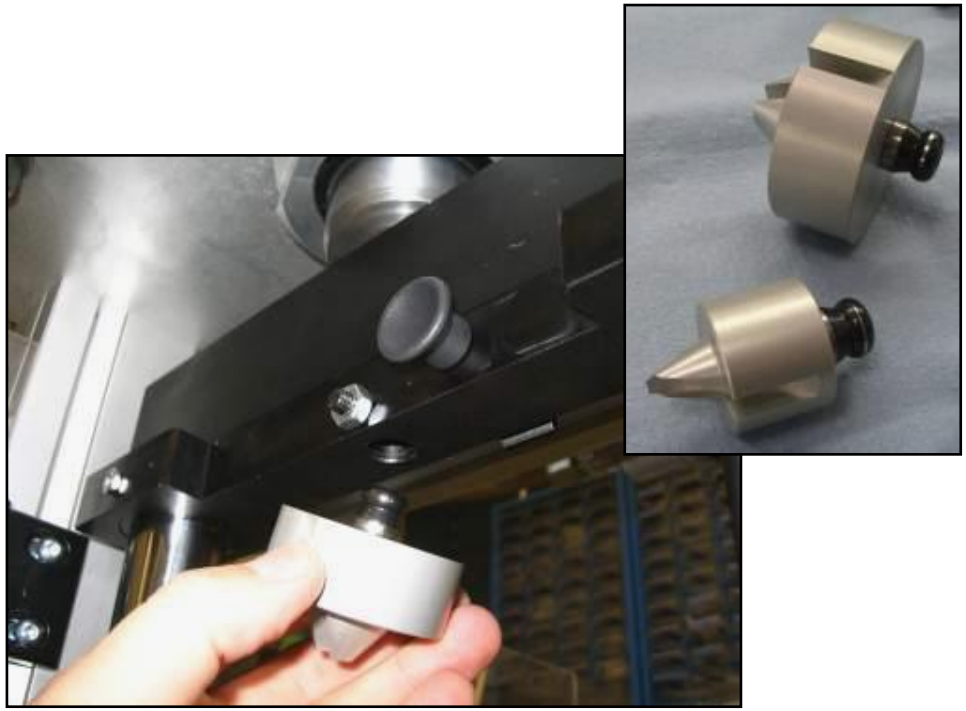


# Quick-Fit Packing Adapter

fast and tool-free conversion



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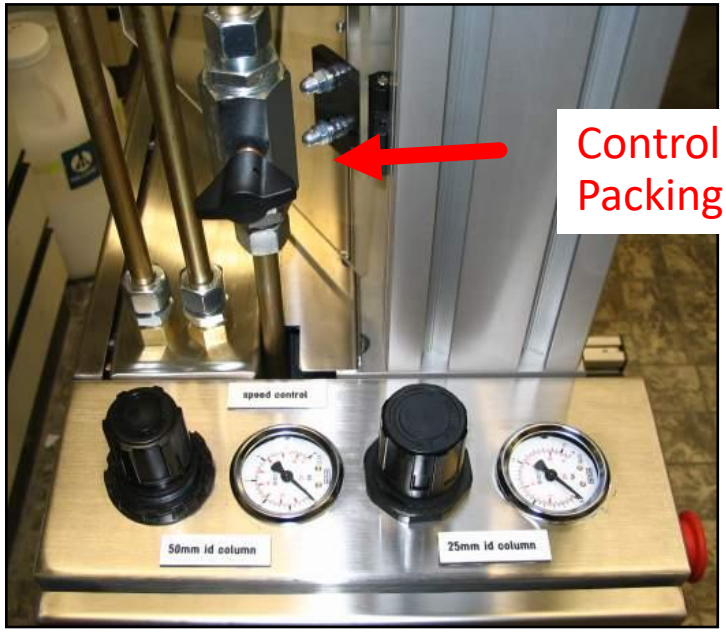
# Individual Pressure Control for Each Column Type




Control Valve for Packing Speed

Dependent on the inserted Spring Column type either the control for the low pressure range (1“-SC) or the high pressure range (2“-SC) is activated automatically.

Emergency Stop Button directly at the pressure control box for fast depressurization of the Multipacker.

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# Influence on column pressure release – MP small:

| | DAC | SAC | press. cycle |
|---|---|---|---|
| ID | max press. | max press. | |
| mm | bar | bar | |
| 25 | 138 | 200 | low |
| 50 | 138 | 200 | high |
| | | | |
| 70 | 76 | 126 | high |
| | | | |
| 30 | 104 | 172 | low |
| 40 | 58 | 96 | low |

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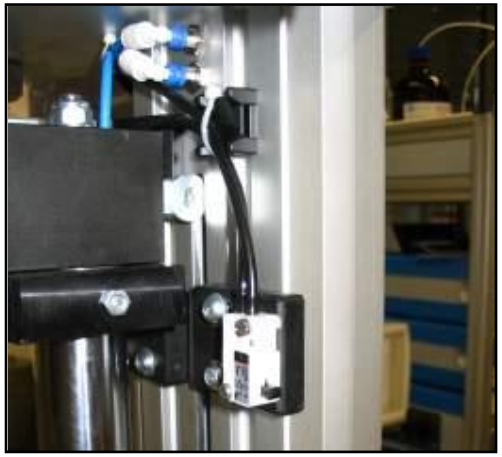
# Unique Safety Features

Emergency Stop Button (red) and System Activation Button (green)


Door Release Sensor that (when aligned with packing adapter) allows the door to be opened without the system depressurizing (necessary for locking the pressurized packed column).

Security Glass Safety Doors with Magnetic Interlock (antistatic and solvent resistent).

Pneumatic Door Sensor to automatically depressurize the system when the door is opened.



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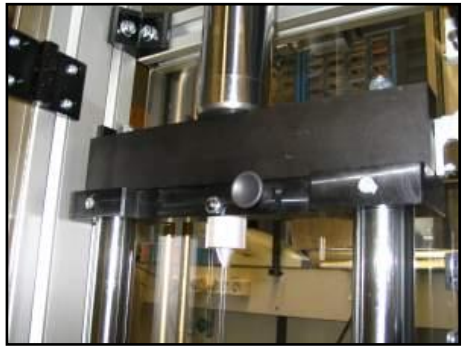
# Packing Mechanism with Detachable Slider

The slider in which the packing adapter is integrated can be detached from the packing mechanism's crossbar by a pull button and moves freely on the two rods of the hydraulic dampening system.

When the column is prepared for packing, this slider holds all the internal column components in position. When the packing is started, the slider re-attaches with the crossbar. The whole packing procedure is now a „hands-free" process.



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# 90° Safety Doors

The new Multipacker features individual safety doors for protection at the front and back side of the instrument (opening 90° to the same side). This allows full and easy access to the column hardware for preparation and handling.

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# Guidance for Inlet Capillaries

The front door of the new instrument features an integrated capillary guidance. It allows to control the inlet capillary and its endfitting from the outside of the closed / secured packing cabinet and protects them from getting damaged by the moving parts.

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# Large MODcol ® Multipacker

for

## 50, 70, 101 and 150 mm ID

Spring®Columns

- Hardware length 40 or 70 cm
- New 50 cm length for ID >/= 70 mm (bed lengths 50 – 325 mm)

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# Large MODcol ® Multipacker

- Complete re-design to fit 4 column dimensions from 50 – 150 mm ID
- Safety concept according to CE- and ATEX-requirements
- Identical safety features as for the new small Multipacker
- Same logical and convenient arrangement and design of the controls as for the small Multipacker
- All controls positioned user-friendly for easy access and operation
- Self-guided packing adapter to allow safe “hands-free“ packing operation
- Professional, simple & robust design of high structural integrity
- Ergonomic system for easy handling and moving

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# Key Features of the MODcol® Multipacker®


- Lowerable packing module (system fits through any standard 80 x 200 cm door)
- 4 blockable wheels and handles at each corner for easy and safe handling
- Individual pressure control circuit for each column I.D.
- Packing pressure and speed adjustable independently
- Column dimension automatically detected
- All moving parts protected by a safety cabinet
- System access through full size front door, protected by a redundant safety circuit
- Safety monitoring / auto - shutdown of the system when the door is open
- Same logical control concept as the small Multipacker

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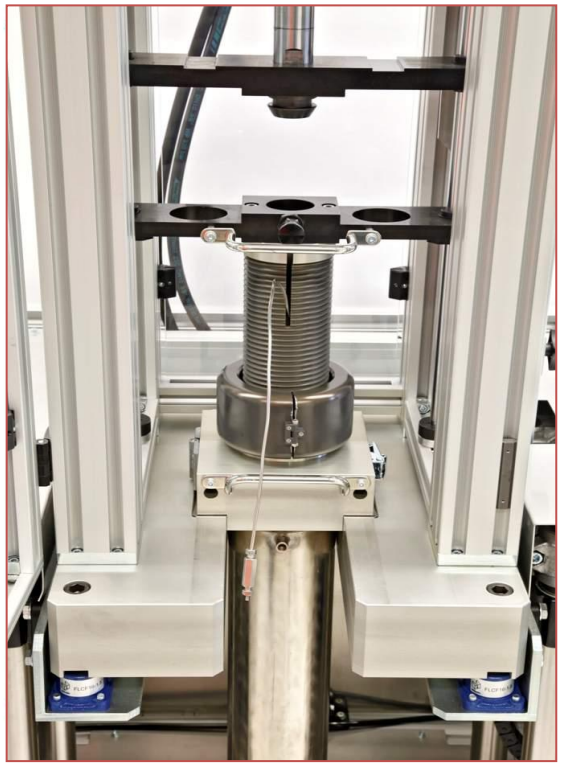

## Detachable Packing Slider

A detachable and automatically re-connecting packing slider allows a hands-free packing process.

## Easy-Access Safety Cabinet

All moving parts of the MultiPacker are protected by a safety cabinet. The packing system can be accessed by a full size front door that is protected by a safety switch, automatically shutting down the system when the door is opened.

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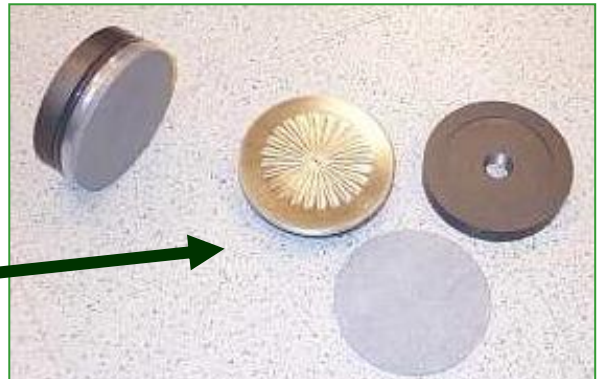
# MODcol® 4''/101mm SPRING® Column Design


- Weight of a column with 15cm bed length less than 15kg versus more than 30 kg for classical 4'' flanged columns.
- Elimination of flanges- Quick Lock, no tools necessary.

Same piston design as for the
25 and 50mm I.D. Spring columns



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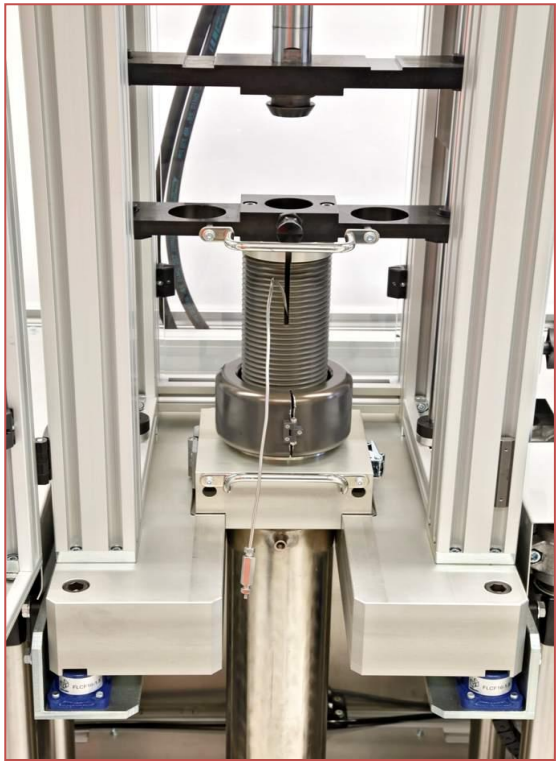
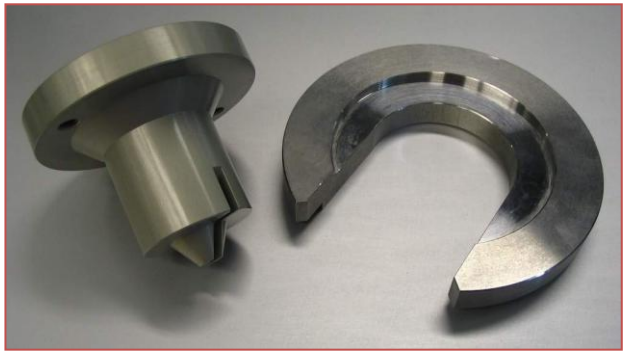
# Column Handling



A hinged column bracket with handles is used to place the 4“ Spring® Column inside the Multipacker®, allowing an easy handling and transportation of the column.



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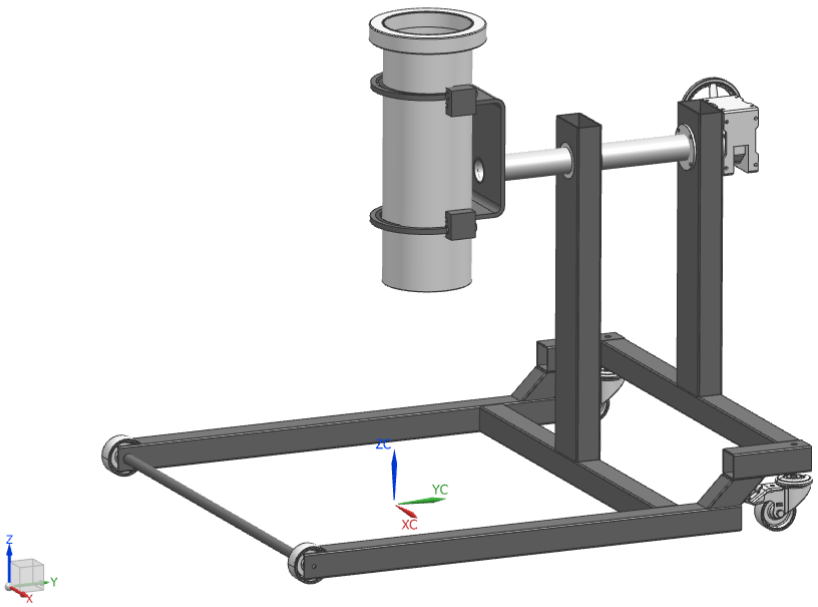
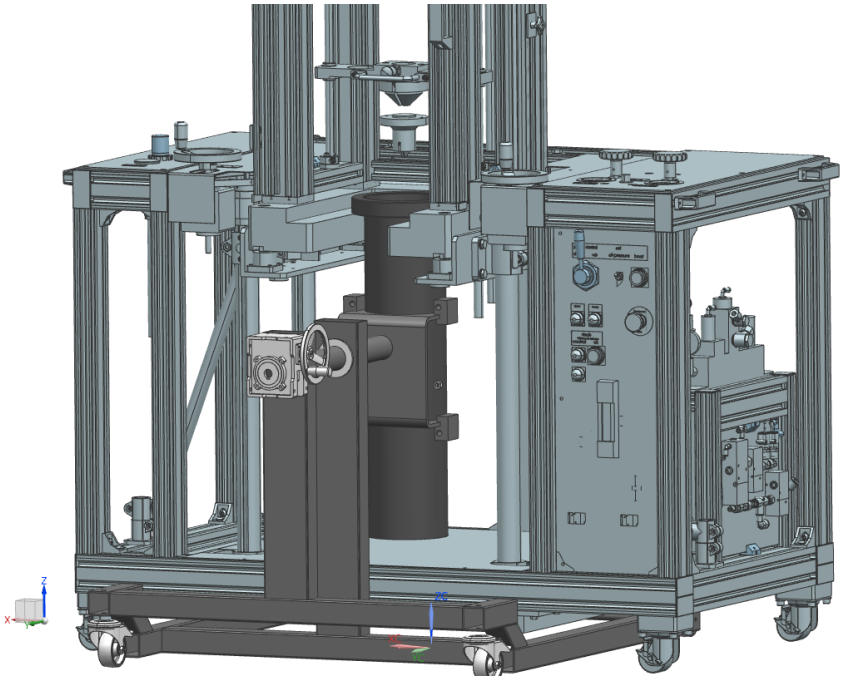
# Mobile Column Holders for Process Scale Columns



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# The MODcol® Multipacker® Instruments Summary


- Two Packing Unit for Multiple Column Dimensions Each
- State-of-the Art Safety & Performance
- Solely Mechanical System (No Electronics)
- Functional Principle Fully Air-Driven
- CE Certification
- EU Machinery Directive 2006/42/EG
- (Use in Explosive Atmospheres)
- Pulsation-Free Packing Process
- „Hands-Free“ Packing Operation
- Extremely User-Friendly
- Professional & Compact Industrial Design
- Maintenance-Free System Concept

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# Process Scale Columns

# THANK YOU

Dr. Maisch GmbH

Any Column, Any Size, Any Media

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