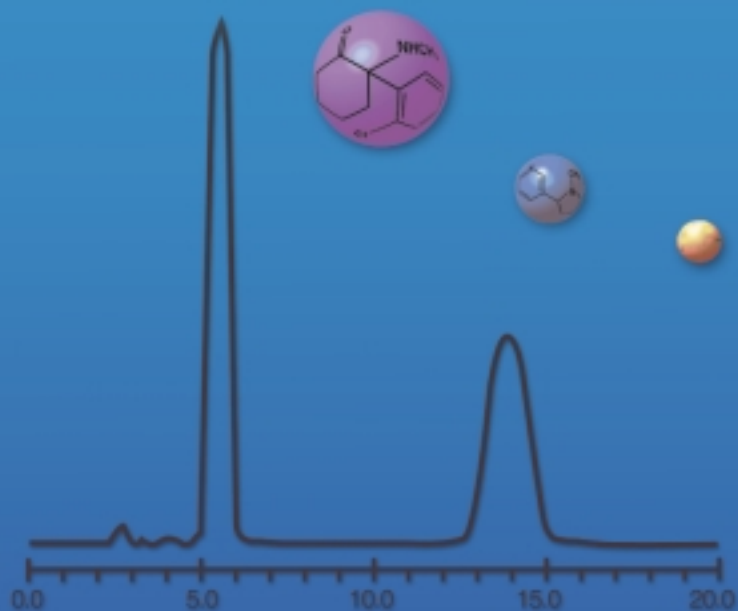


**Technical Support,  
Products and Services for  
Chiral Analysis and Separation**

**2004 Edition**



**CHIRAL**  
TECHNOLOGIES INC

# CHIRAL TECHNOLOGIES, INC.

## Catalog 2004 Edition

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## Message From the President

This catalog represents the beginning of a new chapter for **CHIRAL TECHNOLOGIES, INC.** These pages describe the chromatography products and services we offer to our North American customers in support of their work to develop and manufacture chiral therapeutics.

The breadth of applications for chiral chromatography has advanced significantly since the formation of our company in 1990. At that time Daicel Chemical Industries, Ltd., of Japan, established **CHIRAL TECHNOLOGIES, INC.** as a wholly-owned subsidiary with the intent of building a global business based on chromatography products and separation services. During this period, we have witnessed a dramatic increase in demand for chiral columns, bulk CSPs and outsourcing services to quickly obtain pure enantiomers via chromatography. This demand has led to a large expansion of our capabilities here in the U.S., and the construction of a new Marketing and Technical Center in West Chester, PA.

Our Daicel chiral columns are now the industry standard for HPLC and SFC chiral resolutions. Our core technology is based on derivatized polysaccharides as the selector for our chromatography stationary phases, and recently we expanded this product line to include both coated and immobilized polysaccharides on silica gel.



CHIRAL TECHNOLOGIES, INC. Headquarters



"Our mission is to be the company you think of first for all your chiral chromatography products and services."  
— Tom Lewis

The semi-prep and preparative columns are used increasingly by discovery and chemical development groups of our pharmaceutical industry customers, with both HPLC equipment and increasingly on SFC systems. Our line now includes higher pressure rated columns for SFC applications. There isn't any question that the quickest way to separate a racemic compound into the individual enantiomers is with one of our pre-packed preparative columns. In addition, our sets of columns for SMB systems are finding greater use for scale-up evaluations.

Since the late 1990s over a half dozen commercial pharmaceutical products were manufactured with large scale SMB equipment packed with our bulk chiral stationary phases. During this period over 300 metric tons of chiral separation capacity was installed in the three major world areas. At the same time, our parent, Daicel, installed the manufacturing capacity for bulk chiral stationary phase at its cGMP operation in Arai, Japan to match this growing demand.

On behalf of all employees at **CHIRAL TECHNOLOGIES, INC.**, I want to thank our customers for their continued support and trust in making us the leading supplier of chiral chromatography products and services in North America.



**CHIRAL**  
TECHNOLOGIES INC



**CHIRAL TECHNOLOGIES, INC.:** *The Specialist you rely on for chiral columns and services.*

## Technical Support

Technical Support is an integral component of the mission of **CHIRAL TECHNOLOGIES, INC.** You can obtain rapid and accurate Technical Support through several resources:

- Our Frequently Asked Questions (FAQs) section on the website at [www.chiraltech.com](http://www.chiraltech.com) is regularly updated to reflect the most immediate concerns of our users.
- Send an e-mail to [questions@chiraltech.com](mailto:questions@chiraltech.com) for a rapid response from our team of experts in all areas of chiral chromatography.
- Call us at **+1 800 6CHIRAL** for emergency requests for Technical Support when an immediate response is vital.

With access to a database of 14,000 chiral separations, we are often able to provide guidance to questions related to the separation of a specific compound. For example, what column will do the separation, what solvents can be used, what loading on the column is possible?

Our Technical Support team will assist you with issues related to the use of our chiral analytical columns, preparative separations using semi-preparative and preparative columns, and issues associated with bulk CSPs for large scale applications.

### Quality at CHIRAL TECHNOLOGIES, INC.

Quality at **CHIRAL TECHNOLOGIES, INC.** assures the customer that columns and services are consistent with established standards and criteria.

**Laboratory products:** Each column produced at **CHIRAL TECHNOLOGIES, INC.** is individually tested and shipped with its own test chromatogram allowing customers to verify column performance at any time.

**Contract manufacturing services:** Material generated during contract separations is checked for purity and enantiomeric excess before release. Every project has a written analytical report, summarizing methods and results.

**Documentation:** Written protocols exist for each test and procedure carried out at **CHIRAL TECHNOLOGIES, INC.**



Preparative Separations Lab



Analytical Screening Lab

## Preparative Separation Services

Chiral resolution is the fastest way to obtain pure enantiomers from a racemic mixture. Our new facility in West Chester, PA, offers the capacity and expertise to meet the short time lines normally demanded by the pharmaceutical industry. The facility is equipped with state of the art equipment – Prep HPLC, Prep SFC and SMB systems. With over ten years of experience in the chromatographic separation of chiral compounds, our staff provides high yield, high purity resolutions for quantities ranging from the gram scale to a capacity of 100 kg using the following approach:

- Methods and Quotations are developed using 100 mg samples.
- Quotations are normally issued within two weeks of receipt of first sample.
- Quantities of up to a few kg are normally separated on Preparative HPLC or SFC equipment.
- Larger quantities are separated on an SMB system.

Our pharmaceutical clients often use this service to obtain pure enantiomers for evaluation purposes, toxicity testing, etc., while developing a synthetic route in parallel. When quantities in excess of our capacity are required, we provide the method development services and coordinate the project with our parent, Daicel Chemical Industries, Ltd., or third party custom manufacturers.



## Industrial SMB Applications

The first commercial scale chiral simulated moving bed (SMB) chromatography operation began production at UCB Pharma in 1997. Since then, additional SMB projects in the U.S., Europe and Japan have come on-stream with economically viable commercial processes.

The chiral stationary phase (CSP) is the key to achieving lower cost in a chiral separation at a large scale. In addition to our commercially available CSPs, our Technical Center maintains a library of unique polysaccharide CSPs that can yield increased productivity for specific compounds. Contact us for confidential screening of a compound that is a candidate for manufacturing.

Production scale methods are developed in our facility at **CHIRAL TECHNOLOGIES, INC.** Method development begins with the screening of various CSPs and solvent systems continuing through scale-up studies. Experimental verification provides rapid estimates of the cost of production, production rate and the necessary equipment size for a given process.

We offer full support to companies who perform SMB separations in-house, as well as to those companies planning to outsource. As an option for outsourcing, we can coordinate projects with our parent company, Daicel Chemical Industries, Ltd., which operates a commercial-scale SMB plant in Arai, Japan.



Daicel SMB Production Site, Arai, Japan



Bulk CSPs

## Profile of DAICEL CHEMICAL INDUSTRIES, LTD.

Daicel Chemical Industries, Ltd., of Japan, is a leader in the development, manufacture and marketing of specialty chemical products, with annual sales equivalent to \$2.2 billion. **CHIRAL TECHNOLOGIES, INC.** is a wholly-owned subsidiary of Daicel. Daicel's major products include organic chemicals, cellulose derivatives, functional products, plastics, and aerospace and defense systems.

The business unit responsible for chiral chromatography products and related services is the Chiral Pharmaceuticals Ingredients Company (CPI Company); this business also includes a custom manufacturing operation that produces active pharmaceutical ingredients (APIs) and advanced intermediates for the global pharmaceutical industry.

Daicel's manufacturing plant in Arai, Japan, produces chiral stationary phases, chiral HPLC columns, and operates a commercial-scale SMB facility to produce single enantiomer compounds under cGMP conditions. In addition to chromatography, the CPI Company offers additional areas of expertise for chiral processes, including biotransformation technology and chemical synthesis.



## Analytical Columns

**CHIRALPAK® IA** is the first in a series of immobilized polysaccharide columns. Immobilization provides the column with outstanding solvent tolerance while retaining the chiral resolution characteristics of a polysaccharide phase.

### HPLC / SFC Immobilized Analytical Columns

Part Number	Name	Particle Size (μ)	Internal Diameter (mm)	Column Length (mm)	Product Type
80325	CHIRALPAK IA	5	4.6	250	Analytical

Analytical columns for HPLC and SFC are available with 5 and 10 micron particle sizes. The 5 micron (H series) columns offer higher resolution for use in more demanding applications than the traditional 10 micron columns.

### HPLC / SFC Analytical Columns, H Series

19394	CHIRALPAK AD-H	5	2.1	150	Analytical
19324	CHIRALPAK AD-H	5	4.6	150	Analytical
19325	CHIRALPAK AD-H	5	4.6	250	Analytical
20394	CHIRALPAK AS-H	5	2.1	150	Analytical
20324	CHIRALPAK AS-H	5	4.6	150	Analytical
20325	CHIRALPAK AS-H	5	4.6	250	Analytical
12324	CHIRALCEL OB-H	5	4.6	150	Analytical
12325	CHIRALCEL OB-H	5	4.6	250	Analytical
14394	CHIRALCEL OD-H	5	2.1	150	Analytical
14324	CHIRALCEL OD-H	5	4.6	150	Analytical
14325	CHIRALCEL OD-H	5	4.6	250	Analytical
17394	CHIRALCEL OJ-H	5	2.1	150	Analytical
17324	CHIRALCEL OJ-H	5	4.6	150	Analytical
17325	CHIRALCEL OJ-H	5	4.6	250	Analytical

Reversed-Phase analytical columns were developed specifically for aqueous - organic mobile phases. They are suited for applications where the sample is presented in aqueous media and are frequently used in LC/MS applications which employ thermo-spray ionization interfaces.

### HPLC Analytical Reversed-Phase Columns

19794	CHIRALPAK AD-RH	5	2.1	150	Analytical
19724	CHIRALPAK AD-RH	5	4.6	150	Analytical
20794	CHIRALPAK AS-RH	5	2.1	150	Analytical
20724	CHIRALPAK AS-RH	5	4.6	150	Analytical
14794	CHIRALCEL OD-RH	5	2.1	150	Analytical
14724	CHIRALCEL OD-RH	5	4.6	150	Analytical
14625	CHIRALCEL OD-R	10	4.6	250	Analytical
17794	CHIRALCEL OJ-RH	5	2.1	150	Analytical
17724	CHIRALCEL OJ-RH	5	4.6	150	Analytical

### HPLC / SFC Analytical Columns

19025	CHIRALPAK AD	10	4.6	250	Analytical
19094	CHIRALPAK AD	10	2.1	150	Analytical
20025	CHIRALPAK AS	10	4.6	250	Analytical
12025	CHIRALCEL OB	10	4.6	250	Analytical
13025	CHIRALCEL OC	10	4.6	250	Analytical
14025	CHIRALCEL OD	10	4.6	250	Analytical
15025	CHIRALCEL OF	10	4.6	250	Analytical
16025	CHIRALCEL OG	10	4.6	250	Analytical
17025	CHIRALCEL OJ	10	4.6	250	Analytical
18025	CHIRALCEL OK	10	4.6	250	Analytical

## Analytical Columns and Accessories

Crown Ether columns are especially effective for compounds with a primary amino group adjacent to the chiral center. A typical application for these columns is the resolution of amino acids.

### HPLC Analytical Crown Ether Columns

Part Number	Name	Particle Size ( $\mu$ )	Internal Diameter (mm)	Column Length (mm)	Product Type
27711	CROWNPAK CR	5	4.0	10	Guard Column
27714	CROWNPAK CR (+)	5	4.0	150	Analytical
28714	CROWNPAK CR (-)	5	4.0	150	Analytical

Ligand Exchange columns typically resolve compounds which form bidentate ligands with copper, such as amino acids and hydroxyl acids. Separations are optimized by varying ionic strength or acetonitrile content.

### HPLC Analytical Ligand Exchange Columns

21822	CHIRALPAK MA (+)	3	4.6	50	Analytical
25622	CHIRALPAK WH	10	4.6	50	Guard Column
25625	CHIRALPAK WH	10	4.6	250	Analytical

For maximum lifetime, analytical columns should be used in a series with an appropriate guard cartridge or column. Both formats are available with the packing material to match the protected column. Guard cartridges are mounted in a cartridge holder and utilize the 5 micron H series material. Guard columns contain 10 micron material and are normally used with the 10 micron columns.

### HPLC Analytical Guard Cartridges for use with Cartridge Holder (Package of Three)

80321	CHIRALPAK IA	5	4.0	10	Guard Cartridge
19321	CHIRALPAK AD-H	5	4.0	10	Guard Cartridge
19721	CHIRALPAK AD-RH	5	4.0	10	Guard Cartridge
20321	CHIRALPAK AS-H	5	4.0	10	Guard Cartridge
20721	CHIRALPAK AS-RH	5	4.0	10	Guard Cartridge
12321	CHIRALCEL OB-H	5	4.0	10	Guard Cartridge
14321	CHIRALCEL OD-H	5	4.0	10	Guard Cartridge
14721	CHIRALCEL OD-RH	5	4.0	10	Guard Cartridge
17321	CHIRALCEL OJ-H	5	4.0	10	Guard Cartridge
17721	CHIRALCEL OJ-RH	5	4.0	10	Guard Cartridge

The cartridge holder is necessary for installation of the guard cartridges. The column jackets allow operating temperature of analytical columns to be controlled with a circulating water bath.

### Hardware for Analytical Chromatography

00021	CARTRIDGE HOLDER	-	4.0	10	Hardware
00024	COLUMN JACKET, 15 cm	-	4.6	150	Hardware
00025	COLUMN JACKET, 25 cm	-	4.6	250	Hardware

### HPLC Analytical Guard Columns

19022	CHIRALPAK AD	10	4.6	50	Guard Column
20022	CHIRALPAK AS	10	4.6	50	Guard Column
12022	CHIRALCEL OB	10	4.6	50	Guard Column
13022	CHIRALCEL OC	10	4.6	50	Guard Column
14022	CHIRALCEL OD	10	4.6	50	Guard Column
15022	CHIRALCEL OF	10	4.6	50	Guard Column
16022	CHIRALCEL OG	10	4.6	50	Guard Column
17022	CHIRALCEL OJ	10	4.6	50	Guard Column
18022	CHIRALCEL OK	10	4.6	50	Guard Column



## HPLC Semi-Preparative Columns

Semi-preparative columns permit easy scale-up of a chiral separation using the same CSP in analytical columns. The columns are available in 5, 10, and 20 micron particle sizes to suit different process demands. These HPLC semi-preparative columns must not be used in SFC applications due to the customized hardware that high pressure SFC requires.

### HPLC Semi-Preparative Columns

Part Number	Name	Particle Size (μ)	Internal Diameter (mm)	Column Length (mm)	Product Type
19335	CHIRALPAK AD-H	5	10	250	Semi-preparative
19345	CHIRALPAK AD-H	5	20	250	Semi-preparative
19035	CHIRALPAK AD	10	10	250	Semi-preparative
19045	CHIRALPAK AD	10	20	250	Semi-preparative
19245	CHIRALPAK AD	20	21	250	Semi-preparative
20335	CHIRALPAK AS-H	5	10	250	Semi-preparative
20345	CHIRALPAK AS-H	5	20	250	Semi-preparative
20035	CHIRALPAK AS	10	10	250	Semi-preparative
20045	CHIRALPAK AS	10	20	250	Semi-preparative
20245	CHIRALPAK AS	20	21	250	Semi-preparative
14335	CHIRALCEL OD-H	5	10	250	Semi-preparative
14345	CHIRALCEL OD-H	5	20	250	Semi-preparative
14035	CHIRALCEL OD	10	10	250	Semi-preparative
14045	CHIRALCEL OD	10	20	250	Semi-preparative
14245	CHIRALCEL OD	20	21	250	Semi-preparative
15245	CHIRALCEL OF	20	21	250	Semi-preparative
17335	CHIRALCEL OJ-H	5	10	250	Semi-preparative
17345	CHIRALCEL OJ-H	5	20	250	Semi-preparative
17035	CHIRALCEL OJ	10	10	250	Semi-preparative
17045	CHIRALCEL OJ	10	20	250	Semi-preparative
17245	CHIRALCEL OJ	20	21	250	Semi-preparative

### HPLC Semi-Preparative Reversed-Phase Columns

19745	CHIRALPAK AD-RH	5	21	250	Semi-preparative
20745	CHIRALPAK AS-RH	5	21	250	Semi-preparative
14745	CHIRALCEL OD-RH	5	21	250	Semi-preparative
17745	CHIRALCEL OJ-RH	5	21	250	Semi-preparative

For extended lifetime, semi-preparative columns should be used in series with an appropriate guard column. Semi-preparative guard columns contain 20 micron material for minimum pressure drop and permit maximum flow.

### HPLC Semi-Preparative Guard Columns

19242	CHIRALPAK AD	20	21	50	Guard Column
20242	CHIRALPAK AS	20	21	50	Guard Column
14242	CHIRALCEL OD	20	21	50	Guard Column
17242	CHIRALCEL OJ	20	21	50	Guard Column

CHIRAL TECHNOLOGIES, INC. Technical Support can provide method recommendations and scale-up calculations to facilitate the transfer of separations to preparative scale. Contact us at [questions@chiraltech.com](mailto:questions@chiraltech.com)



## HPLC Preparative Columns

Method Development columns are packed with 20 micron CSP and closely match the performance of large preparative columns. The loading data on these columns yield accurate projections of the full size separation.

### HPLC Method Development Columns

Part Number	Name	Particle Size (μ)	Internal Diameter (mm)	Column Length (mm)	Product Type
19225	CHIRALPAK AD	20	4.6	250	Method Development
20225	CHIRALPAK AS	20	4.6	250	Method Development
14225	CHIRALCEL OD	20	4.6	250	Method Development
17225	CHIRALCEL OJ	20	4.6	250	Method Development

### HPLC Preparative Chromatography Columns

19256	CHIRALPAK AD	20	50	500	Preparative
19266	CHIRALPAK AD	20	100	500	Preparative
20256	CHIRALPAK AS	20	50	500	Preparative
20266	CHIRALPAK AS	20	100	500	Preparative
14256	CHIRALCEL OD	20	50	500	Preparative
14266	CHIRALCEL OD	20	100	500	Preparative
15256	CHIRALCEL OF	20	50	500	Preparative
15266	CHIRALCEL OF	20	100	500	Preparative
17256	CHIRALCEL OJ	20	50	500	Preparative
17266	CHIRALCEL OJ	20	100	500	Preparative

## Simulated Moving Bed Column Sets

Simulated Moving Bed (SMB) technology is a continuous, efficient process suitable for production of metric tons per year of pure chiral material. SMB method development columns are manufactured, tested and sold as a matched set of 8 to perform pilot studies for accurate evaluation of large scale SMB systems.

19233	CHIRALPAK AD	20	10	100	SMB (Set of 8)
20233	CHIRALPAK AS	20	10	100	SMB (Set of 8)
14233	CHIRALCEL OD	20	10	100	SMB (Set of 8)
17233	CHIRALCEL OJ	20	10	100	SMB (Set of 8)

## Bulk Chiral Stationary Phase

Bulk Chiral Stationary Phase (CSP) is supplied for large scale SMB and single column HPLC applications. Material is readily available in 1 kilogram quantities. Bulk quantities are available upon request.

Part Number	Name	Particle Size (μ)	Quantity	Column Length (mm)	Product Type
19020	CHIRALPAK AD CSP	20	1 kilogram	-	CSP
20020	CHIRALPAK AS CSP	20	1 kilogram	-	CSP
14020	CHIRALCEL OD CSP	20	1 kilogram	-	CSP
15020	CHIRALCEL OF CSP	20	1 kilogram	-	CSP
17020	CHIRALCEL OJ CSP	20	1 kilogram	-	CSP



## Supercritical Fluid Chromatography Semi-Preparative Columns

Supercritical Fluid Chromatography (SFC) is ideal for rapid analytical separations and rapid isolation of gram quantities of chiral compounds. SFC uses liquid carbon dioxide as a chromatographic mobile phase modified with alcohols, acetonitrile, or other polar solvents. The acidity of CO<sub>2</sub> eliminates the need for acidic additives, making SFC the ideal technique for preparative separation of acidic compounds. CHIRALCEL® and CHIRALPAK® analytical columns can be used with HPLC and SFC systems. In semi-prep, the high system pressure required to keep CO<sub>2</sub> liquid dictates the use of more robust column hardware.

### Supercritical Fluid Chromatography Semi-Preparative Columns

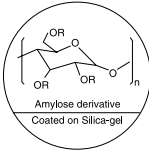
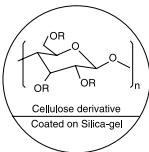
Part Number	Name	Particle Size (μ)	Internal Diameter (mm)	Column Length (mm)	Product Type
19435	CHIRALPAK AD-H	5	10	250	SFC
19445	CHIRALPAK AD-H	5	21	250	SFC
19475	CHIRALPAK AD-H	5	30	250	SFC
20435	CHIRALPAK AS-H	5	10	250	SFC
20445	CHIRALPAK AS-H	5	21	250	SFC
20475	CHIRALPAK AS-H	5	30	250	SFC
14435	CHIRALCEL OD-H	5	10	250	SFC
14445	CHIRALCEL OD-H	5	21	250	SFC
14475	CHIRALCEL OD-H	5	30	250	SFC
15145	CHIRALCEL OF	10	21	250	SFC
16145	CHIRALCEL OG	10	21	250	SFC
17435	CHIRALCEL OJ-H	5	10	250	SFC
17445	CHIRALCEL OJ-H	5	21	250	SFC
17475	CHIRALCEL OJ-H	5	30	250	SFC

Cumulative data from 12 years of applications research have shown that the four columns, developed by Daicel Chemical Industries, Ltd., which consist of the polysaccharide phases AD, OD, AS and OJ, are able to resolve more than 80% of chiral compounds.

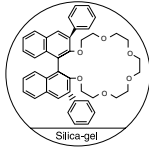

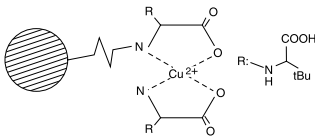
## Phase Legend

Chiral Stationary Phase is the media packed inside columns that separates racemic mixtures into purified enantiomers.

**The Polysaccharide phases** consist of a derivatized cellulose or amylose coated on a silica support. Derivatization of the polysaccharide hydroxyl groups with various side chains gives different helical supramolecular structures. The curved groove of the helix is a chiral environment which can greatly favor the binding of one enantiomer over the other. The use of two polysaccharide backbones and a variety of side chains, coupled with the effect of mobile phase variables, gives the phases an extremely broad range of applications.

CHIRALPAK® A Series	CHIRALCEL® O Series	
Derivatized Amylose	Derivatized Cellulose	
<p><b>Side Groups</b></p> <p><b>CHIRALPAK AD</b></p> $R: -C(=O)-NH-\text{3,5-dimethylphenyl}$ <p>3,5-dimethylphenyl carbamate</p> <p><b>CHIRALPAK AS</b></p> $R: -C(=O)-NH-\text{(S)-}\alpha\text{-methylbenzyl}$ <p>(S)-α-methylbenzyl carbamate</p> 	<p><b>Side Groups</b></p> <p><b>CHIRALCEL OD</b></p> $R: -C(=O)-NH-\text{3,5-dimethylphenyl}$ <p>3,5-dimethylphenyl carbamate</p> <p><b>CHIRALCEL OG</b></p> $R: -C(=O)-NH-\text{4-methylphenyl}$ <p>4-methylphenyl carbamate</p> <p><b>CHIRALCEL OC</b></p> $R: -C(=O)-NH-\text{phenyl}$ <p>phenyl carbamate</p> 	<p><b>CHIRALCEL OJ</b></p> $R: -C(=O)-\text{4-methylbenzoate}$ <p>4-methylbenzoate</p> <p><b>CHIRALCEL OF</b></p> $R: -C(=O)-NH-\text{4-chlorophenyl}$ <p>4-chlorophenyl carbamate</p> <p><b>CHIRALCEL OB</b></p> $R: -C(=O)-\text{benzoate}$ <p>benzoate</p> <p><b>CHIRALCEL OK</b></p> $R: -C(=O)-\text{cinnamate}$ <p>cinnamate</p>

**The Crown Ether and Ligand Exchange columns** are used for specific separations - the Crown Ether phase is specific for primary amino groups at the chiral center while the Ligand Exchange columns resolve compounds with specific copper complexing character.

CROWNPAK® CR	CHIRALPAK MA (+)	CHIRALPAK WH
Crown Ether	Ligand Exchange	Ligand Exchange
 <p>CR+ = (S)-18-crown-6 ether</p>	 <p>N, N diethyl-L-alanine</p>	 <p>Complexed Copper</p>



# CHIRAL

## TECHNOLOGIES INC



### Technical Centers:

*Fully staffed and equipped Technical Centers are located on three continents.  
For the location nearest you, please see the map below.*

**Contact us at the numbers below for further information or to place an order.**

#### Chiral Technologies Europe, S.A.S.

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