

GC Columns



Chromatography Products

www.restek.com

Dear Colleague,

We are pleased to be publishing a new gas chromatography columns mini-catalog. Here you will find an extensive section on GC basics such as column selection, column installation, guard column/retention gap comparison, as well as a discussion of fast GC, featuring our 0.10mm and 0.18mm ID columns. This catalog also contains detailed information on our most popular columns and features our newest product line—Restek's Extremely Inert (Rxi®) high performance column family.



Gary Stidsen
GC Columns
Product Manager
11+ years of service!

The Rxi® fused silica capillary columns are very low bleed and exhibit exceptional inertness for active compounds, both basic and acidic. These columns were engineered for low-level analysis using new deactivation techniques and polymer cross-bonding technologies. Take a look at the Rxi® performance data on pages 23–25 and you'll see why we think these columns will be the best you have ever used. Currently offered in this new line are the Rxi®-1ms, Rxi®-5ms, Rxi®-5Sil MS, Rxi®-17, and Rxi®-XLB columns.

We have also included our original Rtx® columns. These columns have been road tested since 1985 and are known to be one of the best fused silica column lines on the market. Over the last year, we have made further improvements to this line, which are evident in the low bleed and ruggedness that these columns exhibit.

Our specialty application capillary columns are also featured. These columns are designed for certain compound classes or target analyte lists from specific methods. Using these application columns saves you many hours in the laboratory, because the Restek Innovations Chemists have already done the method development work for you. These columns are accompanied by application notes with optimized conditions and backed by our technical support team, experienced chemists who can answer your technical questions and offer method support.

At Restek, our mission is to help you achieve your analytical goals. Our products are proven to help chemists perform their tasks more accurately and more efficiently. For your chromatography needs, call 800-356-1688 or 814-353-1300, visit us online at www.restek.com, or contact your local Restek representative. See pages 4–5 for a list of international subsidiaries and distributors. We are here to help you!

Sincerely,

A handwritten signature in cursive script that reads "Gary B. Stidsen".

Gary Stidsen
GC Columns Product Manager



Innovations Team

Silvia Martinez, Kristi Sellers, Michelle Misselwitz, Chris English, Barry Burger, Jason Thomas, Julie Kowalski, Scott Grossman, Amanda Rigdon. Not shown: Rick Morehead



Gary Stidsen, GC Columns Product Manager and Don Rhoads, Technical Specialist



Steve Constable, Process Development Manager



Chris English, Innovations Team Leader



Scott Grossman, Innovations Chemist and Jack Cochran, Director of New Business & Technology

GC Columns

Detailed Table of Contents	2-3
International Distributors	4-5
Selecting a GC Column	6-14
<i>GC Column Cross-References</i>	12-13
<i>GC Column Installation</i>	14
Guard/Retention Gap Columns	15-19, 25
Columns for Fast GC Analysis	20
Rxi® High Performance Columns	22-31
General Purpose Columns	32-43
Application-Specific Columns	
<i>Specially Deactivated</i>	45-48
<i>Chiral Compounds</i>	49-50
<i>Foods, Flavors, & Fragrances</i>	51-53
<i>Petrochemical</i>	54-58
<i>Clinical/Forensic</i>	59
<i>Pharmaceutical</i>	60-63
<i>Environmental</i>	64-77
PLOT Columns	78-83
Metal (MXT) Columns	84-93
GC Accessories	94-95
OVI Retention Time Index	96

Can't find the column that
you're looking for?
Check out our website at
www.restek.com.

Capillary Columns

Selecting a GC Column	6-14
GC Column Cross-References	12-13
GC Column Installation	14
Guard/Retention Gap Columns	15-19, 25
Fast GC Columns	20-21

High Performance Columns

Overview	22-25
Rxi-1ms	26
Rxi-5ms	27
Rxi-5Sil MS	28-29, 64, 74
Rxi-XLB	30, 71
Rxi-17	31

General Purpose Columns

Rtx-1	33
Rtx-5/Rtx-5MS	34, 62
Rtx-20	35
Rtx-35	35
Rtx-50	36
Rtx-65	36
Rtx-440	37
Rtx-200/Rtx-200MS	38
Rtx-1301	39, 60
Rtx-624	39, 60, 77
Rtx-1701	40
Rt-2330	41
Rt-2560	41
Rtx-Wax	42
Stabilwax	43, 61

Application-Specific Columns

Specialty Deactivated

Basic Compounds Analysis	45-47
Rtx-5 Amine, Rtx-35 Amine, Stabilwax-DB	
Acidic Compounds Analysis	48
Stabilwax-DA	

Chiral Compounds

Enantiomers Analysis	49-50
Rt- β DEXm, Rt- β DEXsm, Rt- β DEXse, Rt- β DEXsp, Rt- β DEXsa, Rt- β DEXcst, Rt- γ DEXsa	

Foods, Flavors, & Fragrances

Polyunsaturated FAME Analysis	51
FAMEWAX	
Flavor and Fragrance Compound Analysis	51-52
Rt-CW20M F&F, Rtx-1 F&F	
Triglycerides in Foods Analysis	53
Rtx-65TG	

Petrochemical

Detailed Hydrocarbon Analysis (DHA)	54
Rtx-1PONA/Rtx-5PONA (Tuning Column)	
Simulated Distillation (C5-C44 Analysis)	55
Rtx-2887/MXT-2887	
Simulated Distillation (C44-C100) Analysis	56
MXT-1HT Sim Dist/MXT-1 Sim Dist/MXT-500 Sim Dist	
Aromatics & Oxygenates in Gasoline Analysis	57
Rt-TCEP	
Biodiesel Fuels Analysis	58
Rtx-Biodiesel TG/MXT-Biodiesel TG	

Clinical/Forensic

Blood Alcohol Analysis	59
Rtx-BAC1/Rtx-BAC2	

Pharmaceutical

Organic Volatile Impurities (OVI) Analysis	60-63
Rtx-1301, Rtx-624, Stabilwax, Rtx-5, Rtx-G27/Rtx-G43	

Environmental

Semivolatiles Analysis	64
<i>Rxi-5Sil MS</i>	
Organophosphorus Pesticides Analysis	65
<i>Rtx-OPPesticides/Rtx-OPPesticides2</i>	
Chlorinated Pesticides Analysis	66-69
<i>Rtx-CLPesticides/Rtx-CLPesticides2, Stx-CLPesticides/Stx-CLPesticides2</i>	
PCB Congeners Analysis	70-71
<i>Rtx-PCB, Rxi-XLB</i>	
Dioxin & Furan Congeners Analysis	72-73
<i>Rtx-Dioxin, Rtx-Dioxin2</i>	
Polycyclic Aromatic Hydrocarbons (PAHs) Analysis	74
<i>Rxi-5Sil MS</i>	
Volatile Organics Analysis	75-77
<i>Rtx-VMS, Rtx-502.2, Rtx-Volatiles, Rtx-624</i>	

PLOT Columns

Features and Benefits of PLOT Columns, Quick Reference Chart, Phase Cross-Reference Chart	79
Rt-Alumina PLOT	80-81
Rt-Msieve 5A PLOT	82
Porous Polymers (Rt-SPLIT/Rt-QS-BOND/Rt-QPLOT/Rt-UPLOT)	83

Metal (MXT) Columns

Overview	85
Guard/Retention Gap Columns	86
Tubing Scorer for MXT Columns	87
MXT-1	87
MXT-5	88
MXT-2887	55, 88
MXT-Biodiesel TG	58, 88
MXT-1HT Sim Dist/MXT-1 Sim Dist/MXT-500 Sim Dist	56, 89
MXT-20	89
MXT-35	90
MXT-50	90
MXT-65/MXT-65 TG	90
MXT-1301	91
MXT-1701	91
MXT-200	91
MXT-WAX	92
MXT-502.2	92
MXT-Volatiles	93
MXT-624	93

GC Accessories

Methods Development Software	94
Leak Detector and Leak Detector Accessory Kit	94
Septa	95
Ferrules	95

Indices

Organic Volatile Impurities Retention Time Index	96
--	----



Catch the Buzz

Sign up for Restek's e-newsletter, *The Buzz*
www.restek.com/buzz

International Distributors & Subsidiaries

Visit www.restek.com for the most current listing of Restek distributors.

Headquarters

Restek ★

110 Benner Circle
Bellefonte, PA 16823 USA
Toll-free (in U.S.): 800-356-1688
Phone: 814-353-1300
Fax: 814-353-1309
www.restek.com

Subsidiaries

France ★

Restek France
Phone: 33 (0)1 60 78 32 10
Fax: 33 (0)1 60 78 70 90
e-mail: restek@restekfrance.fr

Germany ★

Restek GmbH
Phone: 0049 - (0)6172 2797-0
Fax: 0049 - (0)6172 2797-77
e-mail: info@restekgmbh.de
www.restekgmbh.de

Ireland ★

Restek Ireland
Phone: 44-28-90-814576
Fax: 44-28-90-814576
e-mail: resteurope@aol.com

United Kingdom ★

Thames Restek UK LTD
Phone: 01494 563377
Fax: 01494 564990
e-mail: sales@thamesrestek.co.uk

Distributors

European countries

not listed:
Dave Mannus,
European Sales Mgr.
Phone: 44-28-90-814576
Fax: 44-28-90-814576
e-mail: resteurope@aol.com

Other countries not listed:

Contact Restek International
Customer Service
Phone: 814-353-1300, ext. 2025
Fax: 814-353-1309
e-mail: IntlPlusOne@restek.com

Algeria

HTDS ALGERIA
Phone: 21 79 02 10
Fax: 21 79 02 15
e-mail: info@htds.fr

Argentina

Eidomet SRL
Phone: 54-11-4334-6207
Fax: 54-11-4334-1737
e-mail: eidomet@eidomet.com.ar

Australia

Chromalytic Technology Pty Ltd
Phone: 61 3 9762 2034
Fax: 61 3 9761 1169
e-mail: jimjeffs@chromtech.net.au

LECO Australia Pty Ltd

Phone: 61 2 9894 5955
Fax: 61 2 9894 5247
e-mail: ross_giordano@leco.com

Lomb Scientific (Aust) Pty Ltd

Phone: 61 2 8536 6200
Fax: 61 2 8536 6250
e-mail: sales@lomb.com.au

Distributors (cont'd)

Austria

CP-Analytica GmbH
Phone: 43 (0)2572/4381
Fax: 43 (0)2572/20791
e-mail: info@cp-analytica.at

Bahrain

LabGulf FZC
Phone: 971 6 557 4922
Fax: 971 6 557 4923
e-mail: info@labgulf.com

Yousuf Mahmood Husain

Phone: +973 276176
Fax: +973 275819
e-mail: reji@ymh.com.bh

Belarus

New Analytical Systems Ltd.
Phone: +375-17-226-25-17
Fax: +375-17-226-25-17
e-mail: unichrom@unichrom.com

Belgium

Interscience BVBA
Phone: 32 10 450025
Fax: 32 10 453080
e-mail: info@interscience.be

Belize

See Costa Rica distributor

Bolivia

Spektra Ltd
Phone: 591.2.240.6553
Fax: 591.2.214.1740
e-mail: spektra@entelnet.bo

Bosnia and Herzegovina

Analitika d.o.o.
Phone: 00387 33 712 060
Fax: 00387 33 712 061
e-mail: analitika_sa@bih.net.ba

Brazil

Cromatec Comercio de Instrumentos Analíticos Ltda.
Phone: 55 11 5670-2510
Fax: 55 11 5670-2530
e-mail: sac@cromatec.com.br

Bulgaria

Labsystems Ltd.
Phone: +3592 965 7912
Fax: +3592 965 7930
e-mail: shopnikolov@labsystems.bg

Canada

Chromatographic Specialties
Phone: 800-267-8103 /
613-342-4678
Fax: 613-342-1144
e-mail: sales@chromspec.com

Fisher Scientific (Canada)

Phone: 800-234-7437
Fax: 800-463-2996
e-mail: restekcorporation@fishersci.ca

Chile

Del Carpio Analisis y Asesorias Ltda.
Phone: (562) 2691348
Fax: (562) 3415397
e-mail: ventas@delcarpio.cl

China

Beijing Hesi Scientific & Technology Ltd.
Phone: 86 10 82561086
Fax: 86 10 82561088
e-mail: info@bjhesi.com

China (cont'd)

Beijing Mingni Analytical Instrument and Equipment Center
Phone: 010-84726305
Fax: 010-84723212
e-mail: wangqichang@yahoo.com

Dikma Technologies

Phone: 8610-6231-7719
Fax: 8610-6231-7723
e-mail: info@dikma.com.cn

Globetech Systems Ltd.,

a Restek HPLC application partner
Phone: 852-25221114
Fax: 852-25211190
e-mail: lj001@globetechsystems.com

Shimadzu-GL Sciences (Shanghai) Laboratory Supplies Company, Ltd.

Phone: +86-21-6473-2791
Fax: +86-21-6473-4792
e-mail: fujishi@shimadzu.co.jp

Shimadzu International Trading (Shanghai) Co. LTD

Phone: 010-85252421
Fax: 010-85252326
e-mail: bscl@shimadzu.com.cn

Colombia

Impel Ltda.
Phone: 571-290-2862
Fax: 571-290-7290
e-mail: impel@etb.net.co

Innovatek Ltda.

Phone: 57-1 338 0711
Fax: 57-1 327 0936
e-mail: hislent@innovatek.com.co

Costa Rica

LoAnalítico Químico S.A.
Phone: +506 260 50 24
Fax: +506 262 6987
e-mail: sisfonh@racsa.co.cr

Croatia

AnAs Analytical Assistance
Phone: 385-1-662-5606
Fax: 385-1-662-5608
e-mail: vladimir.svob@zg.htnet.hr

Cyprus

C & V Kriticos Suppliers Ltd
Phone: +357 22 33 82 34
Fax: +357 22 33 82 32
e-mail: c.v.kriticos@cytanet.com.cy

Czech Republic

Chromservis s.r.o.
Phone: +420 274 021 222
Fax: +420 274 021 220
e-mail: prode@chromservis.cz

Denmark

VWR & Bie & Bernsten A/S
Phone: +45 43 86 8732
Fax: +45 43 86 8790
e-mail: antje.neave@dk.vwr.com

Dominican Republic

See Costa Rica distributor

Estonia

G.W. Berg OÜ
Phone: 372 6505 658
Fax: 372 6505 653
e-mail: gwb@gwb.ee

Finland

HNU Nordion Ltd. Oy
Phone: +358 9 565 7240
Fax: +358 9 565 424 30
e-mail: lea.julin@hnuNordion.fi

France

Restek France
Phone: 33 (0)1 60 78 32 10
Fax: 33 (0)1 60 78 70 90
e-mail: restek@restekfrance.fr

Germany

Restek GmbH
Phone: 0049 - (0)6172 2797-0
Fax: 0049 - (0)6172 2797-77
e-mail: info@restekgmbh.de

Greece

Link Lab Ltd
Phone: +30 210 7564772
Fax: +30 210 7564723
e-mail: sales@linklab.gr

Honduras

See Costa Rica distributor

Hong Kong

Guyline (Asia) Ltd.
Phone: 852-2856-0606
Fax: 852-2811-2947
e-mail: guyasia@pacific.net.hk

Hungary

Lab-Comp Kft.
Phone: 36 1 347 6090
Fax: 36 1 280 6358
e-mail: labcomp@lab-comp.hu

India

Labindia Instruments Pvt Ltd
Phone: +91 222 533 5389
Fax: +91 222 533 5940
e-mail: smirat@labindia.com

Toshvin Analytical Pvt Ltd

Phone: 91-22-23015096
Fax: 91-22-23013592
e-mail: mumbai@toshvin.com

Indonesia

Pivot ProChem
Phone: 65-6776-7443
Fax: 65-6776-2652
e-mail: prochem@pacific.net.sg

PT. Tawada Graha

Phone: +6221 - 57941139
Fax: +6221 - 57941140
e-mail: prs@tawada-ndt.com

Ireland

(Northern Ireland & Republic of Ireland)
Restek Ireland
Phone: 44-28-90-814576
Fax: 44-28-90-814576
e-mail: resteurope@aol.com

Israel

Bargal Analytical Instruments Ltd
Phone: +972-3-9796-533
Fax: +972-3-9796-538
e-mail: bargal@bargal.co.il

Italy

Chebios s.r.l.
Phone: 39 (06) 39080601 r.a.
Fax: 39 (06) 39080606
e-mail: chebios@chebios.it

CPS Analitica s.r.l.

Phone: +39 (0)2 8954201
Fax: +39 (0)2 89542022
e-mail: cps@cps.it

Superchrom s.r.l.

Phone: +39 02 7610037
Fax: +39 02 70100100
e-mail: superchrom@iol.it

Japan

Shimadzu, GLC
Phone: 81 3 5812 3821
Fax: 81 3 5812 3827
e-mail: daten@glc.shimadzu.co.jp

Uniflex Co., Ltd.

Phone: 04 7147 3751
Fax: 04 7144 8242
e-mail: info@uniflex.co.jp

Jordan

Vivid Separation & Filtration
Phone: 962 6 5831172
Fax: 962 6 5831173
e-mail: vivid01@wanadoo.jo

Korea

See South Korea

Kuwait

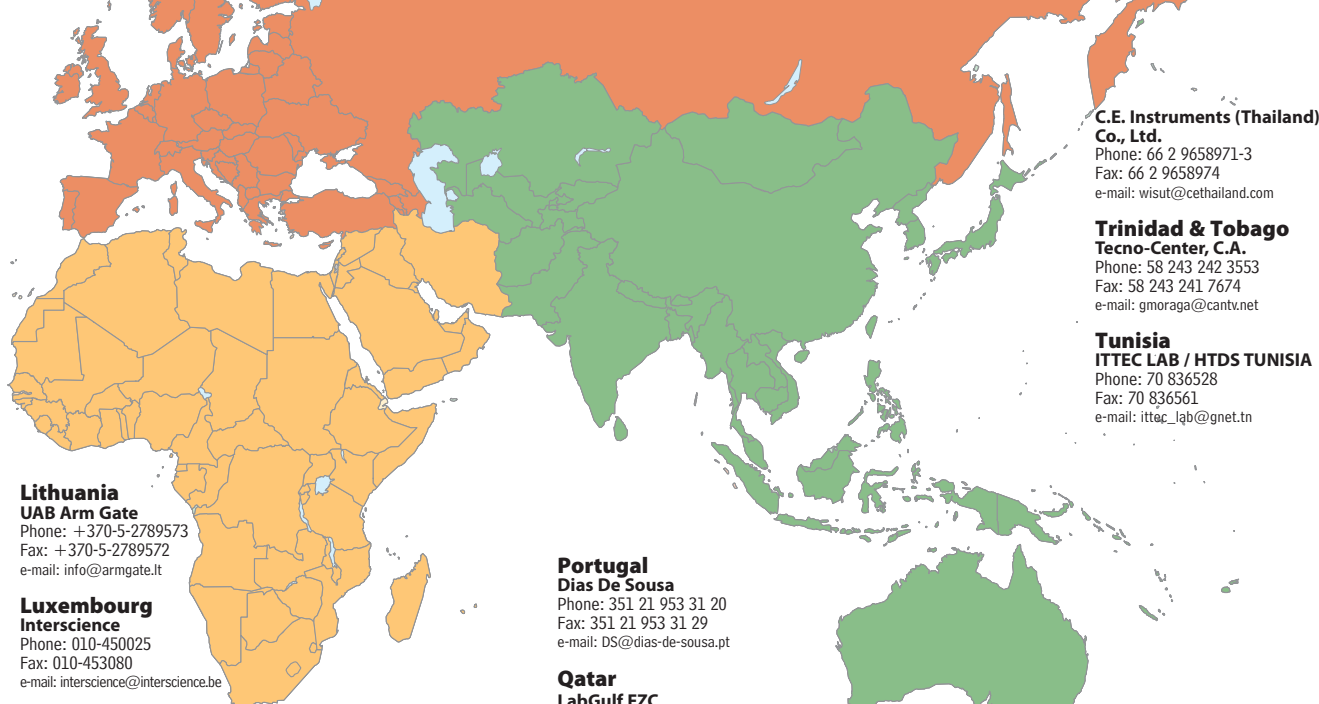
Al-Essa Medical & Scientific Equipment Co WLL
Phone: 965 483 3064
Fax: 965 484 0629
e-mail: john@tsst-kw.com

LabGulf FZC

Phone: 971 6 557 4922
Fax: 971 6 557 4923
e-mail: info@labgulf.com

Latvia

SIA Armgate
Phone: +371 7 976 780
Fax: +371 7 553 723
e-mail: armgate@armgate.lv



Lithuania
UAB Arm Gate
 Phone: +370-5-2789573
 Fax: +370-5-2789572
 e-mail: info@armgate.lt

Luxembourg
Interscience
 Phone: 010-450025
 Fax: 010-453080
 e-mail: interscience@interscience.be

Macedonia
VARUS
 Phone: +389 (0) 23 115122
 Fax: +389 (0) 23 137013
 e-mail: varus@mt.net.mk

Malaysia
Chemopharm Sdn. Bhd.
 Phone: 603-7876-0022
 Fax: 603-7874-7958
 e-mail: enquiry@chemopharm.com.my

Malta
Tektraco Ltd.
 Phone: +35621 378088
 Fax: +35621 376667
 e-mail: sales@tektraco.com

Mexico
VWR International,
S de RL de CV
 Phone: 52-55-5005-0100
 Fax: 52-55-5005-0126
 e-mail: elvira_linazasoro@mx.vwr.com

Tecnologia Cromatografica,
S.A. DE C.V.
 Phone: +52-55-5615-7487
 Fax: +52-55-5598-5917
 e-mail: hector@ocampo@tecrom.com

Montenegro
Millitest d.o.o.
 Phone: 00381 11 30 48 237
 Fax: 00381 11 34 72 636
 e-mail: mila.komaric@millitest.com

Moldova
Laco Alfatec SRL
 Phone: 00373 22 772575
 Fax: 00373 22 763711
 e-mail: arpentin@cni.md

Nepal
Associated Enterprises
 Phone: + (1) 425 0934
 Fax: + (1) 426 1744
 e-mail: info@asoent.com

Netherlands
Interscience B.V.
 Phone: 31 76 5411800
 Fax: 31 76 5420088
 e-mail: info@interscience.nl

New Zealand
LECO Australia Pty Ltd
 Phone: 61 2 9894 5955
 Fax: 61 2 9894 5247
 e-mail: ross_giordano@leco.com

Shimadzu Scientific
Instruments (Oceania) PTY Ltd.
 Phone: 0800 127 446
 Fax: +64 9 836 7757
 e-mail: sales@shimadzu.co.nz

Nicaragua
 See Costa Rica distributor

Nigeria
Labstock Nigeria Limited
 Phone: 234 1 342 5433
 Fax: 234 1 342 5433
 e-mail: sales@labstocknigeria.com

Norway
Instrument Teknikk AS
 Phone: (+47) 23194640
 Fax: (+47) 23194641
 e-mail: it@instrument-teknikk.no

Oman
LabGulf FZC

Phone: 971 6 557 4922
 Fax: 971 6 557 4923
 e-mail: info@labgulf.com

Middle East (Scientific)
Equipments
 Phone: +968-9672 4110
 Fax: +968-2450 4809
 e-mail: techuc@omantel.net.om

Pakistan
Analytical Measuring
Systems (Pvt) Ltd
 Phone: +92-21-5345581
 Fax: +92-21-5345582
 e-mail: amsana@cyber.net.pk

Panama
 See Costa Rica distributor

Paraguay
DEXIN - Grupo Quimico SRL
 Phone: (+598 2) 507-6058
 Fax: (+598 2) 507-0155
 e-mail: ventas@dexin.com.uy

Peru
Electromedica Peruana S.A.
 Phone: 51-1-4601317
 Fax: 51-1-4601448
 e-mail: analitica@empesa.net

Philippines
Brownstone Asia-Tech, Inc.
 Phone: 632 532 4310
 Fax: 632 531 6518
 e-mail: batinic@texttron.com

JEFCOR, Incorporated
 Phone: 632 838 8484
 Fax: 632-838-8483
 e-mail: jefcor@skyinet.net

Poland
Anchem
 Phone: 48 22 646 26 60
 Fax: 48 22 646 26 69
 e-mail: info@anchem.pl

Portugal
Dias De Sousa
 Phone: 351 21 953 31 20
 Fax: 351 21 953 31 29
 e-mail: DS@dias-de-sousa.pt

Qatar
LabGulf FZC
 Phone: 971 6 557 4922
 Fax: 971 6 557 4923
 e-mail: info@labgulf.com

Orbit Trading & Contracting
Company Scientific
Equipment Division
 Phone: +974 4351355
 Fax: 974 4433541
 e-mail: orbittrdg@qatar.net.qa

Romania
Agilrom
 Phone: 40 21 269 12 88
 Fax: 40 21 269 1299
 e-mail: office@agilrom.ro

Russian Federation
LAVERNA Group
 Phone: 7 495 482 2001
 Fax: 7 495 482 3009
 e-mail: petrurk@lab.comcor.ru

Saudi Arabia
K.I. ABDULKADIR &
PARTNERS CO. LTD.
 Phone: +966 2 640 5906
 Fax: +966 2 640 4710
 e-mail: vasudevan.arimbra@kiaksa.com

LabGulf FZC
 Phone: 971 6 557 4922
 Fax: 971 6 557 4923
 e-mail: info@labgulf.com

Scotland
Thames Restek UK LTD
 Phone: 1494 563377
 Fax: 1494 564990
 e-mail: sales@thamesrestek.co.uk

Serbia
Millitest d.o.o.
 Phone: 00381 11 30 48 237
 Fax: 00381 11 34 72 636
 e-mail: mila.komaric@millitest.com

Singapore
CEMS Marketing PTE Ltd.
 Phone: (65)-6786-3559
 Fax: (65)-6786-5598
 e-mail: cems.marketing@pacific.net.sg

Sintech Scientific (SEA) PTE Ltd.
 Phone: (65)-6779-0007
 Fax: (65)-6872-2392
 e-mail: jonathan@sintechscientific.com

Slovakia
Chromservis WAFY s.r.o.
 Phone: +421 (0)2 44630377-9
 Fax: +421 (0)2 44681183
 e-mail: bratislava@chromservis.sk

C.E. Instruments (Thailand)
Co., Ltd.
 Phone: 66 2 9658971-3
 Fax: 66 2 9658974
 e-mail: wisut@cethailand.com

Trinidad & Tobago
Tecno-Center, C.A.
 Phone: 58 243 242 3553
 Fax: 58 243 241 7674
 e-mail: gmoraga@cantv.net

Tunisia
ITTEC LAB / HTDS TUNISIA
 Phone: 70 836528
 Fax: 70 836561
 e-mail: ittec_lab@gnet.tn

Slovenia
MIKRO + POLO d.o.o.
 Phone: +386(0)2 6143 365
 Fax: +386(0)2 6143 320
 e-mail: info@mikro-polo.si

South Africa
Chromspec
 Phone: +27 11 7082086
 Fax: +27 11 7082431
 e-mail: chromspec@icon.co.za

South Korea
Dong Il Shimadzu Corp
 Phone: +82-2-3218-7850
 Fax: +82-2-541-2163
 e-mail: utsong@e-shimadzu.co.kr

Young In Frontier Co., Ltd.
 Phone: 82-2-2140-3300
 Fax: 82-2-2140-3310
 e-mail: yift@younginfrontier.com

Spain
Teknokroma S.
Coop C. Ltda
 Phone: +34 936 748 800
 Fax: +34 936 752 405
 e-mail: comercial@teknokroma.es

Sweden
Dalco Chromtech
 Phone: +46-(0)8-5949 6969
 Fax: +46-(0)8-5949 6968
 e-mail: info@dalcochromtech.se

Switzerland
BGB Analytik AG
 Phone: +41 (0) 61 991 00 46
 Fax: +41 (0) 61 991 00 25
 e-mail: sales@bgb-analytik.com

Taiwan
EHong Instruments co., Ltd
 Phone: 886 227 5522 66
 Fax: 886 227 0776 93
 e-mail: aid@ehong.com.tw

Scientific Hightek Co. Ltd.
 Phone: 886-2-2652-2200
 Fax: 886-2-2653-0022
 e-mail: support@gcl.com.tw

Thailand
C.E. Combination Co., Ltd.
 Phone: +66 2 527 7635 - 7
 Fax: +66 2 527 7638
 e-mail: sales@cecombination.com

Turkey
SEM Endustri A.S.
 Phone: +90 216 325 78 36 PBX
 Fax: +90 216 325 16 24
 e-mail: sales@semilab.com.tr

Ukraine
ALT-Europe Ltd
 Phone/Fax: +38 (044) 492 72 70
 e-mail: rotar@alt-europe.com.ua

United Arab Emirates
LabGulf FZC
 Phone: 971 6 557 4922
 Fax: 971 6 557 4923
 e-mail: info@labgulf.com

Nahla Medical Supplies
 Phone: 971 2 6764975
 Fax: 971 2 6762199
 e-mail: suhas@nahlamed.ae

United Kingdom
Thames Restek UK LTD
 Phone: 01494 563377
 Fax: 01494 564990
 e-mail: sales@thamesrestek.co.uk

Uruguay
DEXIN - Grupo Quimico SRL
 Phone: (+598 2) 507-6058
 Fax: (+598 2) 507-0155
 e-mail: ventas@dexin.com.uy

Venezuela
Tecno-Center, C.A.
 Phone: 58 243 242 3553
 Fax: 58 243 241 7674
 e-mail: gmoraga@cantv.net

Vietnam
Stepro Co. Ltd.
 Phone: 84 4 8513731
 Fax: 84 4 5118391
 e-mail: stepro@fpt.vn

Yemen
Hurab Medical Corporation
 Phone: +967 (01) 226 786
 Fax: +967 (01) 233 845
 e-mail: hurab@y.net.ye

LabGulf FZC
 Phone: 971 6 557 4922
 Fax: 971 6 557 4923
 e-mail: info@labgulf.com

Selecting a GC Column



Top: Jess Andrus, GC Column
Manufacturing Technician



Bottom: Raymond Ciampichini, GC Column
Manufacturing Manager

Selecting a GC Column

Capillary column selection can be a challenging task for many chromatographers. Several simple principles can be kept in mind to simplify the selection process and result in the optimum column for the analytical task at hand. Keep in mind that in selecting the proper capillary column, the chromatographer is faced with many options that require informed decisions when optimizing analysis speed, retention or capacity, and resolution. These three analysis goals are affected by several factors or variables contained in the resolution equation:

$$R = \frac{1}{4} \sqrt{\frac{L}{H}} \times \frac{k}{k+1} \times \frac{\alpha-1}{\alpha}$$

↑ ↑ ↑
Efficiency Retention Selectivity

R=resolution; L=column length; H=height equivalent to theoretical plate (HETP); k=retention factor; α=selectivity

The resolution equation is divided roughly into three sections consisting of variables affecting selectivity, efficiency, and capacity or retention. Looking at how each section of the resolution equation influences the analytical separation will make column selection less difficult.



Research & Development Group

Steve Allison, Lisa Pantzar, Jarl Snider, Mike Wittrig, Donald Rhoads, Valerie Strohm, Doug Smith, Jack Cochran

Our goal is to develop products that will help solve analytical challenges, while making both chemists and laboratories more efficient. If you have a difficult separation, call us—we can help!

Selectivity, α

The selectivity of the capillary column is directly related to how the analyte molecule interacts with the stationary phase being considered. If the analyte strongly interacts with the stationary phase, it can be said that strong “intermolecular” forces exist. These intermolecular forces of attraction of the analyte for the stationary phase are a function of the structure of both the analyte molecule and the stationary phase. If these two structures are similar, then these attractive forces for one another are strong. If they are weak, then analyte to stationary phase attraction is weak, and retention is less. Therefore, when selecting a stationary phase, knowledge of the structure of the analytes of interest and the stationary phase is crucial. Table II provides the chemical structure of Restek’s most common stationary phases.

An example of selectivity can be shown using benzene and butanol (both have nearly the same boiling point) eluting through the 20% diphenyl/80% dimethyl polysiloxane stationary phase (Rtx®-20). The benzene molecule will dissolve into the stationary phase more readily than the butanol based on the concept that “likes dissolve likes”. Benzene solvates more readily with the stationary phase results in more interactions with the stationary phase as it elutes through the column. Therefore, the elution order of these two compounds on the Rtx®-20 stationary phase will be butanol first and benzene second.

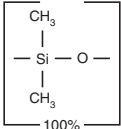
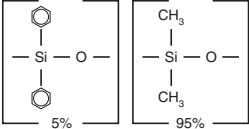
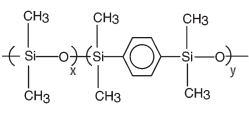
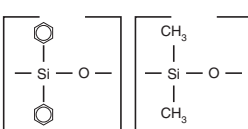
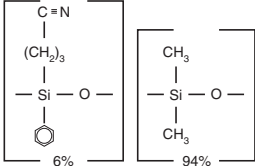
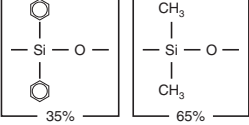
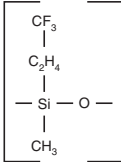
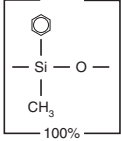
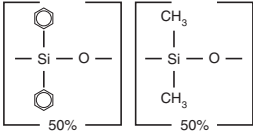
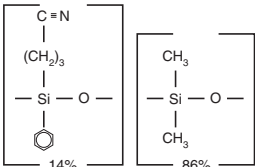
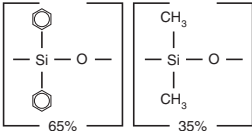
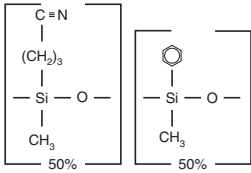
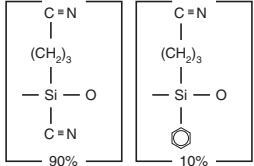
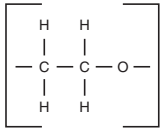
As methyl groups are replaced by different functionalities such as phenyl or cyanopropyl pendant groups, the selectivity of the column shifts towards compounds that will have a better solubility in the stationary phase. For example the Rtx®-200 stationary phase provides high selectivity for analytes containing lone pair electrons, such as halogens, nitrogen, or carbonyl groups. Polyethylene glycol columns, such as the Stabilwax® and Rtx®-Wax columns are highly selective towards polar compounds such as alcohols. Again using the example above, the butanol will more readily solvates into the polyethylene glycol stationary phase; therefore, the butanol will have more interaction with the phase and elute after benzene.

Table I lists the Kovats retention indices for the stationary phases in Table II. Assigning a retention index to each probe listed provides a basis for comparing several stationary phases and their relative retention to one another for a set of molecular probes. For example, when Kovats indices are identical on two column phases, then the resulting separations will be identical. If, however, a Kovats value of one probe varies significantly from the value on another phase for the same probe, then the resulting compound elution order will differ. Thus, the Kovats indices are useful for comparing selectivity of different types of compounds among different phases.

Table I Retention indices for Restek phases

Phase	Benzene	Butanol	Pentanone	Nitropropane
Rtx-1	651	651	667	705
Rtx-5/Rtx-5MS	667	667	689	743
Rtx-20	711	704	740	820
Rtx-1301/Rtx-624	689	729	739	816
Rtx-35	746	733	773	867
Rtx-200	738	758	884	980
Rtx-50	778	769	813	921
Rtx-1701	721	778	784	881
Rtx-65TG	794	779	825	938
Rtx-225	847	937	958	958
Stabilwax	963	1158	998	1230

Table II Structures, polarities, properties, and uses for Restek capillary column phases, in order of increasing polarity

Rxi®-1ms, Rtx®-1, Rtx®-1MS 100% dimethyl polysiloxane  Polarity: non-polar Uses: solvents, petroleum products, pharmaceutical samples, waxes [G1]	Rxi®-5ms, Rtx®-5, Rtx®-5MS 5% diphenyl 95% dimethyl polysiloxane  Polarity: slightly polar Uses: flavors, environmental, aromatic hydrocarbons [G27]	Rxi®-5Sil MS, Rtx®-5Sil MS proprietary  Polarity: slightly polar Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons	Rtx®-20 20% diphenyl 80% dimethyl polysiloxane  Polarity: slightly polar Uses: volatile compounds, alcohols [G32]
Rtx®-1301, Rtx®-624, Rtx®-G43 6% cyanopropylphenyl 94% dimethyl polysiloxane  Polarity: slightly polar Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products [G43]	Rtx®-35 35% diphenyl 65% dimethyl polysiloxane  Polarity: intermediately polar Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides [G42]	Rtx®-200 trifluoropropylmethyl polysiloxane  Polarity: selective for lone pair electrons Uses: environmental, solvents, Freon® gases, drugs, ketones, alcohols [G6]	Rtx®-50 100% methylphenyl polysiloxane  Polarity: intermediately polar Uses: FAMES, carbohydrates [G3]
Rxi®-17 50% diphenyl 50% dimethyl polysiloxane  Polarity: intermediately polar Uses: triglycerides, phthalate esters, steroids, phenols [G3]	Rtx®-1701 14% cyanopropylphenyl 86% dimethyl polysiloxane  Polarity: intermediately polar Uses: pesticides, Aroclor PCBs, alcohols, oxygenates [G46]	Rtx®-65TG 65% diphenyl 35% dimethyl polysiloxane  Polarity: intermediately polar Uses: triglycerides, rosin acids, free fatty acids	Rtx®-225 50% cyanopropylmethyl 50% phenylmethyl polysiloxane  Polarity: polar Uses: FAMES, carbohydrates [G7]
Rt™-2330 90% biscyanopropyl 10% cyanopropylphenyl polysiloxane  Polarity: polar Uses: cis/trans FAMES, dioxin isomers, rosin acids [G48]	Stabilwax®, Rtx®-Wax Carbowax® PEG  Polarity: polar Uses: FAMES, flavors, acids, amines, solvents, xylene isomers [G16]	ordering note Designations in [brackets] are USP codes. We recommend this phase when your application calls for this code.	

Retention, k

The capacity of the column relates to how much material a column can chromatograph without adversely affecting peak shape. If the amount of a compound (mass) exceeds the capacity of a wall coated open tubular column (WCOT), the peak will front, i.e., the column will exhibit peak symmetry of less than 1, a characteristic “shark fin” shaped peak. The goal is to select a column with sufficient capacity that peak shape will not suffer.

There are two primary column-related dimensions that affect capacity, assuming we have selected the proper column phase: column internal diameter (ID), and the phase film thickness (μ).

When selecting column ID, consideration should include the type of injection, the detector being used, and the concentration of sample (amount on-column). The injection technique is an important consideration because the ID of the column may need to be selected based on whether a split, splitless, cool on-column injection, or other sample transfer to the column is being used. The second consideration is how much flow the detector can optimally work under. For example, some MS detectors can only handle column flow up to 1.5mL/min.; therefore, a 0.53mm ID column, which requires higher flows for proper chromatography, is not an option for this detector. The third consideration is sample capacity. If the concentration of the sample exceeds the column capacity, loss of resolution, poor reproducibility, and peak distortion will result. Table III shows several typical column characteristics.

Film thickness (μ) has a direct effect on the retention and elution temperature for each sample component. Extremely volatile compounds should be analyzed on thick-film columns to increase the time the compounds spend in the stationary phase, allowing them to separate. High molecular weight compounds must be analyzed on thinner film columns. This reduces the length of time the analytes stay in the column, and minimizes bleed at required higher elution temperatures. Film thickness also affects the amount of material that can be injected onto the column without overloading. A thicker film column can be used for higher concentration samples.

Table III Typical column characteristics

Characteristic	Column ID				
	0.10mm	0.18mm	0.25mm	0.32mm	0.53mm
Helium Flow (@ 20cm/sec.)	0.05mL/min.	0.3mL/min.	0.7mL/min.	1.2mL/min.	2.6mL/min.
Hydrogen Flow (@ 40cm/sec.)	0.09mL/min.	0.6mL/min.	1.4mL/min.	2.4mL/min.	5.2mL/min.
Sample Capacity (max load per component)	<10ng	<50ng	50–100ng	400–500ng	1000–2000ng
Theoretical Plates/Meter	8000	3700	2700	2100	1300

Efficiency, N

Column efficiency (N) is the column length divided by the height equivalent to a theoretical plate (HETP). The effective theoretical plates are affected by how well the phase has been coated onto the column walls and is measured by how narrow the peaks are when they are eluted at the end of the column. Therefore, the higher the column efficiency (N), the better resolution power the column will have.

Capillary columns are made in various lengths, typically in standard lengths of 10, 15, 30, 60, and 105 meters. Longer columns provide more resolving power, but increase analysis time. Doubling the column length increases resolution by approximately 41% (note: the column length is under the square root function). However, under isothermal conditions, it will double analysis time. In temperature-programmed analyses, retention times are more dependent on temperature than column length, with a marginal increase (approx. 10–20%) in analysis time upon doubling the column length.

did you know?

Restek On-The-Road training seminars are full-day courses presented in an engaging multimedia format. They are equally valuable to beginning chromatographers, those who have moderate experience and want a better understanding of the subject matter, and those interested in the “best practices” and latest technologies. **No sales pitch is presented**, just the facts on how to make your chromatography results better. The bulk of each course is lecture, but numerous demonstrations and problem-solving exercises facilitate and reinforce the understanding of important principles. See www.restek.com/seminars for more information.

What Are the Operating Temperatures for My Column?

All Restek columns have published minimum and maximum operating temperatures that establish the working range for the stationary phase. Note that these ranges vary with the thickness of the coating.

Rtx®-VMS (fused silica)

ID	df (μm)	temp. limits
0.25mm	1.40	-40 to 240/260°C
0.32mm	1.80	-40 to 240/260°C
0.45mm	2.55	-40 to 240/260°C
0.53mm	3.00	-40 to 240/260°C

Many phases list 2 maximum operating temperatures. The first temperature is the maximum isothermal operating temperature. This is the temperature to which the columns are guaranteed to meet the minimum bleed specification (i.e., lowest bleed level). The second temperature is the maximum temperature-programmed operating temperature, the temperature to which the column can be heated for short periods of time (i.e., during a temperature-programmed analysis). The maximum isothermal operating temperature usually is 10–20°C lower than the temperature-programmed temperature. If only one temperature is listed, it is both the isothermal and the maximum temperature.

The minimum operating temperature defines the lowest usable temperature before the stationary phase solidifies. Operating the column below the minimum temperature will not harm the phase, but poor peak shape and other chromatography problems may occur.

Selection of Capillary Column Summary

Selecting the proper column for an analysis can be done by utilizing the resources available. This includes the following steps:

1) Choose proper phase

- Review the application section of this catalog or www.restek.com for similar compound list.
- Call Restek's experienced technical support team (800-356-1688, ext. 4) or e-mail us at:
 - support@restek.com (in the USA)
 - intltechsupp@restek.com (international)
 - or contact your Restek representative.

2) Select column ID, film thickness, and length

- Base consideration on:
 - Injection technique (split, splitless, cool on-column, etc.)
 - Detector type (is higher flow required?)
 - Amount of analyte being injected onto column (sample capacity)

3) Set optimum parameters for your analysis

- Optimize column flow (mL/min.)
- Choose appropriate carrier gas (hydrogen, helium, or nitrogen)
- Optimize oven temperature program



need more help?

- Call 800-356-1688 or 814-353-1300, ext. 4, or your Restek representative.
- Visit www.restek.com
- Email (U.S.): support@restek.com
Email (outside U.S.): intltechsupp@restek.com

Column Cross-References

Columns by Phase

Restek	Phase Composition	USP Nomenclature*	Agilent	Varian	SGE	Phenomenex	Macherey-Nagel	Supelco	Alltech	Quadrex
Rtx-1 (p. 33)	100% dimethyl polysiloxane	G1, G2, G38	HP-1 / DB-1	CP Sil 5 CB	BP-1	ZB-1	Optima-1	SPB-1	AT-1	007-1
Rxi-1ms (p. 26)	100% dimethyl polysiloxane (low bleed)		HP-1/ HP-1ms DB-1/ DB-1ms Ultra-1	VF-1ms / CP-Sil 5 CB Low Bleed/MS		ZB-1ms	Optima-1/ Optima-1ms	SPB-1, Equity-1	AT-1	007-1
Rtx-5 (p. 34,62)	5% diphenyl 95% dimethyl polysiloxane	G27, G36	HP-5/ DB-5	CP-Sil 8 / CP Sil 8 CB	BP-5	ZB-5	Optima-5	SPB-5	AT-5	007-2
Rxi-5ms (p. 27)	5% diphenyl 95% dimethyl polysiloxane (low bleed)		HP-5/ HP-5ms DB-5, Ultra-2					SPB-5, Equity-5	AT-5ms	007-2
Rxi-5Sil MS (p. 28,64,74)	5% phenyl arylene 95% dimethyl polysiloxane		DB-5ms	VF-5ms / CP-Sil 8 CB Low Bleed/MS	BPX-5	ZB-5ms	Optima-5ms	MDN-12		
Rxi-XLB (p. 30,71)	Arylene/methyl modified polysiloxane		DB-XLB	VF-XMS						
Rtx-20 (p. 35)	20% diphenyl 80% dimethyl polysiloxane	G28, G32						SPB-20, VOCOL	AT-20	007-7
Rtx-35 (p. 35)	35% diphenyl 65% dimethyl polysiloxane	G42	HP-35, DB-35, HP35-MS	VF-35ms	BPX-35, BPX-608	ZB-35		SPB-35, SPB-608	AT-35, AT-35MS	007-11
Rtx-50 (p. 36)	100% phenyl methyl polysiloxane (50% phenyl)	G3	HP-50		AT-50		Optima-17	SPB-50	AT-50	007-17
Rxi-17 (p. 31)	50% diphenyl 50% dimethyl polysiloxane		HP-17, DB-17	CP-Sil 24 CB / VF-17ms		ZB-50				
Rtx-65 (p. 36)	65% diphenyl 35% dimethyl polysiloxane	G17								400-65HT, 007-65HT
Restek	Phase Composition	USP Nomenclature	Agilent	Varian	SGE	Phenomenex	Macherey-Nagel	Supelco	Alltech	Quadrex
Rtx-1301 (p. 39,60) Rtx-624 (p. 39,60,77)	6% cyanopropyl phenyl 94% dimethyl polysiloxane	G43	HP-1301, HP-624, DB-1301, DB-624	CP-1301, VF-1301ms, VF-624ms	BP-624	ZB-624	Optima-1301, Optima-624	SPB-1301	AT-624	007-1301
Rtx-1701 (p. 40)	14% cyanopropyl phenyl 86% dimethyl polysiloxane	G46	HP-1701, PAS- 1701, DB-1701	CP Sil 19 CB, VF-1701ms	BP-10	ZB-1701, ZB-1701P	Optima-1701	SPB-1701	AT-1701	007-1701
Rtx-200 (p. 38)	trifluoropropyl methyl polysiloxane	G6	DB-210, DB-200	VF-200ms			Optima-210		AT-210	007-210
Rtx-200MS (p. 38)	trifluoropropyl methyl polysiloxane (low bleed)			VF-200ms						
Rtx-225	50% cyanopropyl 50% phenylmethyl polysiloxane	G7, G19	HP-225, DB-225	CP Sil 43 CB	BP-225		Optima-225		AT-225	007-225
Rtx-440 (p. 37)	modified polysiloxane (unique phase)		unique column							
Rt-2330 (p. 41)	90% biscyanopropyl 10% cyanopropyl phenyl polysiloxane	G48			BPX-70			SP-2330, SP-2331, SP-2380	AT-Silar	
Rt-2560 (p. 41)	bicyanopropyl polysiloxane		HP-88	CP Sil 88				SP-2560		
Stx-500	phenyl carborane-siloxane				HT-5					
Rtx-Wax (p. 42)	polyethylene glycol	G14, G15, G16, G20, G39	HP-Wax, DB-Wax	CP Wax 52 CB	BP-20	ZB-Wax	Optima Wax		AT-Wax	
Stabilwax (p. 43,61)	polyethylene glycol	G14, G15, G16, G20, G39	Innowax	CP Wax 52 CB				Supelcowax-10		
Restek	Phase Composition	USP Nomenclature	Agilent	Varian	SGE	Phenomenex	Macherey-Nagel	Supelco	Alltech	Quadrex
Rt-Alumina (p. 80,81)	Na ₂ SO ₄ deactivation		GS-Alumina, HP PLOT S	CP-AL203 / Na ₂ SO ₄				Alumina-PLOT	AT-Alumina	
Rt-Msieve 5A (p. 82)			GS-Msieve, HP PLOT Molsieve	CP-Molsieve 5A				Molsieve 5A	AT-Molsieve	PLT-5A
Rt-QS-BOND (p. 83)			GS-Q							
Rt-QPLOT (p. 83)				CP-PoraPLOT Q, CP-PoraBond Q				Supel-Q-PLOT	AT-Q	
Rt-SPLIT (p. 83)				CP-PoraPLOT S				Supel-G45		
Rt-UPLOT (p. 83)			HP-PLOT U	CP-PoraPLOT U, CP-PoraBond U				Supel-N PLOT		

Columns by Application

Restek	Applications	Agilent	Supelco	Macherey-Nagel	SGE	Varian	Phenomenex
Specially deactivated phases							
Rtx-5Amine (p. 45)	Amines					CP-Sil 8 CB	
Rtx-35Amine (p. 46)	Amines	unique column					
Stabilwax-DB (p. 47)	Amines	CAM	Carbowax Amine			CP WAX 51	
Stabilwax-DA (p. 48)	Free acids	HP-FFAP, DB-FFAP	Nukol	Permabond FFAP, Optima FFAP	BP-21	CP WAX 58 CB	
Chiral Columns							
Rt-βDEXm (p. 49)	Chiral						
Rt-βDEXsm (p. 49)	Chiral						
Rt-βDEXse (p. 49)	Chiral						
Rt-βDEXsp (p. 49)	Chiral						
Rt-βDEXsa (p. 49)	Chiral						
Rt-βDEXcst (p. 49)	Chiral						
Rt-γDEXsa (p. 49)	Chiral						
Foods, Flavors, & Fragrances							
FAMEWAX (p. 51)	Marine oils		Omegawax				
Rt-CW20M F&F (p. 51)	Flavors & fragrance	HP-20m, CarboWax 20			BP-20M	007-CW	
Rtx-1 F&F (p. 52)	Flavors & fragrance						
Rtx-65 TG (p. 53)	Triglycerides	unique column					
Petroleum							
Rtx-1PONA (p. 54)	Detailed hydrocarbon analysis	HP-PONA, DB-Petro	Petrocol DH		BP1-PONA	CP Sil PONA CB	
Rtx-2887 (p. 55)	Hydrocarbons - ASTM 2887	DB-2887	Petrocol 2887, Petrocol EX2887				
MXT-2887 (p. 55,88)	Hydrocarbons - ASTM 2887						
D3606	Ethanol - ASTM 3606	unique column					
Rt-TCEP (p. 57)			TCEP			CP-TCEP	
MXT-1 Sim Dist (p. 56,89)	Simulated distillation	DBHT-SMD				CP-SIMDIST	
MXT-500 (p. 56,89)	Simulated distillation	unique column					
Rtx-Biodiesel TG (p. 58)	Triglycerides in biodiesel	unique column					
MXT-Biodiesel TG (p. 58,88)							
Clinical/Forensic - Blood Alcohol Testing							
Rtx-BAC1 (p. 59)	Blood alcohol testing	DB-ALC1					
Rtx-BAC2 (p. 59)	Blood alcohol testing	DB-ALC2					
Pharmaceutical							
Rtx-G27 w/IntegraGuard (p. 19,63)	Organic volatile impurities (OVI) - USP 467						
Rtx-G43 w/IntegraGuard (p. 19,63)	Organic volatile impurities (OVI) - USP 467		OVI-G43				
Rtx-1301 (p. 39,60)	Organic volatile impurities (OVI) - USP 467	HP-1301, HP-624, DB-1301, DB-624	SPB-1301		BP-624	CP-1301, VF-1301ms, VF-624	ZB-624
Rtx-624 (p. 39,60,77) (G43)							
Rtx-5 (p. 34,62) (G27)	Organic volatile impurities (OVI) - USP 467	HP-5/ DB-5	SPB-5, Equity-5	Optima-1301, Optima-624	BP-5	CP-Sil 8, CP Sil 8 CB	ZB-5
Stabilwax (p. 43,61) (G16)	Organic volatile impurities (OVI) - USP 467	Innowax	Supelcowax-10		BP-624	CP Wax 52 CB	
Environmental							
Rxi-5Sil MS (p. 28,64,74)	Semivolatiles - EPA Methods 8270, 625, 525	DB-5ms	SLB-5	Optima-5ms		VF-5ms	
Rtx-VMS (p. 75)	Volatiles - EPA Methods 8260, 624, 524	unique column					
Rtx-624 (p. 39,60,77)	Volatiles - EPA Method 624	HP-624, DB-624	SPB-1301	Optima-624		VF-1301ms	ZB-624
Rtx-502.2 (p. 76)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-502.2	VOCOL				
Rtx-VRX	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-VRX					
Rtx-VGC	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	unique column					
Rtx-CLPesticides (p. 66,67)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Rtx-CLPesticides2 (p. 66,67)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Stx-CLPesticides (p. 68,69)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Stx-CLPesticides2 (p. 68,69)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Rtx-PCB (p. 70)	Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners	unique column					
Rxi-XLB (p. 30,71)	Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners	DB-XLB				VF-XMS	
Rtx-OPPesticides (p. 65)	Organophosphorus pesticides - EPA Method 8141	unique column					
Rtx-OPPesticides2 (p. 65)	Organophosphorus pesticides - EPA Method 8141	unique column					
Rtx-Dioxin2 (p. 73)	Dioxin & Furans - EPA Methods	unique column					
Rtx-Dioxin (p. 72)	Dioxin & Furans - EPA Methods	unique column					
Rt-PAH	Polycyclic aromatic hydrocarbons	unique column					
Rtx-TNT & Rtx-TNT2	Explosives - EPA Method 8095	unique column					

GC Column Installation Checklist

The Restek Innovations and Technical Services specialists have found this to be a reliable sequence for avoiding problems when installing a capillary GC column.

Instrument Preparation & Column Installation

1. Cool all heated zones.
2. Visually inspect indicating oxygen and moisture traps. Replace saturated traps.
3. Examine the inlet and the detector. Clean or replace all dirty or corroded parts.
4. Replace the inlet liner and septum, and the injector seals (o-rings, inlet seals, ferrules, etc.).
5. Mount the column in the oven with a support that protects it from scratches. Center the column in the oven. This ensures uniform heat exposure generating consistent retention times.
 - Restek has two types of cages for fused silica columns, an 11-pin cage and the original cage that uses high temperature string to hold the column in place. **If you have the cage with high temperature string, do not remove the string that holds the column in the cage!**
6. Uncoil the ends to make sure the ends are long enough to reach the injector and detector. Cut 10cm from each end of the column.
 - To cut a fused silica column, use the smooth edge of a ceramic scoring wafer (cat.# 20116).
7. While pointing the inlet end of the column downward (to prevent shards from falling into the column), slide the nut and appropriate size ferrule onto the inlet end of the column. Cut an additional 2cm from the end of the column to remove any material scraped from the ferrule onto the edge of the column.
8. Install the column the appropriate distance in the injector, as indicated in your instrument manual.
9. Set the carrier gas to the flow rate or inlet pressure recommended for the column or to your method flow rate/pressure. Confirm presence of column flow by immersing the column outlet in a vial of solvent.
10. Flush the column at ambient temperature with carrier gas: at least 5 minutes for a 25-30m column and 10 minutes for a 50-60m column.
11. Set the injector temperatures. Do not exceed the column's maximum operating temperature (listed on the column tag). Check inlet for leaks.
12. Install the column into the detector as described in the instrument manual. Set the detector gases and temperatures to proper settings.
13. Check the detection connections for leaks, using a thermal conductivity leak detector (cat.# 22839).
14. Verify the carrier gas flow is at the rate you intend to use for your analysis. Set the split vent, septum purge, and any other applicable gas rates as appropriate.
15. Inject an unretained compound, to verify the column is installed correctly and to determine the dead volume time for checking column flow. A symmetric peak indicates the column is installed correctly. Adjust the carrier gas flow as necessary.
16. Condition the column 20°C above the final analysis temperature of your method. Do not exceed the column's maximum operating temperature. For most applications, 1 hour of conditioning is sufficient. For sensitive detectors or low level analysis, longer conditioning times or conditioning the column at the maximum temperature may be beneficial. Extended time at high temperatures will not adversely affect column performance as long as precautions are taken to make sure the carrier gas is clean and is filtered for oxygen and water.
17. To check for instrument performance, analyze a column test mix for a new method, or a known standard to confirm proper column and system performance.
18. Your GC system is now ready to be calibrated and acquire samples.

Note 1: For some types of sensitive detection systems, like MS, PID, and PDD, it is recommended to condition the column as listed in Step 16 without making the connection to the detector. In this case, plug off the detector during conditioning. After conditioning, continue with Step 12.

Note 2: Also when you intend to condition thick-film coated columns (film thickness > 1µm) at temperatures near the maximum operation temperature, it is recommended to do the initial 1-2 hrs conditioning without a connection to the detector and repeat procedure above, starting at Step 12.

Standby Conditions

Short-Term: Leave the column in the GC with the carrier gas flow on at an oven temperature of 100-150°C.

Long-Term: Remove the column from the GC and seal the ends by gently and carefully pushing each end into the curved edge of a septum. Store the column in the original box away from strong lighting.

If you have any questions or problems installing a Restek column, visit www.restek.com/guide_cap.asp, call Technical Service at 800-356-1688 or 814-353-1300, ext. 4, or contact your Restek representative.

Guard Columns and Retention Gaps

Guard columns and retention gaps are widely used in gas chromatography. The concept of the guard column is to trap nonvolatile material at the head of the column, not allowing the material to reach the analytical column. The concept of the retention gap is to help focus the compounds transferred from the inlet to a small band at the head of the analytical column in order to reduce chromatographic peak broadening. Both concepts (trapping nonvolatile material and refocusing the target analytes) may take place when a piece of deactivated tubing is connected to an analytical column as in Figure 1.

please note

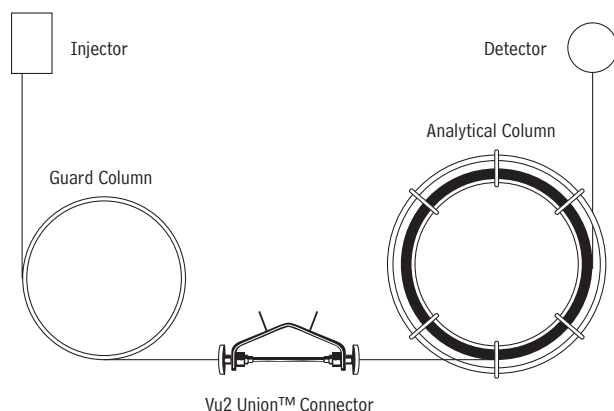
For superior inertness, try our Siltek® guard columns!

See [page 17](#) for details.

Having trouble making a leak-free connection? Try our “built in” Integra-Guard™ columns!

See [page 19](#) for details.

Figure 1 A guard column connected to an analytical column



Analyte Focusing

There are two injection techniques where the retention gap is used to help focus target analytes at the beginning of the analytical column, cool on-column injection and splitless injection.

For cool on-column injection, the use of a retention gap is to help focus the sample components when introducing a liquid sample directly into the retention gap. The cool on-column injection is performed by inserting the syringe needle into the retention gap (this can be accomplished with a 0.53mm ID retention gap and a 26s gauge syringe) and transferring the liquid sample directly into the retention gap. The injection is made with the injector and column oven set below the boiling point of the solvent. As the solvent is evaporated, the volatile target analytes migrate in the solvent towards the analytical column, and the heavier analytes will be distributed over the retention gap. As the oven temperature increases, the target analytes vaporize and move unretained down the retention gap column until the compounds reach the liquid stationary phase of the analytical column. At this juncture, the target analytes are trapped/focused by the liquid phase forming a narrow injection band.

The retention gap may also be useful in hot vaporization injections when the transfer of the compounds from the inlet to the column does not form a focused band. Typical applications include water injections or injections using small ID columns, where split or tailing peaks would indicate an unfocused band. In these applications, the target analytes are trapped in a nonuniform or longitudinally diffuse band at the head of the retention gap (Figure 2a). As the oven temperature is increased, the solvent and target compounds are vaporized and move unretained through the retention gap (Figure 2b). When the target compounds come in contact with the stationary phase, they are refocused in a narrow band (Figure 2c), improving the chromatography.

Protecting the Analytical Column

The concept of a guard column is to protect the analytical column from becoming contaminated with nonvolatile compounds. The guard column is used to retain nonvolatile material, usually in the first 10-20cm, not allowing this material to elute onto the liquid phase of the analytical column. As the oven temperature increases, the more volatile target compounds vaporize, elute down the guard column, and refocus at the head of the analytical column without interference from the nonvolatile material.

did you know?

We test our guard columns/transfer lines with the Grob test mix to ensure high inertness.

Contamination can cause active sites as well as change the conditions of the focusing zone of the analytical column. Both conditions will adversely affect the chromatography. Another advantage of the guard column is when a section is trimmed for maintenance the resolution of closely eluting compounds will not be affected because the guard column is not a contributor to the resolving power of the analytical column. This allows for a longer lifetime of the analytical column, and replacing only the guard column when it becomes too short.



AJ Saclyn
Marketing Specialist

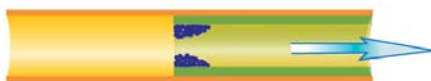
Figure 2 Retention gaps are used to focus components in a tight band at the beginning of the analytical column



a) Sample introduction: a liquid film of solvent and sample is deposited in the first length of capillary.



b) As oven temperature increases, the solvent evaporates and the target compounds elute unretained through the retention gap until they contact the analytical column.



c) When target compounds come in contact with the stationary phase, they are refocused on the analytical column, resulting in a narrow initial band width.

In summary, the retention gap and guard column are essentially the same products, but are used for different purposes. The deactivated tubing helps focus target analytes at the head of the analytical column for on-column and splitless injections, and also prevents nonvolatile material from contaminating the head of the analytical column.

What type of guard column should be used?

When using a guard column, it is important to match the polarity of the solvent and the polarity of the surface deactivation. Rxi® guard columns are good for a wide variety of applications and allows most common solvents (methylene chloride, hexane, isooctane, toluene) to easily wet and create a uniform film on the tubing surface. If more polar solvents such as methanol or water are used, a polar-deactivated guard column is recommended to allow the solvent to wet the tubing surface. Polar-deactivated guard columns are not resistant to harsh “water vaporization” that occurs when water in the liquid state is injected into the tubing and rapidly vaporizes (such as in steam cleaning). Hydroguard™ deactivation is an alternative for direct aqueous injections. However, a Hydroguard™-deactivated guard column will not allow polar solvents to wet the tubing surface, and may cause beading of the solvent if the oven temperature is 20°C below the solvent boiling point.

Siltek® deactivation creates a highly inert surface for very active compounds such as chlorinated pesticides. Base-deactivated guard columns reduce adsorption and tailing for amines and other basic compounds.

How is a guard column connected to the analytical column?

To connect the guard column to the analytical column, Vu2-Union™, Press-Tight®, and other connectors are available. MXT™ unions are available for connecting stainless steel MXT® columns and guard columns.



Vu2 Union™ Connector



Press-Tight® Connector



MXT™ Union
Connector Kit

it's a fact

To eliminate connections, use our unique Integra-Guard™ Column. See [page 19](#).

Rxi® Guard/Retention Gap Columns (Fused Silica)

- Extend column lifetime.
- Excellent inertness—obtain lower detection limits for active compounds.
- Sharper chromatographic peaks by utilizing retention gap technology.
- Maximum temperature: 360°C.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10029	10029-600	10059	10059-600
0.32mm	0.45 ± 0.04mm	10039	10039-600	10064	10064-600
0.53mm	0.69 ± 0.05mm	10054	10054-600	10073	10073-600

Intermediate-Polarity Deactivated Guard/Retention Gap Columns/Transfer Lines (Fused Silica)

Diameters greater than 0.10mm are tested with the Grob test mix, to ensure high inertness.

- Useful for a wide range of applications.
- Use with most common solvents.
- Maximum temperature: 325°C

Nominal ID	Nominal OD	1-Meter	5-Meter	5-Meter/6-pk.
0.025mm*	0.363 ± 0.012mm	10097		
0.05mm*	0.363 ± 0.012mm	10098	10040	10040-600
0.075mm*	0.363 ± 0.012mm	10099		
0.10mm*	0.363 ± 0.012mm	10100	10041	
0.15mm	0.363 ± 0.012mm	10101	10042	
0.18mm	0.37 ± 0.04mm	10102	10046	
0.25mm	0.37 ± 0.04mm		10043	10043-600
0.28mm	0.37 ± 0.04mm		10003	10003-600
0.32mm	0.45 ± 0.04mm		10044	10044-600
0.45mm	0.69 ± 0.04mm		10005	10005-600
0.53mm	0.69 ± 0.05mm		10045	10045-600

Nominal ID	Nominal OD	10-Meter	10-Meter/6-pk.	30-Meter**	60-Meter**†
0.25mm	0.37 ± 0.04mm	10049	10049-600	10012	10013
0.32mm	0.45 ± 0.04mm	10048	10048-600	10022	10023
0.53mm	0.69 ± 0.05mm	10047		10032	10033

Siltek®-Deactivated Guard/Retention Gap Columns/Transfer Lines (Fused Silica)

Tested with the Grob test mix, to ensure high inertness.

- Revolutionary deactivation process for superior inertness.
- Analyze active samples accurately; ideal for chlorinated pesticide analysis (reduces endrin breakdown to less than 1%).
- Maximum temperature: 380°C.

Nominal ID	Nominal OD	5-Meter	10-Meter
0.25mm	0.37 ± 0.04mm	10026	10036
0.32mm	0.45 ± 0.04mm	10027	10037

Polar-Deactivated Guard/Retention Gap Columns (Fused Silica)

Tested with the Grob test mix, to ensure high inertness.

- Polyethylene glycol deactivation layer provides optimum wettability for polar compounds.
- Minimize peak splitting when using polar solvents such as methanol or water.
- Compatible with Stabilwax®, Rtx®-225, and Rtx®-2330 capillary columns.
- Maximum temperature: 280°C.

Nominal ID	Nominal OD	5-Meter	10-Meter	30-Meter**	60-Meter**†
0.25mm	0.37 ± 0.04mm	10065	10068	10014	10015
0.32mm	0.45 ± 0.04mm	10066	10069	10024	10025
0.53mm	0.69 ± 0.05mm	10067	10070	10034	10035

*Not tested with the Grob test mix because of a large pressure drop.

**30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion.

it's a fact

To eliminate connections, use an Integra-Guard™ Column. See [page 19](#).

also available**MXT® Guard/Retention Gap Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 86](#) for our Intermediate-Polarity Deactivated MXT® Guard/Retention Gap Columns/Transfer Lines.

it's a fact**Use guard columns to:**

- Reduce effects of dirty samples on column performance.
- Reduce downtime and maintenance.

**did you know?**

Siltek®-deactivated guard columns minimize breakdown and improve recovery of analytes!



Chris English
Innovations Team
Manager
11+ years of service!

Base-Deactivated Guard/Retention Gap Columns (Fused Silica)

- Excellent inertness for basic compounds—tested with a basic amine test mix.
- Recommended for use with Rtx®-5 Amine, Rtx®-35 Amine, and Stabilwax®-DB capillary columns.
- Maximum temperature: 315°C.

Chemists using guard columns in analyses of basic compounds frequently observe peak tailing and low recovery. This happens because conventionally deactivated tubing surfaces can be adsorptive to basic compounds. Restek offers base-deactivated guard columns for completely inert sample pathways.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10000	10000-600
0.32mm	0.45 ± 0.04mm	10001	10001-600
0.53mm	0.69 ± 0.05mm	10002	10002-600

did you know?

We test our guard columns/transfer lines with the Grob test mix to ensure high inertness.

Hydroguard™ Water-Resistant Guard/Retention Gap Tubing/Transfer Lines (Fused Silica)

- Extend analytical column lifetime by preventing degradation by harsh “steam-cleaning” water injections.
- Maximum temperature: 325°C.

When transfer lines from purge & trap systems, air monitoring equipment, or other instruments carry condensed water vapor, deactivated column tubing quickly becomes active because of the creation of free silanol groups. These silanol groups adsorb active oxygenated compounds such as alcohols and diols.

Restek chemists have addressed this concern and found a solution—the Hydroguard™ deactivation process. A unique deactivation chemistry creates a high-density surface that is not readily attacked by aggressive hydrolysis. The high-density surface coverage of the Hydroguard™ deactivation layer effectively prevents water vapor from reaching the fused silica surface beneath. Use Hydroguard™ tubing for connecting GCs to:

- Purge & trap systems.
- Headspace analyzers.
- Air analysis equipment and concentrator units.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	30-Meter**	60-Meter**†
0.05mm*	0.363 ± 0.012mm	10075				
0.10mm*	0.363 ± 0.012mm	10076				
0.15mm	0.363 ± 0.012mm	10077				
0.18mm	0.37 ± 0.04mm	10078				
0.25mm	0.37 ± 0.04mm	10079	10079-600	10082	10085	10088
0.32mm	0.45 ± 0.04mm	10080	10080-600	10083	10086	10089
0.53mm	0.69 ± 0.05mm	10081	10081-600	10084	10087	10090

*Not tested with the Grob test mix because of a large pressure drop.

**30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion.

also available

MXT® Guard Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 86](#) for our Hydroguard™ MXT® Guard Tubing/Transfer Lines.

best choice

Siltek® treated tubing (cat. # 22505, www.restek.com) is recommended for purge and trap transfer lines.

Innovative Integra-Guard™ Columns

For analysts who find it inconvenient to make a leak-free connection between the guard column and the analytical column, we offer Integra-Guard™ columns. These innovative columns incorporate both the guard column and analytical column in a continuous length of tubing, eliminating the connection and all connection-associated problems! The guard column section is tied separately from the analytical column, using high-temperature string.

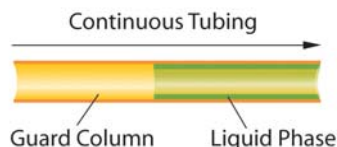
Our wide variety of Integra-Guard™ capillary columns are listed in the figure below. The Integra-Guard™ column is so economical that we challenge you to compare our price against that of a conventional connection, even if you assemble it yourself. If you are currently using a guard column, or are considering using one, call today and ask about Integra-Guard™ columns.

Ordering is simple. Just add the appropriate suffix number and price to the analytical column's catalog number and price. For example, a 30m, 0.25mm ID, 0.25μm Rtx®-5 column with a 5-meter Integra-Guard™ column is cat.# 10223-124.

restek
innovation!

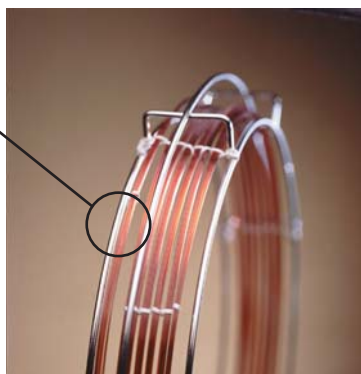
Integra-Guard™ Columns: guard columns WITHOUT connections—protecting your analytical column has never been this easy!

Integra-Guard™ built-in guard column



ID	Length	Suffix #
0.25mm	5m	-124
	10m	-127
0.32mm	5m	-125
	10m	-128
0.53mm	5m	-126
	10m	-129

Phases currently available as Integra-Guard™ columns



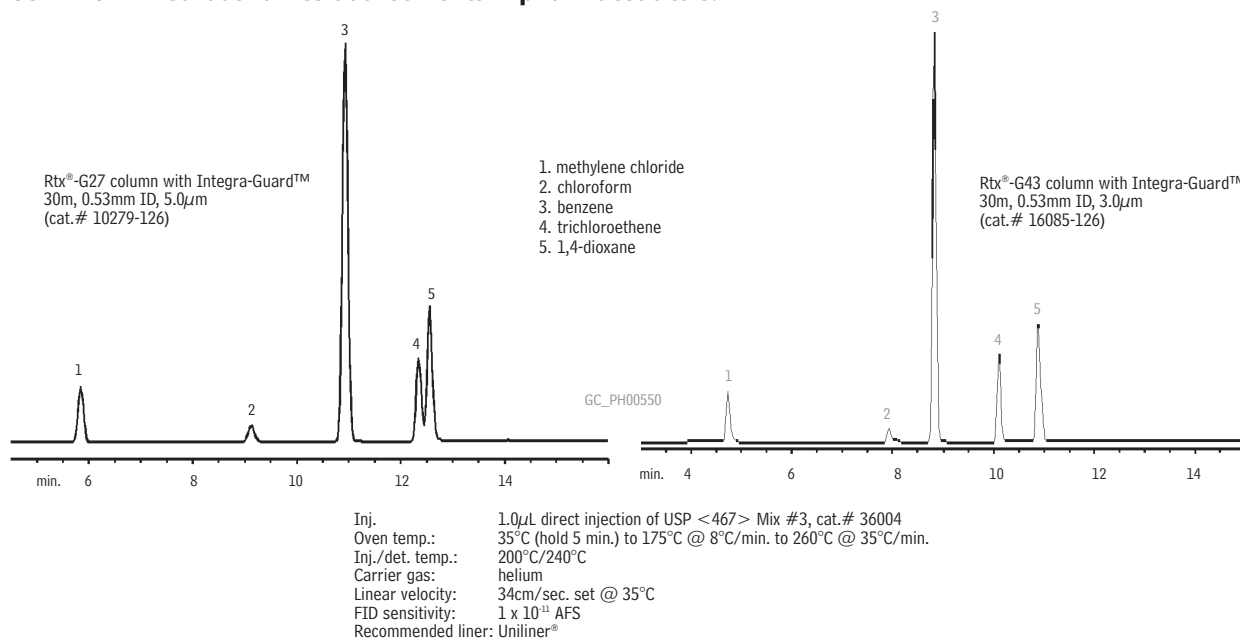
Rtx®-1
Rtx®-5
Rtx®-5MS
Rtx®-1301
Rtx®-624
Rtx®-1701
Rtx®-20
Rtx®-35
Rtx®-BAC 1 & 2
Stabilwax®

similar
products

DuraGuard, EZ-Guard,
Guardian

Integra-Guard™ columns are available for all phases listed, for columns with 0.25, 0.32, or 0.53mm ID and lengths to 75 meters.

An Rtx®-G27 or Rtx®-G43 column with a 5-meter Integra-Guard™ column meets the requirements of USP <467> methods for residual solvents in pharmaceuticals.



Columns for Fast GC Analysis and Comprehensive GC



Jaap de Zeeuw
International
GC Specialist

tech tip

Operating considerations for 0.10mm ID columns

The small degree of extra care involved in using 0.10mm ID columns will be more than repaid by faster analyses and higher column efficiencies. 0.10mm ID columns require higher operating pressures (>40psig), which can result in more ferrule leaks, septum leaks, and sample flashback through leaking syringe plungers. Connections must be monitored and leak-checked more often. Operating a 0.10mm ID column below optimum pressure will cause poor resolution and other poor performance. Sample capacity also is reduced, relative to wider-bore columns. Take care to not overload the column, and make sure you inject fast when using split injection.

Fast GC Using 0.10mm and 0.18mm ID Capillary Columns and Comprehensive GC

- Significantly reduces analysis time without sacrificing resolution.
- Highest column efficiencies, great for GC/MS.
- Excellent for comprehensive GC (GCxGC) as second dimension column.

Narrow bore (0.18mm ID) columns are attractive alternatives to conventional-diameter capillary columns because they provide faster analysis times and higher resolving power. As column ID decreases, column efficiency (plates/meter) greatly increases. For instance, a 0.18mm ID column (5,150 plates/meter) is 32% more efficient than a 0.25mm ID column (3,900 plates/meter). Therefore, resolution can be achieved with a shorter column, which decreases the analysis time. When switching from a 0.25mm ID column to a 0.10mm ID column (8,500 plates/meter) the column efficiency is improved dramatically (118%).

Typically, 0.18mm ID columns are used for fast GC analysis, and methods are easily converted. The 0.10mm ID columns require more research to switch methods to the smaller ID due to higher back pressures and lower column capacity.

The outer diameter of the 0.10mm and 0.18mm ID tubing is the same as 0.25mm ID tubing, which makes connections less complicated.

Rxi®-1ms Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	13301	
0.18mm	0.18	-60 to 330/350°C		13302

Rxi®-5ms Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	13401	
0.18mm	0.18	-60 to 330/350°C		13402
	0.30	-60 to 330/350°C		13409
	0.36	-60 to 330/350°C		13411

Rxi®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity similar to 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

Rxi®-17 Columns (fused silica)

(Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

ID	df (μm)	temp. limits	10-Meter
0.10mm	0.10	40 to 280/320°C	13501

Rtx®-Wax Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	20 to 250°C	41601	41602
	0.20	20 to 240/250°C	41603	41604

Rt™-LC50 Columns (fused silica)

ID	df (μm)	temp. limits	10-Meter
0.10mm	0.10	100°C to 270°C	19736
0.18mm	0.10	100°C to 270°C	19735

Rtx®-CLPesticides (fused silica)

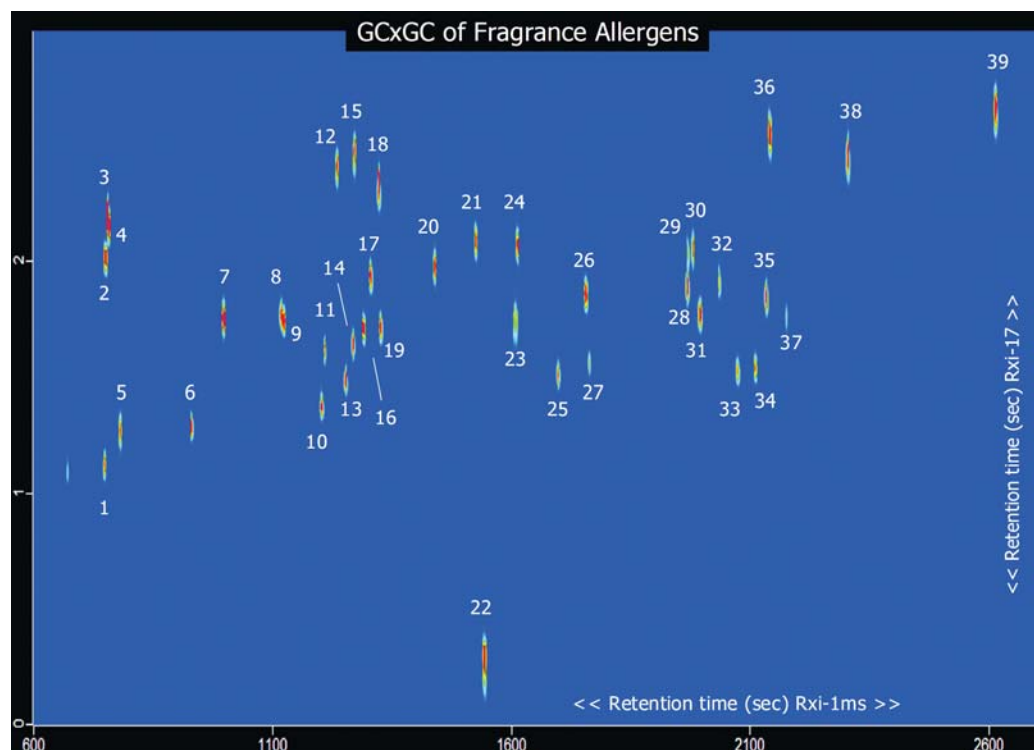
ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 310/330°C	43101	
0.18mm	0.18	-60 to 310/330°C	42101	42102

Rtx®-CLPesticides2 (fused silica)

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 310/330°C	43301	43302
0.18mm	0.14	-60 to 310/330°C	42301	42302

Fragrance Allergens

Rxi®-1ms & Rxi®-17 (GC x GC)



GC_FF01010

1. limonene
2. 1-fluoronaphthalene
3. benzyl alcohol
4. phenyl acetaldehyde
5. eucalyptol
6. linalool
7. camphor
8. methyl-2-octynoate
9. estragole
10. citronellol
11. citral 1
12. *trans*-cinnamaldehyde
13. geraniol
14. citral 2
15. anise alcohol
16. hydroxycitronellol
17. safrole
18. cinnamyl alcohol
19. methyl-2-nonynoate
20. eugenol
21. methyl eugenol
22. coumarin
23. hydroxycitronellol
24. contaminant
25. isoeugenol
26. α -isomethyl ionone 1
27. linal
28. α -isomethyl ionone 2
29. amyl cinnamal
30. lylal 1
31. lylal 2
32. amylcinnamyl alcohol 1
33. amylcinnamyl alcohol 2
34. farnesol 1
35. farnesol 2
36. hexyl cinnamal 1
37. hexyl cinnamal 2
38. benzyl salicylate
39. benzyl cinnamate

Columns: Rxi®-1ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13323)
 Rxi®-17, 1m, 0.10mm ID, 0.10 μ m (cat.# 13501)

Sample: fragrance allergens in MTBE

Instrument: LECO Corporation GCxGC/FID with quad-jet, dual-stage modulator and secondary oven

Inj.: 0.2 μ L split (split ratio 1:200),
 4mm laminar cup splitter (cat.# 20801)

Inj. temp.: 250°C

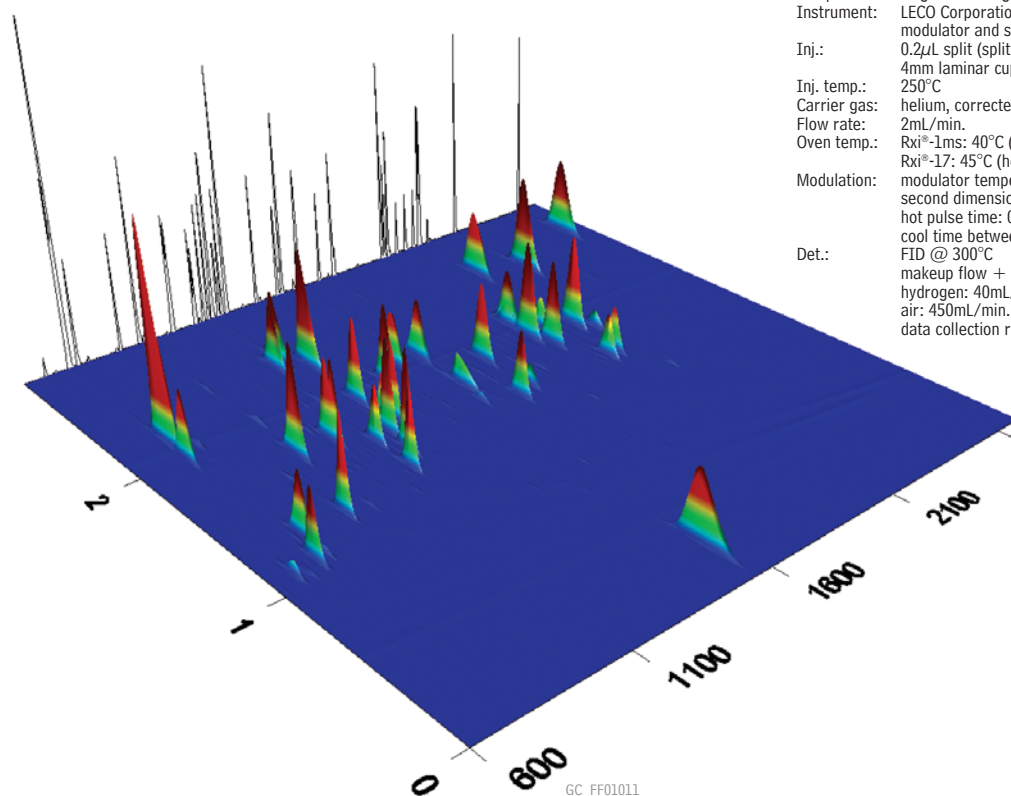
Carrier gas: helium, corrected constant flow via pressure ramps

Flow rate: 2mL/min.

Oven temp.: Rxi®-1ms: 40°C (hold 1 min.) to 240°C @ 4°C/min.
 Rxi®-17: 45°C (hold 1 min.) to 245°C @ 4°C/min.

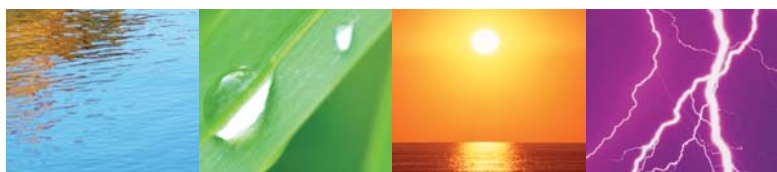
Modulation: modulator temperature offset 20°C
 second dimension separation time: 3 sec.
 hot pulse time: 0.8 sec.
 cool time between stages: 0.7 sec.

Det.: FID @ 300°C
 makeup flow + column flow: 50mL/min.
 hydrogen: 40mL/min.
 air: 450mL/min.
 data collection rate: 200 Hz



Rxi® Columns

Exceptionally Inert Capillary Columns



Unsurpassed inertness

An Rxi® column's inertness allows analysis of active compounds at levels not attainable with other manufacturers' columns. Basic and acidic compounds can be analyzed on the same column, often under the same conditions.

Ultra-low bleed

Save time and money through faster baseline stabilization. With the lowest column bleed in the industry, Rxi® columns improve detection for trace level GC/MS analysis. Ultra-low bleed also reduces conditioning time after instrument maintenance.

Guaranteed reproducibility

Consistency is everything. With Rxi® column technology, we guarantee it: every new column will perform exactly as the column it replaces.

Unmatched performance

Every Rxi® column is held to stringent performance specifications for coating efficiency, selectivity, film thickness, inertness, and bleed. This guarantees you the most reliable columns available anywhere.



Restek's Exceptionally Inert Rxi® Capillary GC Columns

As GC detectors become more sensitive, accurately quantifying low concentrations of target compounds becomes much more challenging. We developed the Rxi® column line specifically to improve low-level quantification. Our goal was to develop a superior column that had the highest inertness, lowest bleed, and greatest reproducibility of any column available.

The exceptionally low bleed levels of Rxi® columns improve low-level analysis by reducing detector noise. This improves signal-to-noise ratios for low-level compounds leading to more accurate and reproducible results. A highly inert column improves results for active compounds by preventing adsorption of target analytes in the system. The inertness of Rxi® columns allows analysis of acidic and basic compounds on the same column—often under the same conditions—without the peak tailing, that can skew results for low-level analytes.

Finally, consistent column performance is critical to low-level analysis. In developing the Rxi® columns we wanted to guarantee reproducibility, so customers would always receive a column that worked as well as their previous column. To guarantee column-to-column reproducibility we redesigned the entire manufacturing process and used strict quality specifications. Every Rxi® column is individually tested for coating efficiency, selectivity, film thickness, inertness, and bleed level. As a result, Rxi® columns offer the most consistent retention times and highest level of inertness on the market. The data presented here demonstrate the unmatched performance of the Rxi® columns; we guarantee these columns, engineered to improve low-level analyses, are the most reliable columns available.

Low Bleed

Our bleed test is performed using a flame ionization detector with a compound marker to ensure the accuracy of the comparison. Column bleed was evaluated at 330°C and also at 350°C. As shown in Figure 1, the Rxi®-5ms column exhibits the lowest bleed of any column at both 330°C and 350°C. Note that at 350°C the variation in the bleed levels of the columns tested increases significantly. This increase is due to the difference in how the stationary phases are cross-linked by different manufacturers. As shown, the Rxi® technology, used by Restek columns, results in a very stable stationary phase that does not degrade, or bleed, compared to other columns on the market.

Highly Inert

We used pyridine (a basic compound) and 2,4-dinitrophenol (an acidic compound) to evaluate the activity level of our Rxi® columns. In this test, if the column was too acidic the pyridine peak would tail, whereas if the column was too basic the 2,4-dinitrophenol peak would tail and exhibit a low response factor. The excellent peak symmetry shown in Figure 2 demonstrates the neutrality of the Rxi®-5ms column for both acidic and basic compounds. Additionally, while many other commercially available columns are not able to detect 2,4-dinitrophenol at 0.5ng on-column, the Rxi®-5ms column produces a response factor of 0.14.

Figure 1 Rxi®-5ms columns have the lowest bleed among all major column brands.

Comparison of 30m x 0.25mm ID, 0.25µm columns at 330°C through 350°C; hydrogen carrier gas; flame ionization detection.

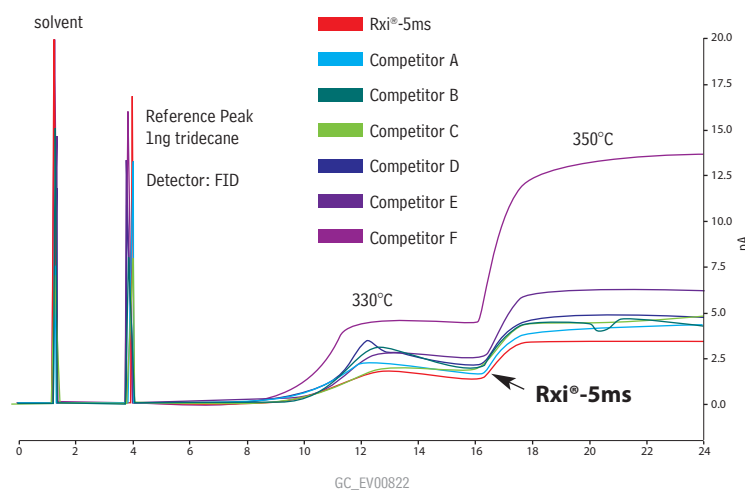
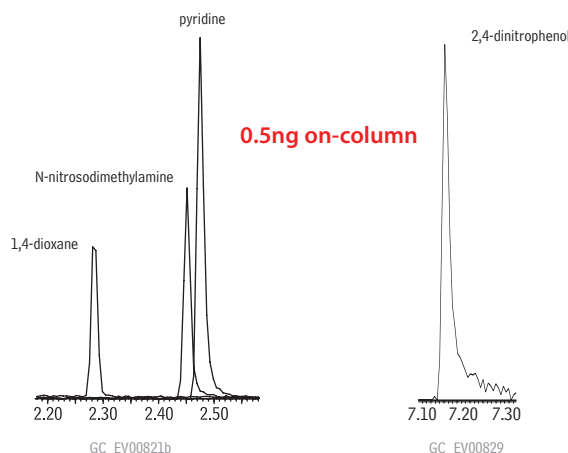
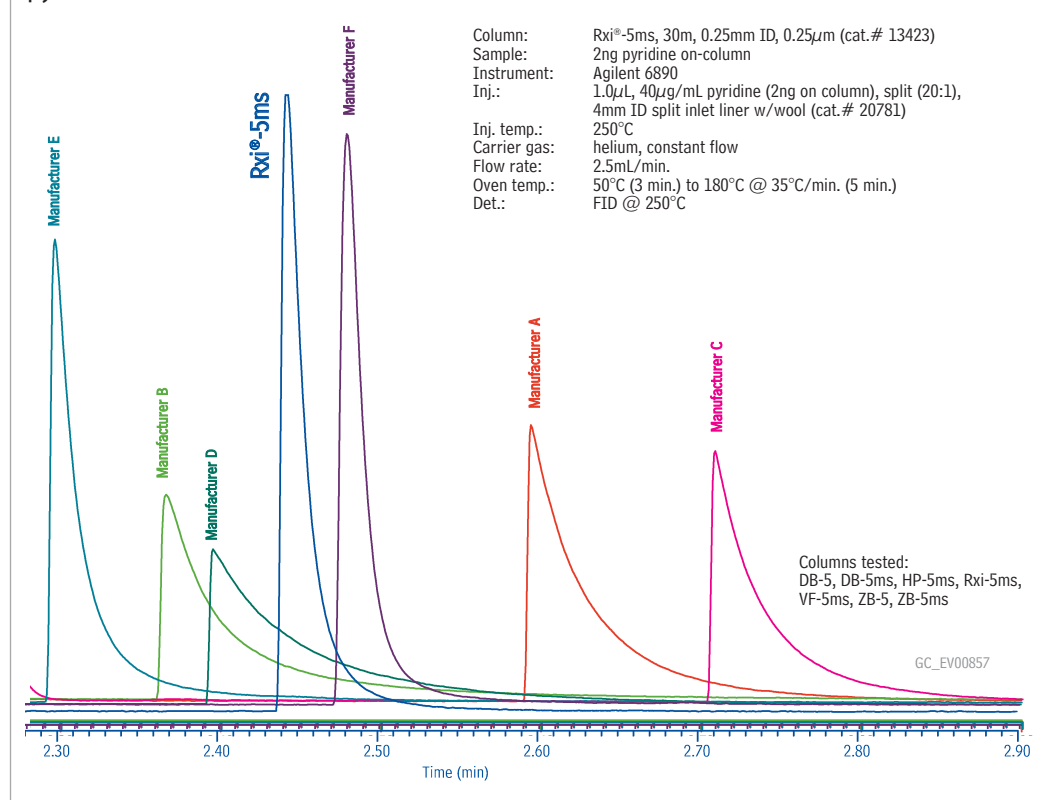


Figure 2 Peak symmetry for pyridine or 2,4-dinitrophenol is excellent from an Rxi®-5ms column, even with 0.5ng on-column!



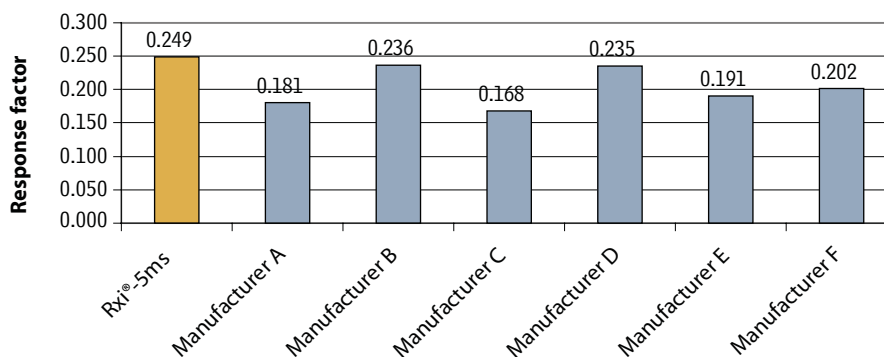
To further compare the inertness of the Rxi®-5ms column toward basic compounds to other columns on the market, 2ng of pyridine was used as a test probe. As shown in Figure 3, the tailing of pyridine is a very sensitive marker for inertness, and the excellent peak symmetry on the Rxi®-5ms column demonstrates its inertness for basic compounds.

Figure 3 An Rxi®-5ms column provides the most symmetric peak for the basic compound pyridine.



Another comparison of column inertness to acidic compounds was made with 2ng 2,4-dinitrophenol. Figure 4 compares the mean response factors obtained on several columns and demonstrates that the Rxi®-5ms column is the most sensitive and gives the highest response factor for 2,4-dinitrophenol. In summary, Rxi®-5ms is the most inert column available for both basic and acidic compounds.

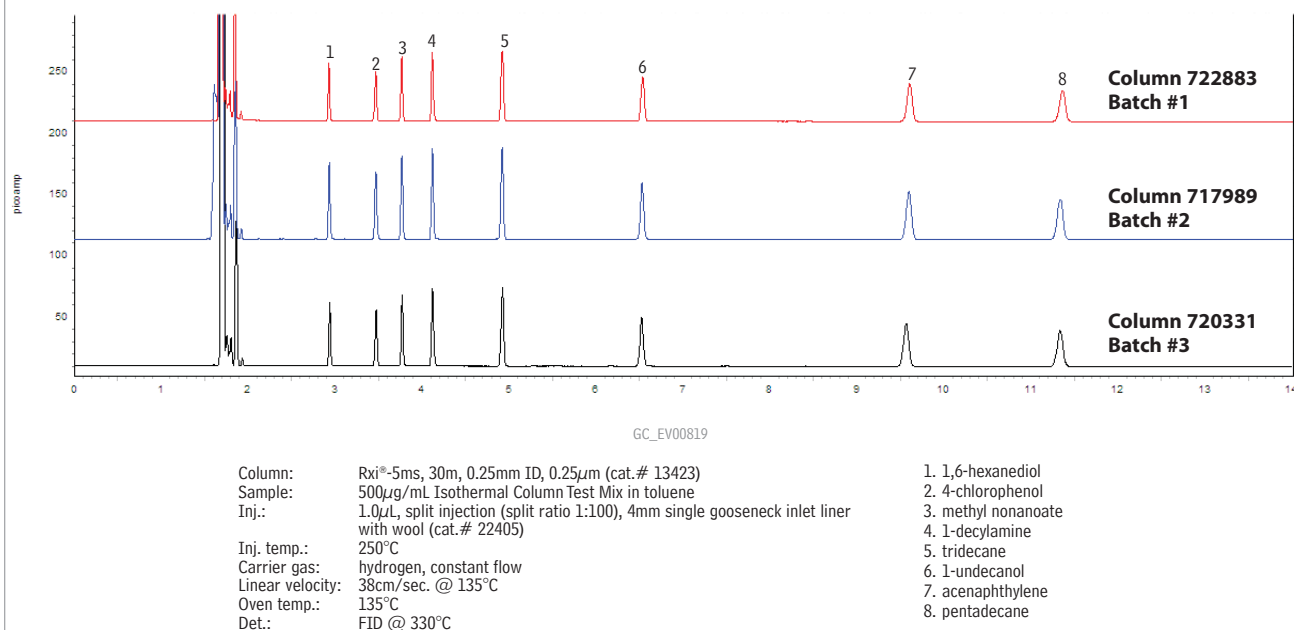
Figure 4 The Rxi®-5ms column gives the highest response factor for the acidic compound 2,4-dinitrophenol.



Column-to-Column Reproducibility

Column-to-column reproducibility is critical to obtaining consistent, reliable results for low-level analytes. We re-engineered our column manufacturing process to guarantee column-to-column reproducibility. The data in Figure 5 compare column performance from three separate production lots that were manufactured independently over a three-month period. The inertness and retention time of the probes match exactly across all three column batches. This means the responses and peak characteristics of active compounds will not vary from column-to-column, or lot-to-lot.

Figure 5 Rxi® column technology assures reliable column-to-column performance.



Summary

Rxi® columns offer unmatched performance in the three areas most critical to the accurate analysis of low-level analytes: bleed, inertness and reproducibility. Whether you are pursuing lower detection limits or simply looking for greater column-to-column consistency, Rxi® columns will outperform any column in the industry. Try these columns for yourself. We are sure you will be 100% satisfied, guaranteed.

Rxi® Guard/Retention Gap Columns

- Extend column lifetime.
- Excellent inertness—obtain lower detection limits for active compounds.
- Sharper chromatographic peaks by utilizing retention gap technology.
- Maximum temperature: 360°C.

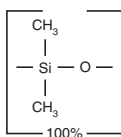
Fused Silica

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10029	10029-600	10059	10059-600
0.32mm	0.45 ± 0.04mm	10039	10039-600	10064	10064-600
0.53mm	0.69 ± 0.05mm	10054	10054-600	10073	10073-600



Restek West

Roy Lautamo, Bill Bromps, Ryan Smith, Shawn Reese

Rxi®-1ms
Structure

Rxi®-1ms (nonpolar phase, Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for drugs of abuse, essential oils, hydrocarbons, pesticides, PCB congeners or (e.g.) Aroclor mixes, sulfur compounds, amines, solvent impurities, simulated distillation, oxygenates, gasoline range organics (GRO), refinery gases.
- Ultra-low bleed—improved signal-to-noise ratio, for better sensitivity and mass spectral integrity.
- Temperature range: -60°C to 330/350°C (bleed tested temperature/maximum operating temperature).
- Equivalent to USP G2 phase.

Rxi®-1ms Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C	13320	13323	13326
	0.50	-60 to 330/350°C	13335	13338	13341
	1.00	-60 to 330/350°C	13350	13353	13356
0.32mm	0.25	-60 to 330/350°C	13321	13324	13327
	0.50	-60 to 330/350°C	13336	13339	13342
	1.00	-60 to 330/350°C	13351	13354	13357
0.53mm	4.00	-60 to 330/350°C		13396	
	0.50	-60 to 330/350°C	13337	13340	
	1.00	-60 to 330/350°C	13352	13355	
	1.50	-60 to 330/350°C	13367	13370	13373

ID	df (μm)	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10	-60 to 330/350°C	13301				
0.18mm	0.18	-60 to 330/350°C			13302		
0.20mm	0.33	-60 to 330/350°C		13397		13398	13399

similar phases

DB-1, DB-1ms, HP-1, HP-1ms, Ultra-1, SPB-1, Equity-1, VF-1ms, CP-Sil 5 CB Low Bleed/MS

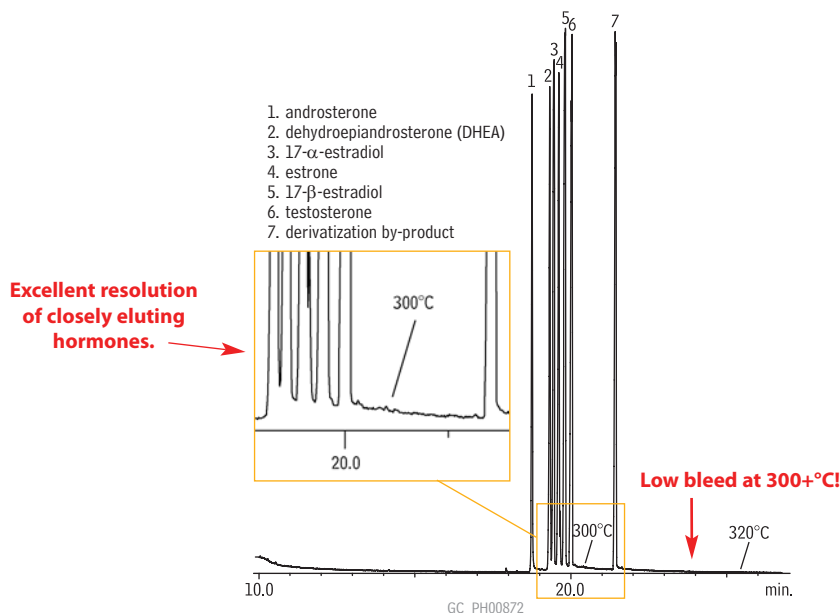
free literature

Rxi®-1ms: The Ultimate High Performance Fused Silica Capillary Column

Download your free copy from www.restek.com.

Flyer
lit. cat.# 580075B

Steroids: Hormones on an Rxi®-1ms column.



Column: Rxi®-1ms, 30m, 0.25mm ID, 0.25μm (cat.# 13323)
 Sample: 100μg/mL each hormone in methanol or ethanol; compounds derivatized using 2% methoxylamine HCl (CH₃ONH₂) in pyridine, then N-trimethylsilylimidazole (TMSI), then analyzed 1.0μL splitless (hold 0.5 min.), 3.5mm single gooseneck inlet liner (cat.# 20961)
 Inj.:
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1mL/min.
 Oven temp.: 100°C to 320°C @ 10°C/min. (hold 10 min.)
 Det: MS: Shimadzu 17A with QP5000
 Transfer line temp.: 280°C
 Scan range: 40-700amu
 Ionization: EI
 Mode: scan

Rxi®-5ms (low polarity phase, Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

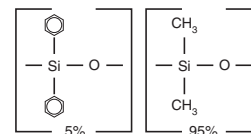
- General purpose columns for semivolatiles, phenols, amines, residual solvents, drugs of abuse, pesticides, PCB congeners or (e.g.) Aroclor mixes, solvent impurities.
- Most inert column on the market.
- Ultra-low bleed—improved signal-to-noise ratio, for better sensitivity and mass spectral integrity.
- Temperature range: -60°C to 330/350°C (bleed tested temperature/maximum operating temperature).
- Equivalent to USP G27 phase.

Rxi®-5ms Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C	13420	13423	13426
	0.40	-60 to 330/350°C		13481	
	0.50	-60 to 330/350°C	13435	13438	13441
	1.00	-60 to 330/350°C	13450	13453	13456
0.32mm	0.25	-60 to 330/350°C	13421	13424	13427
	0.50	-60 to 330/350°C	13436	13439	13442
	1.00	-60 to 330/350°C	13451	13454	13457
0.53mm	0.25	-60 to 330/350°C	13422	13425	
	0.50	-60 to 330/350°C	13437	13440	
	1.00	-60 to 330/350°C	13452	13455	
	1.50	-60 to 330/350°C	13467	13470	

ID	df (μm)	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10	-60 to 330/350°C	13401				
0.18mm	0.18	-60 to 330/350°C			13402		
	0.30	-60 to 330/350°C			13409		
	0.36	-60 to 330/350°C			13411		
0.20mm	0.33	-60 to 330/350°C		13497		13498	13499

Rxi®-5ms Structuresimilar **phases**

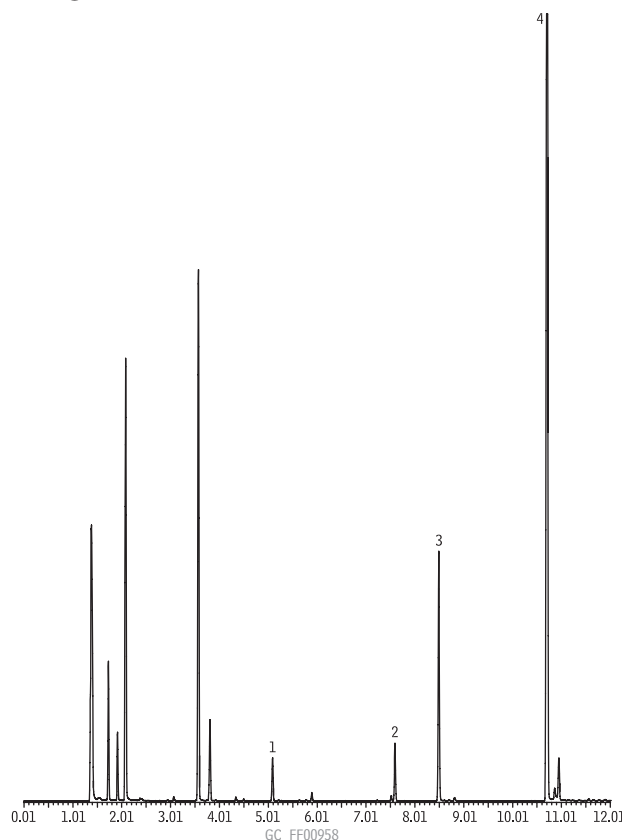
DB-5, HP-5, HP-5ms, Ultra-2, SPB-5, Equity-5, CP-Sil 8

free literature

Rxi®-5ms ColumnsDownload your free copy from www.restek.com.

Flyer

lit. cat.# 580046A

Fresh garlic on an Rxi®-5ms column.

1. allyl methylsulfide
2. 3,3'-thiobis-1-propene
3. allyl mercaptan
4. diallyl disulphide

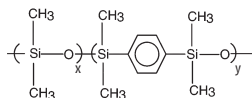
Column: Rxi®-5ms, 30m, 0.25mm ID, 1.0μm (cat.# 13453)
with a 5m, 0.32mm ID IP deactivated guard column (cat.# 10044)

Sample: fresh garlic
Inj.: split (10:1)
Inj. temp.: 220°C
Flow rate: 1.5mL/min.
Oven temp.: 35°C (hold 1 min.) to 220°C @ 15°C/min. to 300°C @ 45°C/min.
Det: MS
Scan range: 35-350amu
Ionization: EI
Mode: scan

Headspace Conditions

Instrument: PerkinElmer TurboMatrix 40 Trap Headspace Sampler
Column pressure: 15psi (103kPa)
Inj. pressure: 30psi (207kPa)
Thermostat time: 15 min.
Vial pressurize time: 1 min.
Withdraw time: 0.2 min.
Injection time: 0.02 min.
Oven temp.: 80°C
Needle temp.: 90°C
Transfer temp.: 110°C

new!

Rxi®-5Sil MS
Structure

Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60°C to 350°C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

Rxi®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	13605	13608	
	0.25	-60 to 330/350°C	13620	13623	13626
	0.50	-60 to 330/350°C	13635	13638	
	1.00	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25	-60 to 330/350°C	13621	13624	
	0.50	-60 to 330/350°C		13639	
	1.00	-60 to 325/350°C		13654	
0.53mm	1.50	-60 to 310/330°C		13670	

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

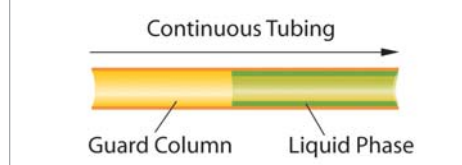
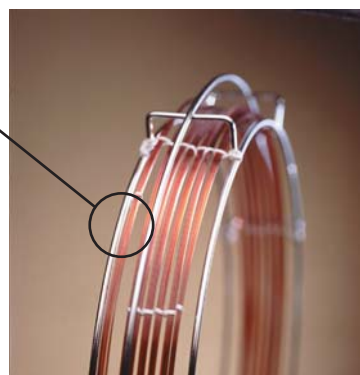
similar phases

DB-5MS, VF-5ms,
CP-Sil 8 Low-Bleed/MS

Rxi®-5Sil MS with Integra-Guard™

- Extend column lifetime.
- Eliminate leaks with a built-in retention gap.
- Inertness verified by isothermal testing.

Description	cat.#
30m, 0.25mm, 0.25μm Rxi-5Sil MS with 5m, 0.25mm ID Integra-Guard	13623-124
30m, 0.25mm, 0.25μm Rxi-5Sil MS with 10m, 0.25mm ID Integra-Guard	13623-127
30m, 0.25mm, 0.50μm Rxi-5Sil MS with 10m, 0.25mm ID Integra-Guard	13638-127

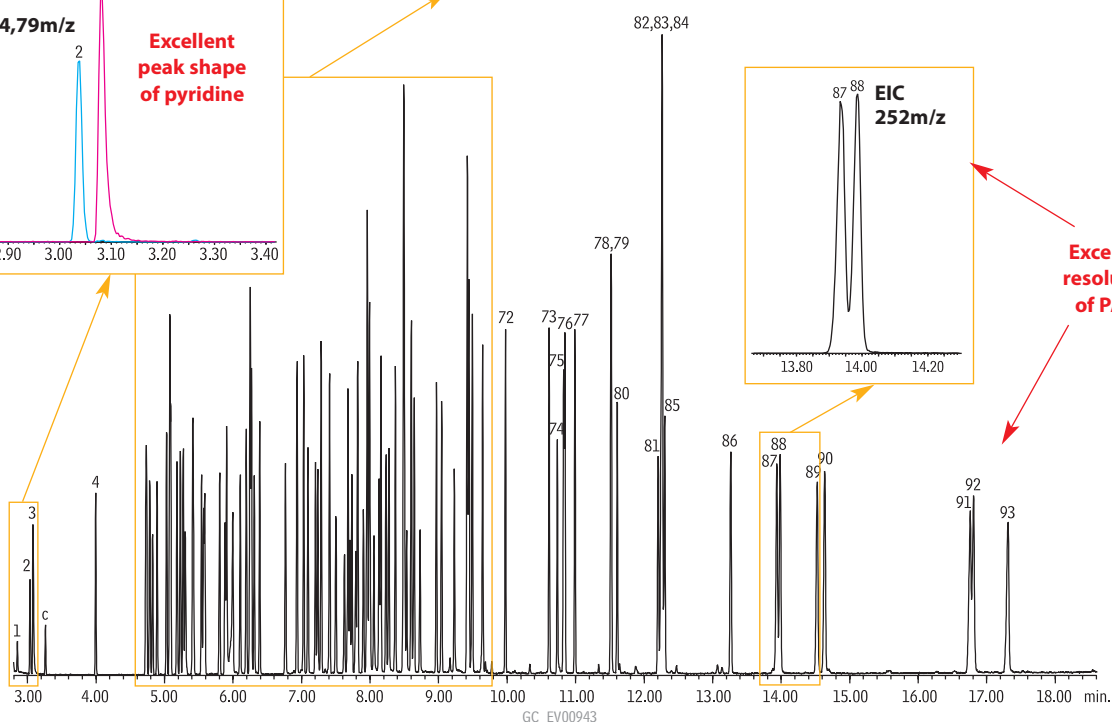
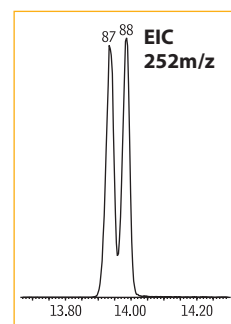
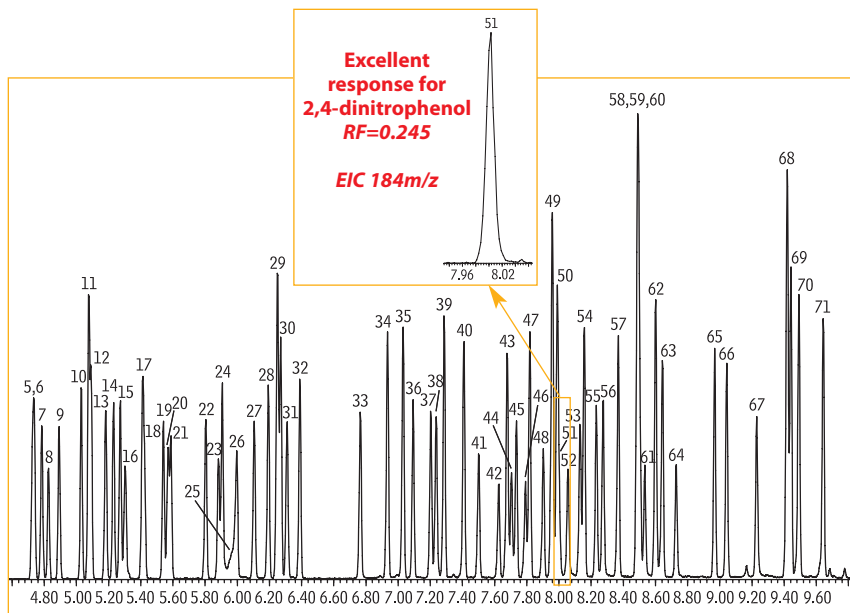
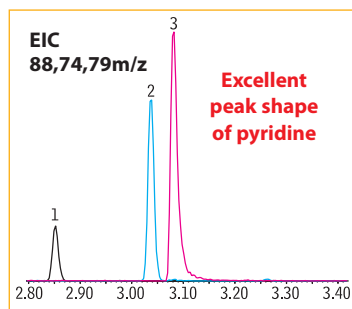
Integra-Guard™ built-in guard column**Phases currently available as Integra-Guard™ columns**

Rtx®-1
Rtx®-5
Rtx®-5MS
Rtx®-1301
Rtx®-624
Rtx®-1701
Rtx®-20
Rtx®-35
Rtx®-BAC 1 & 2
Stabilwax®

Integra-Guard™ columns are available for all phases listed, for columns with 0.25, 0.32, or 0.53mm ID and lengths to 75 meters.

Semivolatile organics for US EPA Method 8270 on an Rxi®-5Sil MS column.

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25 μ m (cat.# 13623)
 Sample: US EPA Method 8270D Mix, 1 μ L of 10 μ g/mL (IS 40 μ g/mL)
 8270 MegaMix® (cat.# 31850)
 Benzoic Acid (cat.# 31879)
 8270 Benzidines Mix (cat.# 31852)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Revised B/N Surrogate Mix (cat.# 31887)
 1,4-Dioxane (cat.# 31853)
 SV Internal Standard Mix (cat.# 31206)
 Inj.: 1.0 μ L (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 25psi @ 0.2 min., 60mL/min. @ 0.15 min.
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 320°C @ 5°C/min. (hold 1 min.)
 Det.: MS
 Transfer line temp.: 280°C
 Scan range: 35-550amu
 Ionization: EI
 Mode: scan



- | | | | | | |
|-----------------------------------|---|-------------------------------|--|-----------------------------------|-----------------------------------|
| 1. 1,4-dioxane | 17. 4-methylphenol/3-methylphenol | 34. 2-methylnaphthalene | 51. 2,4-dinitrophenol | 66. hexachlorobenzene | 83. bis(2-ethylhexyl) phthalate |
| 2. <i>n</i> -nitrosodimethylamine | 18. <i>n</i> -nitroso-di- <i>n</i> -propylamine | 35. 1-methylnaphthalene | 52. 4-nitrophenol | 67. pentachlorophenol | 84. chrysene-d12 (IS) |
| 3. pyridine | 19. hexachloroethane | 36. hexachlorocyclopentadiene | 53. 2,4-dinitrotoluene | 68. phenanthrene-d10 (IS) | 85. chrysene |
| c. toluene | 20. nitrobenzene-d5 (SS) | 37. 2,4,6-trichlorophenol | 54. dibenzofuran | 69. phenanthrene | 86. di- <i>n</i> -octyl phthalate |
| 4. 2-fluorophenol (SS) | 21. nitrobenzene | 38. 2,4,5-trichlorophenol | 55. 2,3,5,6-tetrachlorophenol | 70. anthracene | 87. benzo(b)fluoranthene |
| 5. phenol-d6 (SS) | 22. isophorone | 39. 2-fluorobiphenyl (SS) | 56. 2,3,4,6-tetrachlorophenol | 71. carbazole | 88. benzo(k)fluoranthene |
| 6. phenol | 23. 2-nitrophenol | 40. 2-chloronaphthalene | 57. diethyl phthalate | 72. di- <i>n</i> -butyl phthalate | 89. benzo(a)pyrene |
| 7. aniline | 24. 2,4-dimethylphenol | 41. 2-nitroaniline | 58. 4-chlorophenyl phenyl ether | 73. fluoranthene | 90. perylene-d12 (IS) |
| 8. bis(2-chloroethyl) ether | 25. benzoic acid | 42. 1,4-dinitrobenzene | 59. fluorene | 74. benzidine | 91. indeno(1,2,3-cd)pyrene |
| 9. 2-chlorophenol | 26. bis(2-chloroethoxy)methane | 43. dimethyl phthalate | 60. 4-nitroaniline | 75. pyrene-d10 (SS) | 92. dibenzo(a,h)anthracene |
| 10. 1,3-dichlorobenzene | 27. 2,4-dichlorophenol | 44. 1,3-dinitrobenzene | 61. 4,6-dinitro-2-methylphenol | 76. pyrene | 93. benzo(ghi)perylene |
| 11. 1,4-dichlorobenzene-d4 (IS) | 28. 1,2,4-trichlorobenzene | 45. 2,6-dinitrotoluene | 62. <i>n</i> -nitrosodiphenylamine (diphenylamine) | 77. <i>p</i> -terphenyl-d14 (SS) | |
| 12. 1,4-dichlorobenzene | 29. naphthalene-d8 (IS) | 46. 1,2-dinitrobenzene | 63. 1,2-diphenylhydrazine (as azobenzene) | 78. 3,3'-dimethylbenzidine | |
| 13. benzyl alcohol | 30. naphthalene | 47. acenaphthylene | 64. 2,4,6-tribromophenol (SS) | 79. butyl benzyl phthalate | |
| 14. 1,2-dichlorobenzene | 31. 4-chloroaniline | 48. 3-nitroaniline | 65. 4-bromophenyl phenyl ether | 80. bis(2-ethylhexyl) adipate | |
| 15. 2-methylphenol | 32. hexachlorobutadiene | 49. acenaphthene-d10 (IS) | | 81. 3,3'-dichlorobenzidine | |
| 16. bis(2-chloroisopropyl) ether | 33. 4-chloro-3-methylphenol | 50. acenaphthene | | 82. benzo(a)anthracene | |

c = contaminant

new!

Rxi®-XLB (low polarity proprietary phase)

- General purpose columns exhibiting extremely low bleed. Ideal for many GC/MS applications, including pesticides, PCB congeners or (e.g.) Aroclor mixes, PAHs.
- Unique selectivity.
- Temperature range: 30°C to 360°C.

Improvements in polymer synthesis and tubing deactivation enable us to make inert, stable Rxi®-XLB columns especially well-suited for analyzing active, high molecular weight compounds with sensitive GC/MS systems, including ion trap detectors. Excellent efficiency, coupled with inertness, low bleed, and high thermal stability, make Rxi®-XLB columns ideal for analyzing semivolatile compounds in drinking water (e.g., US EPA Method 525).

Rxi®-XLB Columns (fused silica)

(low polarity proprietary phase)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	30 to 340/360°C	13705	13708	
	0.25	30 to 340/360°C	13720	13723	13726
	0.50	30 to 340/360°C		13738	
	1.00	30 to 340/360°C	13750	13753	
0.32mm	0.10	30 to 340/360°C		13709	
	0.25	30 to 340/360°C	13721	13724	13727
	0.50	30 to 340/360°C		13739	
	1.00	30 to 340/360°C		13754	
0.53mm	0.50	30 to 340/360°C		13740	
	1.50	30 to 320/340°C	13767	13770	

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	30 to 340/360°C	43701	
0.18mm	0.18	30 to 340/360°C		43702

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

tech tip

In combination with an Rxi®-XLB column, simple adjustments to the injection conditions can greatly improve sensitivity for active and high molecular weight Method 525.2 target compounds.

- By eliminating contact between the sample and the hot metal surfaces in the injection port, a Drilled Uniliner® inlet liner prevents analytes from degrading in the injection port.
- A pulsed injection (30psi/0.4 min.) reduces the time the analytes spend in the injection port, and helps to minimize breakdown.

similar phases

DB-XLB, VF-Xms

Rxi®-17 (midpolarity phase; Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

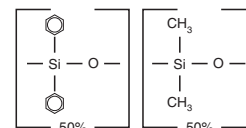
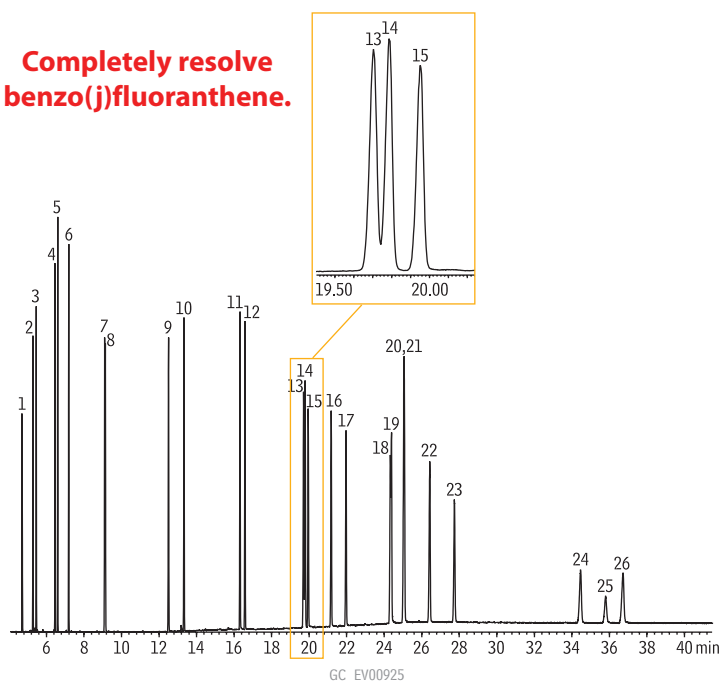
- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 0°C to 320°C.

Rxi®-17 Columns (fused silica)

(Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	40 to 280/320°C	13520	13523
	0.50	40 to 280/320°C	13535	13538
	1.00	40 to 280/320°C	13550	13553
0.32mm	0.25	40 to 280/320°C	13521	13524
	0.50	40 to 280/320°C	13536	13539
	1.00	40 to 280/320°C	13551	13554
0.53mm	0.25	40 to 280/320°C	13522	13525
	0.50	40 to 280/320°C	13537	13540
	0.83	40 to 280/320°C		13569
	1.00	40 to 280/320°C	13552	13555
	1.50	40 to 280/320°C	13567	13570

ID	df (μm)	temp. limits	10-Meter
0.10mm	0.10	40 to 280/320°C	13501

Rxi®-17
Structuresimilar **phases**DB-17, DB-608, VF-17ms,
CP-Sil 24 CB**Polycyclic aromatic hydrocarbons on an Rxi®-17 column.****Completely resolve
benzo(j)fluoranthene.**

Peak List	Ret. Time (min.)
1. naphthalene	4.70
2. 1-methylnaphthalene	5.28
3. 2-methylnaphthalene	5.46
4. acenaphthylene	6.45
5. acenaphthene	6.60
6. fluorene	7.18
7. phenanthrene	9.10
8. anthracene	9.14
9. fluoranthene	12.50
10. pyrene	13.33
11. benzo(a)anthracene	16.32
12. chrysene	16.58
13. benzo(b)fluoranthene	19.70
14. benzo(k)fluoranthene	19.78
15. benzo(j)fluoranthene	19.95
16. benzo(a)pyrene	21.17
17. 3-methylcholanthrene	21.97
18. dibenzo(a,h)acridine	24.33
19. dibenzo(a,i)acridine	24.39
20. indeno(1,2,3-cd)pyrene	25.04
21. dibenzo(a,h)anthracene	25.07
22. benzo(ghi)perylene	26.43
23. 7H-dibenzo(c,g)carbazole	27.75
24. dibenzo(a,e)pyrene	34.46
25. dibenzo(a,i)pyrene	35.80
26. dibenzo(a,h)pyrene	36.73

Column: Rxi®-17, 30m, 0.25mm ID, 0.25μm (cat.# 13523)
Sample: PAH mix, 20μg/mL each component:
EPA Method 610 Mix (cat.# 31011)
PAH Supplement Mix (cat.# 31857)
1-methylnaphthalene (cat.# 31283)
2-methylnaphthalene (cat.# 31285)

Inj.: 1.0μL pulsed splitless injection (20ng each component on column),
4mm Drilled Uniliner® inlet liner with hole near top (cat.# 21055);
pulse: 20psi @ 0.3 min., 40mL/min. @ 0.2 min.

Inj. temp.: 300°C
Carrier gas: helium, constant flow
Flow rate: 1.2mL/min.
Oven temp.: 90°C (hold 1.0 min.) to 215°C @ 25°C/min. (hold 0.5 min.) to
235°C @ 4°C/min., to 280°C @ 15°C/min., to 320°C @
4°C/min. (hold 20 min.)

Det.: Agilent 5973 GC/MS
Scan range: 50-550amu
Solvent delay: 4.0 min.
Tune: DFTPP
Ionization: EI

Restek's Original Crossbonded Fused Silica Capillary Columns



Chemically bonded capillary columns

- Allow for direct solvent injection onto column.
- Columns can be solvent rinsed.

Comprehensive GC column selection

- Available in many dimensions, including variations in length, internal diameter, and film thickness.
- Internal diameters include 0.10mm and 0.18mm for faster analysis time and higher resolution power.

Broad range of stationary phases

- Columns based on polysiloxane backbone; functional groups added to the polymers to vary selectivity.
- Polyethylene glycol (PEG) phases.



Rtx®-1 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for solvent impurities, PCB congeners or (e.g.) Aroclor mixes, simulated distillation, drugs of abuse, gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, oxygenates.
- Temperature range: -60°C to 350°C.
- Equivalent to USP G1, G2, G38 phases.

Rtx®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

Rtx®-1 Columns (fused silica)

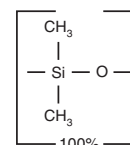
(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	0.10	-60 to 330/350°C	10105	10108	10111		
	0.25	-60 to 330/350°C	10120	10123	10126		10129
	0.50	-60 to 330/350°C	10135	10138	10141		10144
	1.00	-60 to 320/340°C	10150	10153	10156		10159
0.32mm	0.10	-60 to 330/350°C	10106	10109	10112		
	0.25	-60 to 330/350°C	10121	10124	10127		10130
	0.50	-60 to 330/350°C	10136	10139	10142		
	1.00	-60 to 320/340°C	10151	10154	10157		10160
	1.50	-60 to 310/330°C	10166	10169	10172		10175
	3.00	-60 to 280/300°C	10181	10184	10187		10190
	4.00	-60 to 280/300°C		10198			
	5.00	-60 to 260/280°C	10176	10178	10180		
0.45mm	2.55	-60 to 270/290°C				10992	
0.53mm	0.10	-60 to 320/340°C	10107	10110			
	0.25	-60 to 320/340°C	10122	10125	10128		
	0.50	-60 to 310/330°C	10137	10140	10143		
	1.00	-60 to 310/330°C	10152	10155	10158		
	1.50	-60 to 310/330°C	10167	10170	10173		
	3.00	-60 to 270/290°C	10182	10185	10188		10189
	5.00	-60 to 270/290°C	10177	10179	10183		10194
	7.00	-60 to 240/260°C	10191	10192	10193		
ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter		
0.10mm	0.10	-60 to 330/350°C	41101	41102			
	0.40	-60 to 320/340°C	41103	41104			
0.18mm	0.20	-60 to 330/350°C	40101	40102	40103		
	0.40	-60 to 320/340°C	40110	40111	40112		

Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

crossbond® technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

**Rtx®-1
Structure****similar phases**

DB-1, DB-1MS, HP-1, HP-1MS, Ultra-1, SPB-1, Equity-1, MDN-1, VF-1ms, CP-Sil 5 CB

also available**MXT® Columns**

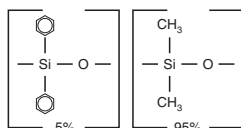
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 87](#) for our MXT®-1 columns.

it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-1ms columns! See [pages 22-26](#).

**Catch the Buzz**

Sign up for Restek's e-newsletter, *The Buzz*
www.restek.com/buzz

Rtx®-5/Rtx®-5MS
Structure

Rtx®-5/Rtx®-5 MS (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners or (e.g.) Aroclor mixes, essential oils, semivolatiles.
- Temperature range: -60°C to 350°C.
- Equivalent to USP G27 and G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

Rtx®-5 Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10	-60 to 330/350°C	10205	10208	10211	10214
	0.25	-60 to 330/350°C	10220	10223	10226	10229
	0.50	-60 to 330/350°C	10235	10238	10241	10244
	1.00	-60 to 320/340°C	10250	10253	10256	10259
0.32mm	0.10	-60 to 330/350°C	10206	10209	10212	10215
	0.25	-60 to 330/350°C	10221	10224	10227	10230
	0.50	-60 to 330/350°C	10236	10239	10242	10245
	1.00	-60 to 330/350°C	10251	10254	10257	10260
	1.50	-60 to 310/330°C	10266	10269	10272	10275
	3.00	-60 to 280/300°C	10281	10284	10287	10290
0.53mm	0.10	-60 to 320/340°C	10207	10210	10213	
	0.25	-60 to 320/340°C	10222	10225	10228	
	0.50	-60 to 310/330°C	10237	10240	10243	
	1.00	-60 to 310/330°C	10252	10255	10258	
	1.50	-60 to 310/330°C	10267	10270	10273	
	3.00	-60 to 270/290°C	10282	10285	10288	
	5.00	-60 to 270/290°C	10277	10279	10283	

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10	-60 to 330/350°C	41201	41202	
	0.40	-60 to 320/340°C	41203	41204	
0.18mm	0.20	-60 to 325/340°C	40201	40202	40203
	0.40	-60 to 315/330°C	40210	40211	40212

30-meter	6-pack cat. #
0.25mm ID, 0.25μm	10223-600
0.25mm ID, 0.50μm	10238-600
0.32mm ID, 1.00μm	10254-600
0.53mm ID, 1.50μm	10270-600

Six columns for the price of five!

Other phases and configurations available on request.

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-5MS—Low-bleed GC/MS Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- Column specifically tested for low bleed performance.

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	12605	12608	12611
	0.25	-60 to 330/350°C	12620	12623	12626
	0.50	-60 to 330/350°C	12635	12638	12641
	1.00	-60 to 325/350°C	12650	12653	
0.32mm	0.10	-60 to 330/350°C	12606	12609	12612
	0.25	-60 to 330/350°C	12621	12624	12627
	0.50	-60 to 330/350°C	12636	12639	12642
	1.00	-60 to 325/350°C	12651	12654	
0.53mm	0.50	-60 to 320/340°C	12637	12640	
	1.00	-60 to 320/340°C	12652	12655	
	1.50	-60 to 310/330°C	12667	12670	

it's a **fact**

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rtx®-5ms columns! See pages 22-25, 27.

similar **phases**

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5, CP-Sil 8 CB

DB-5MS is a silarylene based polymer, similar to Rxi-5Sil MS.

also **available****MXT® Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See page 88 for our MXT®-5 columns.

Rtx®-5 Amine Columns

See page 45.

Rtx®-20 (low to midpolarity phase; Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

- General purpose columns for volatile compounds, flavor compounds, alcoholic beverages.
- Temperature range: -20°C to 320°C.
- Equivalent to USP G28, G32 phases.

Rtx®-20 polymer is synthesized to exacting standards. All residual catalysts and low molecular weight fragments are removed from the polymer, providing a tight mono-modal distribution and extremely low bleed.

Rtx®-20 Columns (fused silica)

(Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-20 to 300/320°C	10320	10323	10326
	0.50	-20 to 290/310°C	10335	10338	
	1.00	-20 to 280/300°C	10350	10353	
0.32mm	0.25	-20 to 300/320°C	10321	10324	
	0.50	-20 to 290/310°C	10336	10339	
	1.00	-20 to 280/300°C	10351	10354	10357
	1.50	-20 to 270/290°C	10366	10369	
	3.00	-20 to 250/270°C	10381	10384	
0.53mm	0.25	-20 to 260/280°C	10322	10325	
	0.50	-20 to 260/280°C		10340	
	1.00	-20 to 260/280°C	10352	10355	
	3.00	-20 to 240/260°C	10382	10385	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-35 (midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- General purpose columns for organochlorine pesticides, PCB congeners or (e.g.) Aroclor mixes, herbicides, pharmaceuticals, sterols, rosin acids, phthalate esters.
- Temperature range: 40°C to 320°C.
- Equivalent to USP G42 phase.

An Rtx®-35 column is a popular confirmation column for pesticides and herbicides, in conjunction with an Rtx®-5 or Rtx®-1701 column. The higher phenyl content causes useful elution order and retention time changes.

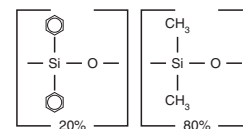
Rtx®-35 Columns (fused silica)

(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	40 to 320°C	10420	10423	
	0.50	40 to 310°C	10435	10438	
	1.00	40 to 290°C	10450	10453	10456
0.32mm	0.25	40 to 320°C	10421	10424	10427
	0.50	40 to 310°C	10436	10439	
	1.00	40 to 290°C	10451	10454	
	1.50	40 to 270/290°C	10466	10469	
0.53mm	3.00	40 to 250/270°C	10481	10484	
	0.25	40 to 260/280°C	10422	10425	
	0.50	40 to 300°C	10437	10440	
	1.00	40 to 290°C	10452	10455	
	1.50	40 to 280°C	10467	10470	
	3.00	40 to 240/260°C	10482	10485	

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20	40 to 300/320°C	40401	40402	40403
	0.40	40 to 290/310°C	40410	40411	40412

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-20 Structuresimilar **phase**

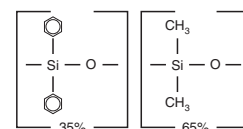
SPB-20

did you **know?**

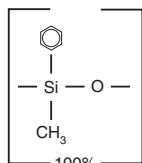
Rtx®-20 columns and Rtx®-35 columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See **page 19** for descriptions and ordering information.

also **available****MXT® Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 89** for our MXT®-20 columns and **page 90** for our MXT®-35 columns.

Rtx®-35 Amine ColumnsSee **page 46**.**Rtx®-35 Structure**similar **phases**

DB-35, HP-35, SPB-35, SPB-608

Rtx[®]-50
Structure

similar phases

HP-50, SPB-50, SP-2250

also available

MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 90](#) for our MXT[®]-50 columns.

Rtx[®]-50 (midpolarity phase; Crossbond[®] 100% methylphenyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 40°C to 320°C.
- Equivalent to USP G3 phase.

The high thermal stability of Rtx[®]-50 columns makes possible dual-column analysis with common phases such as Rtx[®]-1MS or Rtx[®]-5MS. Between analyses, high temperatures can be used to drive less volatile contaminants off of the column.

Rtx[®]-50 Columns (fused silica)(Crossbond[®] 100% methylphenyl polysiloxane)

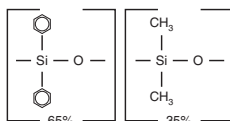
ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	40 to 300/320°C	10520	10523	10526
	0.50	40 to 290/310°C	10535	10538	10541
	1.00	40 to 280/300°C	10550	10553	10556
0.32mm	0.25	40 to 300/320°C	10521	10524	10527
	0.50	40 to 290/310°C	10536	10539	10542
	1.00	40 to 280/300°C	10551	10554	10557
0.53mm	0.25	40 to 280/300°C	10522		
	0.50	40 to 270/290°C	10537	10540	10543
	0.83	40 to 270/290°C		10569	
	1.00	40 to 260/280°C	10552	10555	10558
	1.50	40 to 250/270°C	10567	10570	10573

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20	40 to 310/330°C	40501	40502	40503
	0.40	40 to 300/320°C	40510	40511	40512

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx[®]-65 (mid to high polarity phase; Crossbond[®] 65% diphenyl/35% dimethyl polysiloxane)

- General purpose columns for phenols, fatty acids.
- Temperature range: 50°C to 300°C.
- Equivalent to USP G17 phase.

Rtx[®]-65
Structure

The Rtx[®]-65 phase contains the highest phenyl content of any bonded stationary phase available, to improve separation of aromatic compounds through increased phase-analyte interaction. A unique polarity makes these columns ideal for a variety of analyses, from phenols to FAMES. As a confirmation column for EPA Method 604 phenols, an Rtx[®]-65 column produces a different elution order, compared to the primary Rtx[®]-5 column. Rtx[®]-65 columns elute FAMES according to equivalent chain length, similar to bonded Carbowax[®] columns, but the Rtx[®]-65 phase does not suffer the thermal stability limitations of other polar stationary phases.

Rtx[®]-65 Columns (fused silica)(Crossbond[®] 65% diphenyl/35% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	50 to 300°C	17020	17023
	0.50	50 to 280/300°C	17035	17038
	1.00	50 to 260/280°C	17050	17053
0.32mm	0.25	50 to 300°C	17021	17024
	0.50	50 to 280/300°C	17036	17039
	1.00	50 to 260°C	17051	17054
0.53mm	0.25	50 to 290/300°C	17022	17025
	0.50	50 to 270/290°C	17037	17040
	1.00	50 to 250/270°C	17052	17055

similar phases

TAP-CB, 400-65HT, 007-65HT

also available

MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 90](#) for our MXT[®]-65 columns.

also available

Rbx[®]-65TG ColumnsSee [page 53](#).crossbond[®] technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

Rtx®-440 (intermediate polarity proprietary Crossbond® phase)

- General purpose columns for pesticides, PAHs, or other semivolatiles. Ideal for low/trace level analyses.
- Low bleed, high-resolution columns with unique selectivity.
- Temperature range: 20°C to 340°C.

restek
innovation!

Rtx®-440 Columns (fused silica)

(intermediate-polarity proprietary Crossbond® phase)

ID	df (μm)	temp. limits	30-Meter	
0.25mm	0.25	20°C to 320/340°C	12923	
	0.50	20°C to 320/340°C	12938	
0.32mm	0.25	20°C to 320/340°C	12924	
	0.50	20°C to 320/340°C	12939	
0.53mm	0.50	20°C to 320/340°C	12940	
	1.00	20°C to 320/340°C	12955	

ID	df (μm)	temp. limits	20-Meter	40-Meter
0.18mm	0.18	20°C to 320/340°C	42902	42903



Dave Krantz
Vice President of
Operations
5+ years of service!

Organochlorine Pesticides (US EPA Method 8081A) on an Rtx®-440 column.

Column: Rtx®-440 30m, 0.25mm ID, 0.50μm (cat.# 12939)

Sample: Organochlorine Pesticides Mix AB #2 (cat.# 32292),
8-80μg/mL each component in ethyl acetate
Chlorobenzilate (cat.# 32211) 1000μg/mL in methanol
Diallate (*cis* & *trans*) (custom) 1000μg/mL in hexane
Hexachlorobenzene (cat.# 32231) 1000μg/mL in acetone
Hexachlorocyclopentadiene (cat.# 32232) 1000μg/mL in methanol
Isodrin (custom) 1000μg/mL in hexane
Kepone (custom) 1000μg/mL in hexane
Mirex (custom) 1000μg/mL in hexane
2,4'-DDD (cat.# 32098) 1000μg/mL in methanol
2,4'-DDE (cat.# 32099) 1000μg/mL in methanol
2,4'-DDT (cat.# 32200) 1000μg/mL in methanol
TCMX (cat.# 32027) 200μg/mL in acetone
DCB (cat.# 32029) 200μg/mL in acetone
Inj.: 1.0μL splitless (hold 0.75 min.), 2mm Siltek®
treated single gooseneck inlet liner (cat.# 20961-214.1)

Inj. temp.: 275°C

Carrier gas: hydrogen, constant pressure

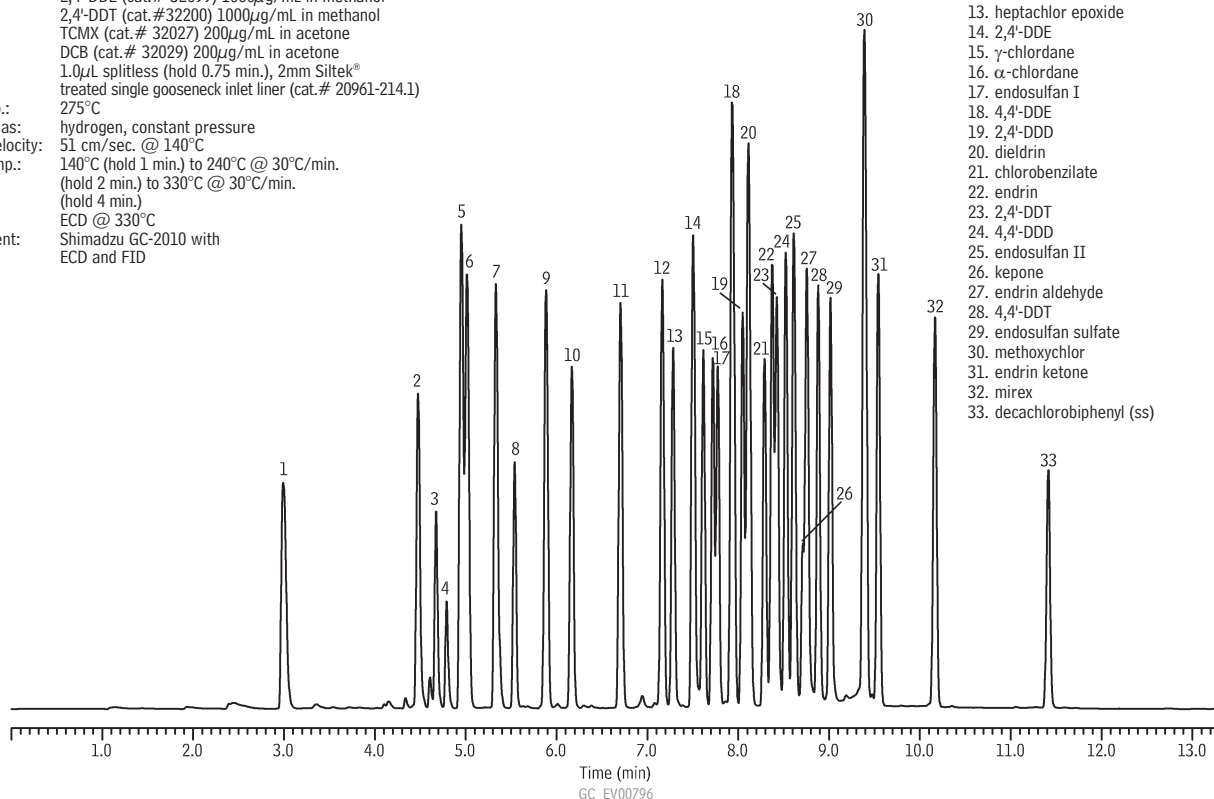
Linear velocity: 51 cm/sec. @ 140°C

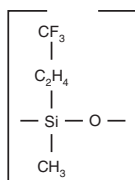
Oven temp.: 140°C (hold 1 min.) to 240°C @ 30°C/min.
(hold 2 min.) to 330°C @ 30°C/min.
(hold 4 min.)

Det.: ECD @ 330°C

Instrument: Shimadzu GC-2010 with
ECD and FID

1. hexachlorocyclopentadiene
2. 2,4,5,6-tetrachloro-m-xylene (ss)
3. *cis*-diallate
4. *trans*-diallate
5. α-BHC
6. hexachlorobenzene
7. γ-BHC
8. β-BHC
9. δ-BHC
10. heptachlor
11. aldrin
12. isodrin
13. heptachlor epoxide
14. 2,4'-DDE
15. γ-chlordane
16. α-chlordane
17. endosulfan I
18. 4,4'-DDE
19. 2,4'-DDD
20. dieldrin
21. chlorobenzilate
22. endrin
23. 2,4'-DDT
24. 4,4'-DDD
25. endosulfan II
26. kepone
27. endrin aldehyde
28. 4,4'-DDT
29. endosulfan sulfate
30. methoxychlor
31. endrin ketone
32. mirex
33. decachlorobiphenyl (ss)



Rtx®-200
Structure**Rtx®-200** (midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

- General purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, glycols. Excellent confirmation column, with an Rtx®-5 column, for phenols, nitrosamines, organochlorine pesticides, chlorinated hydrocarbons, and chlorophenoxy herbicides.
- Temperature range: -20°C to 340°C.
- Equivalent to USP G6 phase.

Rtx®-200 columns have accomplished many difficult separations not possible on any other bonded stationary phase. Many analysts consider these the best, most inert midpolarity columns available. The trifluoropropyl stationary phase has a unique selectivity that changes elution orders and resolves compounds that phenyl, cyano, or Carbowax® phases can not. The Rtx®-200 column offers exceptional thermal stability, low bleed, and superior inertness—even for active compounds such as phenols, and with sensitive detectors such as ECDs, NPDs, and MSDs.

similar **phases**

DB-200, DB-210

Rtx®-200 Columns (fused silica)

(Crossbond® trifluoropropylmethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10	-20 to 320/340°C	15005	15008	15011	
	0.25	-20 to 320/340°C	15020	15023	15026	15029
	0.50	-20 to 310/330°C	15035	15038	15041	15044
	1.00	-20 to 290/310°C	15050	15053	15056	15059
0.32mm	0.10	-20 to 320/340°C	15006	15009	15012	
	0.25	-20 to 320/340°C	15021	15024	15027	15030
	0.50	-20 to 310/330°C	15036	15039	15042	15045
	1.00	-20 to 290/310°C	15051	15054	15057	15060
	1.50	-20 to 280/300°C	15066	15069	15072	15075
0.53mm	0.10	-20 to 310/330°C	15007	15010	15013	
	0.25	-20 to 310/330°C	15022	15025	15028	
	0.50	-20 to 300/320°C	15037	15040	15043	
	1.00	-20 to 290/310°C	15052	15055	15058	
	1.50	-20 to 280/300°C	15067	15070	15073	
	3.00	-20 to 260/280°C	15082	15085	15088	15091
ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter	
0.18mm	0.20	-20 to 310/330°C	45001	45002	45003	
	0.40	-20 to 310/330°C	45010	45011	45012	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

also **available****MXT® Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 91](#) for our MXT®-200 columns.

Rtx®-200MS—Low-bleed GC/MS Columns (fused silica)

(Crossbond® trifluoropropylmethyl polysiloxane)

- Column specifically tested for low bleed performance.

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.10	-20 to 320/340°C	15605	15608
	0.25	-20 to 320/340°C	15620	15623
	0.50	-20 to 310/330°C	15635	15638
	1.00	-20 to 290/310°C	15650	15653
0.32mm	0.10	-20 to 320/340°C	15606	15609
	0.25	-20 to 320/340°C	15621	15624
	0.50	-20 to 310/330°C	15636	15639
	1.00	-20 to 290/310°C	15651	15654
0.53mm	0.50	-20 to 300/320°C	15637	15640
	1.00	-20 to 290/310°C	15652	15655
	1.50	-20 to 280/300°C	15667	15670

Rtx®-1301 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G43 phase.

Many analysts feel the Rtx®-1301 column has the best cyanosilicone bonded stationary phase available, with no other column manufacturer providing lower bleed, longer lifetime, or better inertness. Our polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed—even with sensitive detectors such as ECDs and MSDs.

Rtx®-1301 (G43) Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	0.25	-20 to 280°C	16020	16023	16026		
	0.50	-20 to 270°C	16035	16038	16041		
	1.00	-20 to 260°C	16050	16053	16056		
	1.40	-20 to 240°C			16016		
0.32mm	0.25	-20 to 280°C	16021	16024	16027		
	0.50	-20 to 270°C	16036	16039	16042		
	1.00	-20 to 260°C	16051	16054	16057		
	1.50	-20 to 250°C	16066	16069	16072		
	1.80	-20 to 240°C		16092	16093		
0.53mm	0.25	-20 to 280°C	16022	16025	16028		
	0.50	-20 to 270°C	16037	16040	16043		
	1.00	-20 to 260°C	16052	16055	16058		
	1.50	-20 to 250°C	16067	16070	16073		
	3.00	-20 to 240°C	16082	16085	16088	16076	16091

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

please **note**

Rtx®-1301 columns and Rtx®-624 columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See [page 19](#) for descriptions and ordering information.

Rtx®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

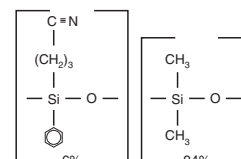
- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-20 to 240°C	10968	10969		
0.32mm	1.80	-20 to 240°C	10970	10972		
0.45mm	2.55	-20 to 240°C			10982	
0.53mm	3.00	-20 to 240°C	10971	10973	10974	10975

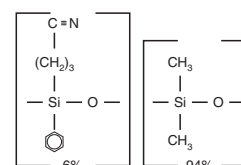
ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	1.00	-20 to 240°C		40924	40925

Rtx®-1301 Structuresimilar **phases**

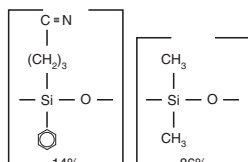
DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

also **available****MXT® Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [pages 91 and 93](#) for our MXT®-1301 and MXT®-624 columns.

Rtx®-624 Structuresimilar **phases**

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

Rtx®-1701
Structure

Rtx®-1701 (midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

- General purpose columns for alcohols, oxygenates, PCB congeners or (e.g.) Aroclor mixes, pesticides.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G46 phase.

Rtx®-1701 is one of the more popular stationary phases used in capillary GC. The mix of cyano and phenyl functional groups increases the polarity and offers a different elution order relative to less polar Rtx®-1 or Rtx®-5 columns. An Rtx®-1701 column is ideal for confirmation analysis, in combination with an Rtx®-35 or Rtx®-5 column. The polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed, even with sensitive detectors such as ECDs and MSDs.

Rtx®-1701 Columns (fused silica)

(Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10	-20 to 280°C			12011	
	0.25	-20 to 280°C	12020	12023	12026	
	0.50	-20 to 270/280°C	12035	12038	12041	
	1.00	-20 to 260/280°C	12050	12053	12056	
0.32mm	0.10	-20 to 280°C		12009		
	0.25	-20 to 280°C	12021	12024	12027	
	0.50	-20 to 270/280°C	12036	12039	12042	
	1.00	-20 to 260/280°C	12051	12054	12057	12060
	1.50	-20 to 240/260°C	12066	12069	12072	
0.53mm	0.10	-20 to 270/280°C	12007			
	0.25	-20 to 270/280°C	12022	12025	12028	
	0.50	-20 to 260/270°C	12037	12040	12043	
	1.00	-20 to 250/270°C	12052	12055	12058	
	1.50	-20 to 240/260°C	12067	12070	12073	
	3.00	-20 to 230/250°C	12082	12085	12088	

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10	-20 to 280°C	42201	42202	
0.18mm	0.20	-20 to 280°C	42001	42002	42003
	0.40	-20 to 270/280°C	42010	42011	42012

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

similar phases

DB-1701, HP-1701, SPB-1701, VF-1701, CP-Sil 19 CB

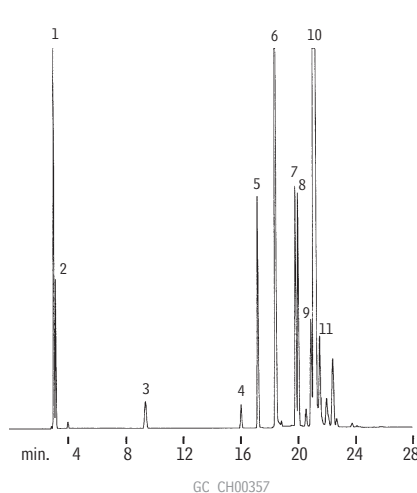
please note

Rtx®-1701 columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See [page 19](#) for descriptions and ordering information.

also available

MXT® Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 91](#) for our MXT®-1701 columns.

Styrene impurities on an Rtx®-1701 column.

1. 1,3-butadiene
2. butene
3. acrylonitrile
4. diethylhydroxylamine
5. toluene
6. vinylcyclohexene
7. ethylbenzene
8. *m*-xylene
9. *o*-xylene
10. styrene
11. cumene

Column: Rtx®-1701, 30m, 0.53mm ID, 3.0μm (cat.# 12085)
 Inj.: 0.5mL split injection of a 95% pure styrene
 Oven temp.: 40°C (hold 10 min.) to 150°C @ 12°C/min. (hold 15 min.)
 Inj./det. temp.: 150°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 40°C
 FID sensitivity: 16 x 10⁻¹¹ AFS
 Split vent: 40cc/min.

Permission to publish this chromatogram granted by Copolymer Rubber and Chemical Corp.

Rt™-2330 (highly polar phase; 90% biscyanopropyl/10% phenylcyanopropyl polysiloxane—not bonded)

- General purpose columns for *cis/trans* FAMES, dioxin isomers.
- Temperature range: 0°C to 275°C.
- Equivalent to USP G48 phase.

Rt™-2330 is one of the most polar capillary column stationary phases. Cyano groups on both sides of the polymer backbone give the phase a strong dipole moment and high selectivity for *cis/trans* compounds or compounds with conjugated double bonds. Highly polar columns typically exhibit poor column efficiencies, high bleed, and short column lifetimes when thermally cycled. To overcome some of these problems, we developed a surface treatment that is more compatible with the Rt™-2330 phase. In addition, our improved polymer produces columns with improved column efficiency and lower bleed.

Because the Rt™-2330 stationary phase is not bonded, it should not be solvent rinsed.

Rt™-2330 Columns (fused silica)

(90% biscyanopropyl/10% phenylcyanopropyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10	0 to 260/275°C	10705	10708	10711	10714
	0.20	0 to 260/275°C	10720	10723	10726	10729
0.32mm	0.10	0 to 260/275°C	10706	10709	10712	10715
	0.20	0 to 260/275°C	10721	10724	10727	10730
0.53mm	0.10	0 to 260/275°C	10707	10710	10713	
	0.20	0 to 260/275°C	10722	10725	10728	

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.10	0 to 260/275°C	40701	40702	40703

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rt™-2560 (highly polar phase; biscyanopropyl polysiloxane—not bonded)

- Application-specific column for *cis/trans* FAMES.
- Stable to 250°C.

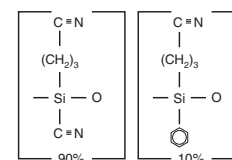
Because the Rt™-2560 stationary phase is not bonded, it should not be solvent rinsed.

Rt™-2560 Column (fused silica)

(biscyanopropyl polysiloxane)

ID	df (μm)	temp. limits	100-Meter
0.25mm	0.20	20 to 250°C	13199

Rt™-2330 Structure



similar phases

DB-23, HP-23, SP-2330, SP-2380

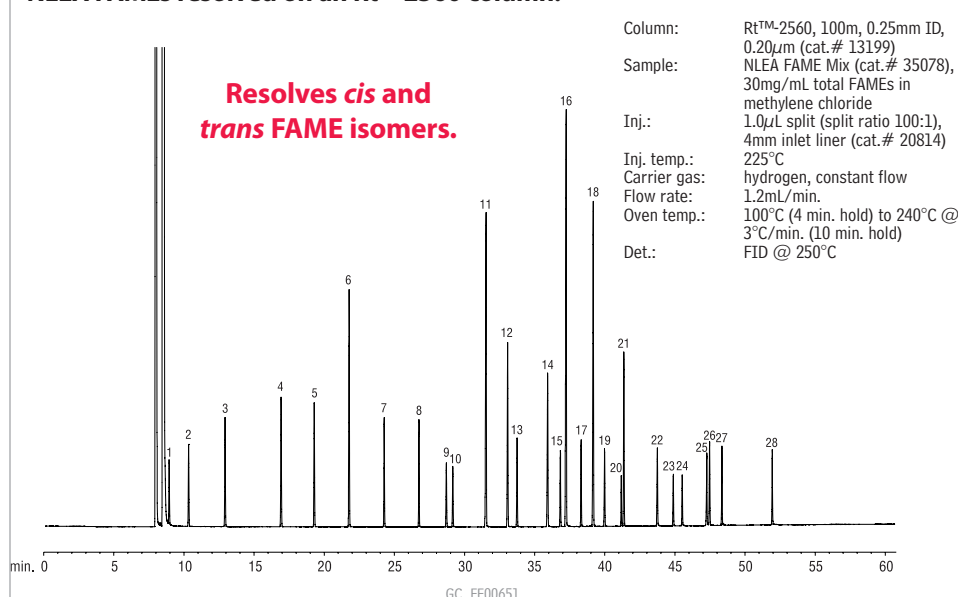
Doing Dioxin Analysis?

Rtx®-Dioxin and Rtx®-Dioxin2 columns provide better resolution and higher maximum temperatures than conventional biscyanopropyl columns. See [pages 72–73](#).

similar phases

SPB-2560, HP-88, Silar 10C, CP-Sil 88 FAME, CP-Sil 88

NLEA FAMES resolved on an Rt™-2560 column.



Column: Rt™-2560, 100m, 0.25mm ID, 0.20μm (cat.# 13199)
 Sample: NLEA FAME Mix (cat.# 35078), 30mg/mL total FAMES in methylene chloride
 Inj.: 1.0μL split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
 Inj. temp.: 225°C
 Carrier gas: hydrogen, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
 Det.: FID @ 250°C

1. C4:0 methyl butyrate
2. C6:0 methyl hexanoate
3. C8:0 methyl octanoate
4. C10:0 methyl decanoate
5. C11:0 methyl undecanoate
6. C12:0 methyl laurate
7. C13:0 methyl tridecanoate
8. C14:0 methyl myristate
9. C14:1 methyl myristoleate (*cis*-9)
10. C15:0 methyl pentadecanoate
11. C16:0 methyl palmitate
12. C16:1 methyl palmitoleate (*cis*-9)
13. C17:0 methyl heptadecanoate
14. C18:0 methyl stearate
15. C18:1 methyl elaidate (*trans*-9)
16. C18:1 methyl oleate (*cis*-9)
17. C18:2 methyl linoleate (*trans*-9,12)
18. C18:2 methyl linoleate (*cis*-9,12)
19. C20:0 methyl arachidate
20. C20:1 methyl eicosenoate (*cis*-11)
21. C18:3 methyl linolenate (*cis*-9,12,15)
22. C22:0 methyl behenate
23. C22:1 methyl erucate (*cis*-13)
24. C23:0 methyl tricosanoate
25. C24:0 methyl lignocerate
26. C20:5 methyl eicosapentaenoate (*cis*-5,8,11,14,17)
27. C24:1 methyl nervonate (*cis*-15)
28. C22:6 methyl docosahexaenoate (*cis*-4,7,10,13,16,19)

a **plus 1** story

"For many years, I have searched the market place for a bonded polar GC phase that delivered the chemical inertness, long-term phase stability and practical robustness necessary to meet my operational requirements. Only after an extensive nine month in-house testing programme, can I say that I have finally found that phase in Rtx®-Wax."

Steve Rowlands, Quest International (Kent UK)

similar **phases**

DB-WAX, HP-Wax

Rtx®-Wax (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, solvents, BTEX aromatics, flavor compounds, alcohols.
- Temperature range: 20°C to 250°C.
- Equivalent to USP G14, G15, G16, G20, G39 phases.

Rtx®-Wax columns are the most inert and efficient PEG columns currently available. The extended operating temperature range allows analysis of compounds having a wide volatility range, and ensures low bleed at temperatures as high as 250°C. Selectivity is comparable to other Carbowax® columns, for compounds of intermediate to high polarity. Selectivity data available on request.

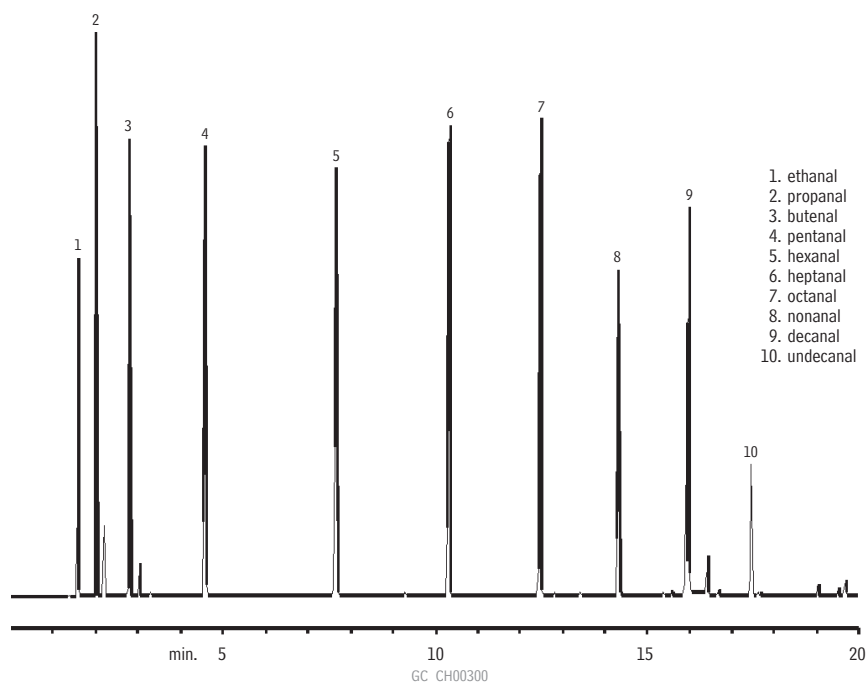
Rtx®-Wax Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	20 to 250°C	12405	12408	
	0.25	20 to 250°C	12420	12423	12426
	0.50	20 to 250°C	12435	12438	12441
0.32mm	0.10	20 to 250°C	12406	12409	
	0.25	20 to 250°C	12421	12424	12427
	0.50	20 to 250°C	12436	12439	12442
	1.00	20 to 240/250°C	12451	12454	12457
0.53mm	0.25	20 to 250°C	12422	12425	
	0.50	20 to 250°C	12437	12440	12443
	1.00	20 to 240/250°C	12452	12455	12458

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	20 to 250°C	41601	41602
	0.20	20 to 240/250°C	41603	41604

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Sharp, well-resolved peaks for aldehydes, using an Rtx®-Wax column.

Column: Rtx®-Wax, 30m, 0.25mm ID, 0.50μm (cat.# 12438)
 Inj.: split injection of C2-C11 aldehydes mixture
 On-column conc.: 250ng
 Oven temp.: 40°C (hold 5 min.) to 200°C @ 10°C/min.
 Inj./det. temp.: 200°C
 Carrier gas: hydrogen
 Linear velocity: 35cm/sec. set @ 40°C
 FID sensitivity: 82 x 10⁻¹¹ AFS
 Split ratio: 100:1

free literature

Selection Guide for Polar Wax GC Column Phases

- Performance information about six polyethylene glycol (PEG) columns.

- Applications for each column.

Download your free copy from www.restek.com.

Technical Guide
lit. cat.# 59890

Stabilwax® (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, flavor compounds, essential oils, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 250°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

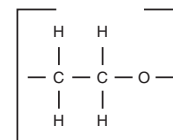
Our polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. The bonding mechanisms produce a column that can be rejuvenated by solvent washing. Compared to silicone stationary phases, PEG phases are more resistant to damage from strongly acidic or basic volatile compounds.

Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

ID	df (μm)	temp. limits	15-Meter	30-Meter	30-Meter 6/pk.	60-Meter
0.25mm	0.10	40 to 250°C	10605	10608		10611
	0.25	40 to 250°C	10620	10623		10626
	0.50	40 to 250°C	10635	10638		10641
0.32mm	0.10	40 to 250°C	10606	10609		10612
	0.25	40 to 250°C	10621	10624		10627
	0.50	40 to 250°C	10636	10639		10642
	1.00	40 to 240/250°C	10651	10654	10654-600	10657
0.53mm	0.10	40 to 250°C	10607	10610		10613
	0.25	40 to 250°C	10622	10625		10628
	0.50	40 to 250°C	10637	10640		10643
	1.00	40 to 240/250°C	10652	10655	10655-600	10658
	1.50	40 to 230/240°C	10666	10669		10672
	2.00	40 to 220/230°C	10667	10670		

Stabilwax® Structure



new and improved manufacturing procedure

- Better column-to-column reproducibility

similar phases

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

ordering note

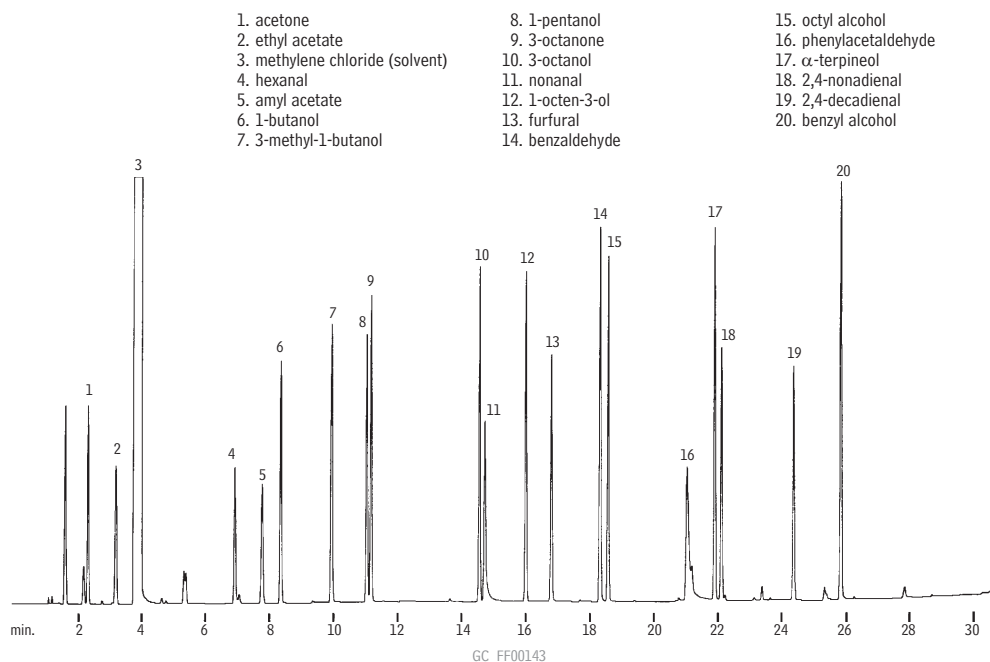
Stabilwax® columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See [page 19](#) for descriptions and ordering information.

also available

MXT® Columns

Rugged, flexible, Silcosteel® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 92](#) for our MXT®-WAX columns.

Synthetic mushroom aroma on a Stabilwax® column.



Column: Stabilwax®, 30m, 0.32mm ID, 1.0μm (cat.# 10654)
Sample: 1.0μL split injection of a synthetic mushroom aroma
Conc.: 10ng per component
Oven temp.: 40°C to 220°C @ 6°C/min.
Inj./det. temp.: 260°C
Carrier gas: hydrogen
Linear velocity: 40cm/sec.
FID sensitivity: 4 x 10¹¹ AFS
Split ratio: 100:1

Application-Specific Columns



Application-specific columns

- Designed for specific classes of compounds and methods.
- Includes specially deactivated columns.

Many chromatography markets and applications represented

- Foods, Flavors, & Fragrances.
- Petrochemical.
- Clinical/Forensic.
- Pharmaceutical.
- Environmental.

Unique stationary phases and applications

- Designed to help solve chromatographic challenges.



Basic Compounds Analysis

Rtx®-5 Amine (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 315°C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-5 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-5 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding, or even weakly acidic compounds such as phenols. Every Rtx®-5 Amine column is tested to ensure that it exceeds the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

Rtx®-5 Amine Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	-60 to 300/315°C	12320	12323
	0.50	-60 to 300/315°C	12335	12338
	1.00	-60 to 300/315°C	12350	12353
0.32mm	1.00	-60 to 300/315°C	12351	12354
	1.50	-60 to 290/305°C	12366	12369
0.53mm	1.00	-60 to 290/305°C	12352	12355
	3.00	-60 to 280/295°C	12382	12385

restek
innovation!

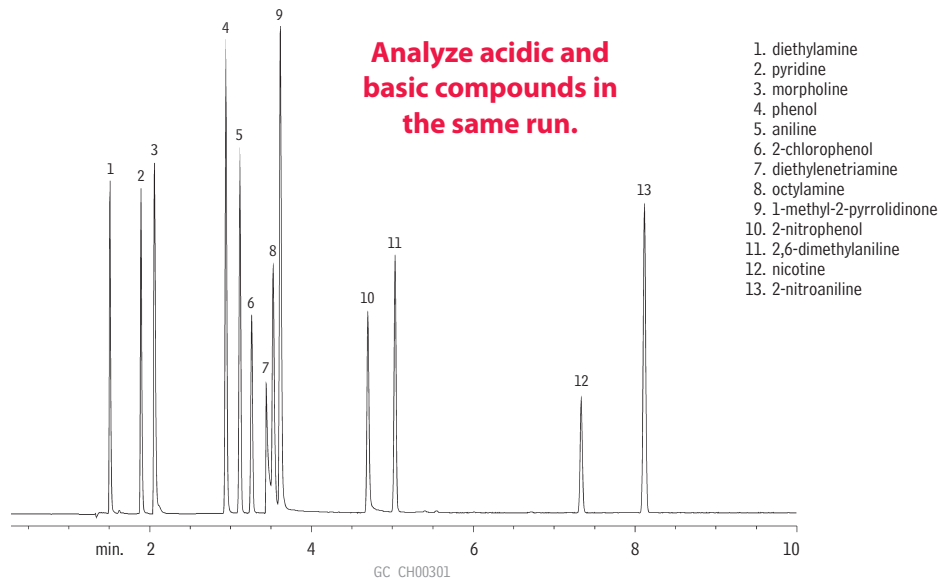
similar **phase**

PTA-5

also **available**

See **page 46** for Rtx®-35
Amine columns.

Excellent peak shapes for amines & phenols on an Rtx®-5 Amine column.



Column: Rtx®-5 Amine, 30m, 0.32mm ID, 1.0μm (cat.# 12354)
 Sample: 1.0μL split injection of amines and phenols in water
 On-column conc.: 22ng
 Oven temp.: 120°C to 220°C @ 10°C/min.
 Inj./det. temp.: 305°C
 Carrier gas: hydrogen
 Linear velocity: 38cm/sec. set @ 120°C
 FID sensitivity: 6.4 x 10⁻¹¹ AFS
 Split ratio: 25:1

please **note**

We recommend using
base-deactivated fused silica
guard columns (**page 18**) and
base-deactivated liners
(www.restek.com) with Rtx®-5
Amine columns.

Basic Compounds Analysis

restek
innovation!

Rtx®-35 Amine (midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 220°C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-35 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-35 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding. Every Rtx®-35 Amine column is tested to ensure that it meets the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

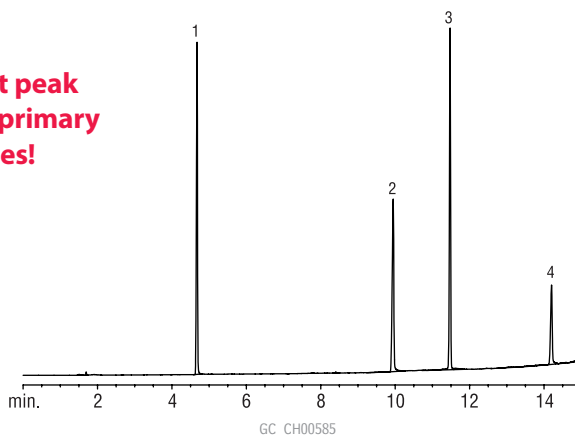
Rtx®-35 Amine Columns (fused silica)

(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.50	0 to 220°C	11335	11338
	1.00	0 to 220°C	11350	11353
0.32mm	1.00	0 to 220°C	11351	11354
	1.50	0 to 220°C	11366	11369
0.53mm	1.00	0 to 220°C	11352	11355
	3.00	0 to 220°C	11382	11385

Sharp ethanolamine peaks, low bleed: Rtx®-35 Amine column.

Excellent peak
shape for primary
amines!



1. monoethanolamine
2. diethanolamine
3. triethyleneglycol monomethylether
4. triethanolamine

Column: Rtx®-35 Amine, 30m, 0.32mm ID, 1.0μm (cat. # 11354)
 Sample: 500μg/mL ethanolamine standard in water
 Inj.: 1.0μL split (split ratio 10:1),
 cup splitter inlet liner (cat. # 20709)
 Inj. temp.: 300°C
 Carrier gas: helium, constant pressure
 Linear velocity: 40cm/sec. @ 50°C
 Oven temp.: 50°C (hold 0.50 min.) to 280°C @15°C/min.
 Det.: FID @ 300°C

Basic Compounds Analysis

Stabilwax®-DB (polar phase; Crossbond® base-deactivated Carbowax® polyethylene glycol)

- Application-specific columns for underivatized amines and other basic compounds, including alkylamines, diamines, triamines, nitrogen-containing heterocyclics. No need for column priming.
- Temperature range: 40°C to 220°C.

Stabilwax®-DB columns reduce adsorption and improve responses for many basic compounds, without analyte derivatization or column priming. For different selectivity of basic compounds, or higher oven temperatures, use an Rtx®-5 Amine or Rtx®-35 Amine column.

Stabilwax®-DB is a bonded stationary phase, but avoid rinsing these columns with water or alcohols.

Stabilwax®-DB Columns (fused silica)

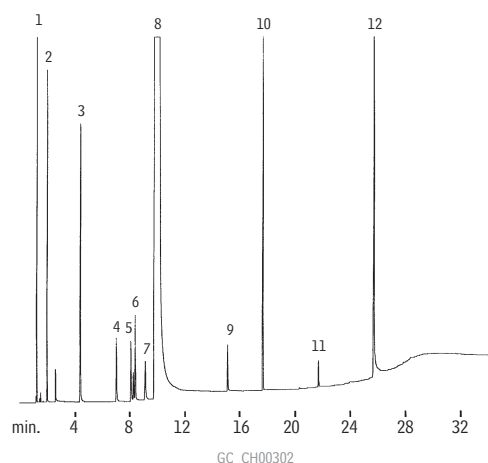
(Crossbond® Carbowax® polyethylene glycol for amines and basic compounds)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	40 to 210/220°C	10820	10823	
	0.50	40 to 210/220°C		10838	
0.32mm	0.25	40 to 210/220°C	10821	10824	
	0.50	40 to 210/220°C		10839	
	1.00	40 to 210/220°C	10851	10854	10857
0.53mm	0.50	40 to 210/220°C		10840	
	1.00	40 to 210/220°C	10852	10855	10858
	1.50	40 to 210/220°C		10869	

similar **phases**

DB-CAM, Carbowax® Amine,
CP Wax 51 for amines

Hexamethylenediamine (HMD) on a Stabilwax®-DB column.



**Excellent resolution
and peak shape for
impurities in HMD!**

1. cyclohexane
2. hexamethylenimine
3. 1,4-diaminobutane
4. pentamethylenediamine
5. 1,2-diaminocyclohexane
6. 1,5-diamino-2-methylpentane
7. aminomethylcyclopentylamine
8. hexamethylenediamine
9. 6-aminocapronitrile
10. *n*-valeramide
11. adiponitrile
12. bis-hexamethylenetriamine

Column: Stabilwax®-DB, 30m, 0.32mm ID, 0.25μm (cat.# 10824)
 Sample: 0.4μL direct injection of a neat hexamethylenediamine (HMD) sample
 On-column conc.: 10 to 1000ng/component
 Oven temp.: 95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 4 min.)
 Inj./det. temp.: 250°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 2 x 10⁻¹¹ AFS

Acidic Compounds Analysis

Stabilwax®-DA (polar phase; Crossbond® acid-deactivated Carbowax® polyethylene glycol)

- Application-specific columns for free (underivatized) acids, some inorganic acids.
- Resistant to oxidative damage.
- Temperature range: 40°C to 250°C.
- Equivalent to USP G25, G35 phases.

Stabilwax®-DA bonded polyethylene glycol has an acidic functionality incorporated into the polymer structure. This permits analysis of acidic compounds without derivatization, significantly reduces adsorption of acids, and increases sample capacity for volatile free acids. Stabilwax®-DA columns last longer and give better peak shapes for high molecular weight acids. Some inorganic acids also chromatograph well on a Stabilwax®-DA column; the limitation is the volatility of the acidic compound.

Stabilwax®-DA Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol for acidic compounds)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	40 to 250°C	11005	11008	11011
	0.25	40 to 250°C	11020	11023	11026
	0.50	40 to 250°C	11035	11038	11041
0.32mm	0.10	40 to 250°C	11006	11009	11012
	0.25	40 to 250°C	11021	11024	11027
	0.50	40 to 250°C	11036	11039	11042
	1.00	40 to 240/250°C	11051	11054	11057
0.53mm	0.10	40 to 250°C	11007	11010	11013
	0.25	40 to 250°C	11022	11025	11028
	0.50	40 to 250°C	11037	11040	11043
	1.00	40 to 240/250°C	11052	11055	11058
	1.50	40 to 230/240°C	11062	11065	11068

similar phases

DB-FFAP, HP-FFAP, NUKOL,
OV-351, CP-Wax 58 CB, FFAP

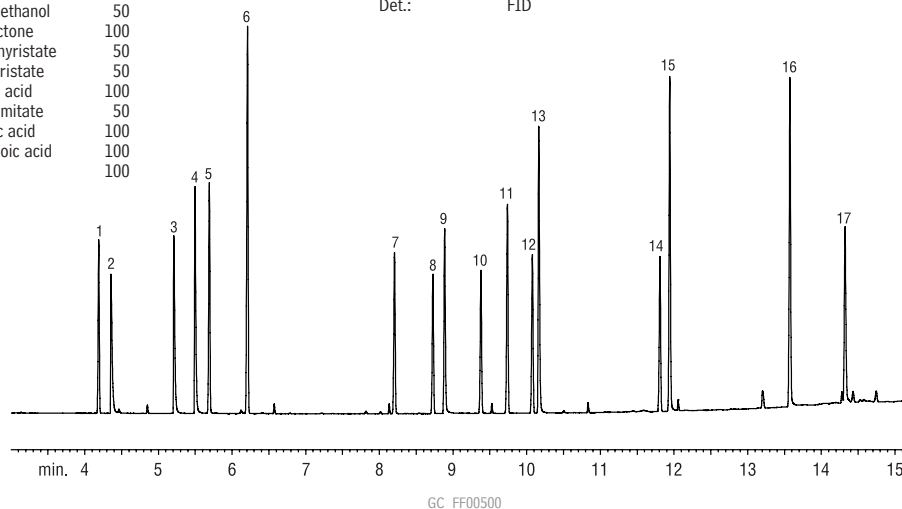
crossbond®
technology

reduces bleed, prolongs
column lifetime, and allows
rejuvenation through solvent
rinsing.

Underivatized alcoholic beverage acids and methyl esters on a Stabilwax®-DA column.

Peak List	Conc. (ppm)
1. ethyl octanoate	100
2. acetic acid	100
3. propionic acid	100
4. isobutyric acid	100
5. 3-decanol	50
6. ethyl decanoate	50
7. ethyl laurate	50
8. <i>cis</i> -lactone	100
9. 2-phenylethanol	50
10. <i>trans</i> -lactone	100
11. methyl myristate	50
12. ethyl myristate	50
13. octanoic acid	100
14. ethyl palmitate	50
15. decanoic acid	100
16. dodecanoic acid	100
17. vanillin	100

Column: Stabilwax®-DA, 30m, 0.18mm ID, 0.18μm (cat.# 550752)
Inj.: 1μL splitless (hold 0.5 min.) at conc. shown in
peak list, in ethyl acetate, 4mm ID splitless liner
w/wool (cat.# 20814-202.1)
Inj. temp.: 240°C
Carrier gas: hydrogen
Make-up gas: nitrogen
Linear velocity: 28psi @ 240°C
Oven temp.: 70°C to 240°C at 12°C/min. (hold 3 min.)
Det.: FID



Enantiomers Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

By adding β or γ cyclodextrin to our bonded Rtx®-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our unique DEX columns, and our columns continue to demonstrate stability after hundreds of temperature program cycles. Call our Technical Service chemists, or your Restek representative, for assistance in matching a column to your chiral analysis. Example applications are available at www.restek.com

Rt™- β DEXm Columns (fused silica)

(permethylated beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13100
0.32mm	0.25	40 to 230°C	13101

Uses: General purpose chiral phase with many published applications.

Rt™- β DEXsm Columns (fused silica)

(2,3-di-O-methyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13105
0.32mm	0.25	40 to 230°C	13104

Uses: Excellent column for most chiral compounds in essential oils.

Rt™- β DEXse Columns (fused silica)

(2,3-di-O-ethyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13107
0.32mm	0.25	40 to 230°C	13106

Uses: Similar in performance to Rt™- β DEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

Rt™- β DEXsp Columns (fused silica)

(2,3-di-O-propyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13111
0.32mm	0.25	40 to 230°C	13110

Uses: Often useful in dual-column configurations, with the Rt™- β DEXsm column, for complex enantiomeric separations.

Rt™- β DEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13109
0.32mm	0.25	40 to 230°C	13108

Uses: Unique selectivity for esters, lactones, and other fruit flavor components.

Rt™- β DEXcst Columns (fused silica)

(Proprietary cyclodextrin material doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13103
0.32mm	0.25	40 to 230°C	13102

Uses: Proprietary stationary phase, developed specifically for the fragrance industry. Also used for pharmaceutical applications.

Rt™- γ DEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl gamma cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μ m)	temp. limits	30-Meter
0.25mm	0.25	40 to 230°C	13113
0.32mm	0.25	40 to 230°C	13112

Uses: Larger organic molecules. Also useful for flavor compounds in fruit juices.

free literature

A Guide to the Analysis of Chiral Compounds by GC

Many example chromatograms in our 24-page chiral analysis guide will help you find the best chiral columns for your applications.

Download your free copy from www.restek.com

Technical Guide
lit. cat.# 59889

please note

Application-specific chiral column kits are available! See [page 50](#).

free literature

Grape Flavor Analysis, Using an Rt™- γ DEXsa GC Column

Download your free copy from www.restek.com.

Applications Note
lit. cat.# 59553

GC Analysis of Chiral Flavor Compounds in Apple Juices, Using Rt™- β DEXsm and Rt™- β DEXse Columns

Download your free copy from www.restek.com.

Applications Note
lit. cat.# 59546

Enantiomers Analysis

Convenient chiral column kits, based on sample type. Enantiomeric profile and confirmational identification of individual chiral compounds.

- Broad range of columns and selectivities.
- Rugged, highly stable columns.
- Extended column lifetime.
- Convenience and cost savings.

For phase descriptions, or to order columns separately, see page 47.

Pharmaceutical Chiral Column Kits

(fused silica)

Dimensions & Columns	cat. #
30m, 0.25mm ID, 0.25 μ m Rt- β DEXcst & Rt- β DEXsm columns	13190
30m, 0.32mm ID, 0.25 μ m Rt- β DEXcst & Rt- β DEXsm columns	13191

Environmental Chiral Column Kits

(fused silica)

Dimensions & Columns	cat. #
30m, 0.25mm ID, 0.25 μ m Rt- β DEXcst & Rt- β DEXsm columns	13192
30m, 0.32mm ID, 0.25 μ m Rt- β DEXcst & Rt- β DEXsm columns	13193

Juices Chiral Column Kits

(fused silica)

Dimensions & Columns	cat. #
30m, 0.25mm ID, 0.25 μ m Rt- β DEXse, Rt- β DEXsm & Rt- γ DEXsa columns	13194
30m, 0.32mm ID, 0.25 μ m Rt- β DEXse, Rt- β DEXsm & Rt- γ DEXsa columns	13195

Essential Oils Chiral Column Kits

(fused silica)

Dimensions & Columns	cat. #
30m, 0.25mm ID, 0.25 μ m Rt- β DEXsm, Rt- β DEXse, Rt- β DEXsa, & Rt- β DEXsp columns	13196
30m, 0.32mm ID, 0.25 μ m Rt- β DEXsm, Rt- β DEXse, Rt- β DEXsa, & Rt- β DEXsp columns	13197

please note

Application-specific chiral column kits offer convenience and cost savings.

tech tip

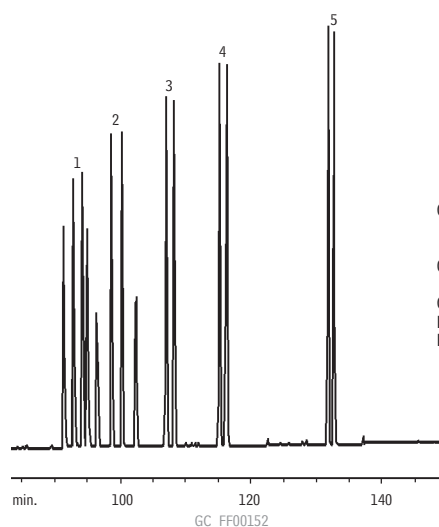
Chiral selectivity improves significantly by realizing lower elution temperatures. This can be achieved by:

Faster linear velocities (80cm/sec.) with hydrogen carrier gas.

Slower temperature ramp rates (1–2°C/min.).

Appropriate minimum operating temperature (40 or 60°C).

On-column concentrations of 50ng or less.

Complex γ -lactones mix resolved on an Rt™- β DEXcst column.

1. (+/-)- γ -heptalactone
2. (+/-)- γ -octalactone
3. (+/-)- γ -nonalactone
4. (+/-)- γ -decalactone
5. (+/-)- γ -dodecalactone

Column: Rt™- β DEXcst, 30m, 0.32mm ID, 0.25 μ m (cat. # 13102)
 Oven temp.: 60°C (hold 1 min.) to 200°C @ 1°C/min.
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec. set @ 60°C
 Det.: FID @ 220°C

Polyunsaturated FAME Analysis

FAMEWAX (polar phase; Crossbond® polyethylene glycol)

- Application-specific columns for FAMEs, specially tested with a FAME mixture.
- Temperature range: 20°C to 250°C.

The elution order of polyunsaturated FAMEs on FAMEWAX columns is comparable to that on other Carbowax® columns, but baseline resolution is achieved in significantly less time.

FAMEWAX Columns (fused silica)

(Crossbond® polyethylene glycol)

ID	df (μm)	temp. limits	30-Meter
0.25mm	0.25	20 to 250°C	12497
0.32mm	0.25	20 to 250°C	12498
0.53mm	0.50	20 to 250°C	12499

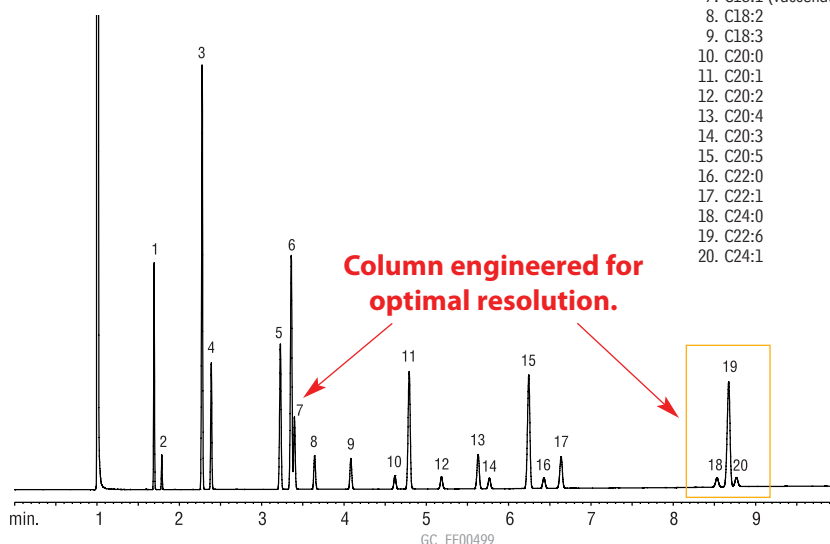
similar **phase**

Omegawax

FAMEs (marine oil standard) on a FAMEWAX column.

Column: FAMEWAX, 30m, 0.32mm ID, 0.25μm (cat. # 12498)
 Inj.: 1μL
 Conc.: 10,000μg/mL in isooctane (total FAMES; see breakdown in peak list)
 Oven temp.: 195–240°C at 5°C/min., 1 min. hold
 Inj./det. temp.: 250°C/275°C
 Carrier gas: hydrogen
 Flow rate: 3mL/min. (constant flow)
 Split ratio: 100:1

Peak List	Conc. (μg/mL)
1. C14:0	600
2. C14:1	100
3. C16:0	1600
4. C16:1	500
5. C18:0	800
6. C18:1 (oleate)	1300
7. C18:1 (vaccenate)	400
8. C18:2	200
9. C18:3	200
10. C20:0	100
11. C20:1	900
12. C20:2	100
13. C20:4	300
14. C20:3	100
15. C20:5	1000
16. C22:0	100
17. C22:1	300
18. C24:0	100
19. C22:6	1200
20. C24:1	100



free literature

Foods, Flavors, and Fragrances

Includes important analysis tips and chromatograms for analysis of fats and oils, carbohydrates, vitamins, amino acids, organic acids, preservatives, flavors and fragrances, essential oils, and chiral separations. Retention time indices and complete product listings for all relevant GC and HPLC products also are included.

Minicatalog

lit. cat. # 59260A

Monitoring Volatile Compounds in Food Contact Packaging, Using Purge and Trap GC/MS and an Rtx®-5MS Capillary Column

Download your free copy from www.restek.com

Applications Note
lit. cat. # 59348

Flavor and Fragrance Compounds Analysis

Rt™-CW20M F&F (polar phase; Carbowax® polyethylene glycol—not bonded)

- Application-specific columns for flavor and fragrance compounds, specially tested.
- True nonbonded Carbowax® 20M polarity.
- Temperature range: 20°C to 220°C.

Rt™-CW20M F&F Columns (fused silica)

(Carbowax® polyethylene glycol)

ID	df (μm)	temp. limits	30-Meter	50-Meter
0.25mm	0.25	60 to 220°C	12523	
0.32mm	0.33	60 to 220°C		12539

similar **phases**

HP-20M, Carbowax® 20M

Flavor & Fragrance Compounds Analysis

please **note**

Our Rt™-CW20M F&F column is the perfect confirmation column for flavor and fragrance analysis. See page 51.

Rtx®-1 F&F (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns for flavor and fragrance compounds.
- Stable to 350°C.

Retention index libraries in the flavor and fragrance industry have been compiled from years of data and thousands of compounds. Any slight variation in column selectivity could render the column useless. Rtx®-1 F&F columns are tailored to match the selectivity required in the industry, while offering excellent thermal stability. Our stringent quality testing ensures column-to-column reproducibility and extended column lifetimes over conventional 100% dimethyl polysiloxane columns.

Rtx®-1 F&F Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	50-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C		18023		18026
	0.50	-60 to 330/350°C		18038		18041
	1.00	-60 to 320/340°C		18053		18056
0.32mm	0.25	-60 to 330/350°C		18024		18027
	0.50	-60 to 330/350°C		18039	18010	18042
	1.00	-60 to 320°C		18054		18057
0.53mm	0.50	-60 to 310/330°C	18037	18040		18043
	1.00	-60 to 310/330°C	18052	18055		18058
	1.50	-60 to 310/330°C	18067	18070		18073

similar **phase**

HP-1



GC Columns Manufacturing Group

Jason Fisher, Sheldon McMurtrie, Michele Richner, Tom Barone, Ken Kline, Linda Holden, Tom Gurecki, Jack Haesler, Aaron Decker, Carolyn Williams, Dale Lucas, Kelsea Miller



Raymond Ciampichini, Pete Rose, David Rhodes, Jackie Glasgow, Kim Shaffer, Marcia Fulton, Santina Newlen, David W. Rhodes, Henry Knepp, Russ Stewart, Jessica Andrus, Tim Wilson

*We work hard to ensure the products you receive are of the highest quality.
We are ISO 9001 certified and take pride in making the best columns on the market.*

Triglycerides in Foods Analysis

Rtx®-65TG (high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- Application-specific columns, specially tested for triglycerides.
- Stable to 370°C.

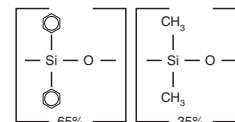
The Rtx®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370°C thermal stability, an Rtx®-65TG column should not be used for analyses of polar compounds.

Rtx®-65TG Columns (fused silica)

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.10	40 to 370°C	17005	17008
0.32mm	0.10	40 to 370°C	17006	17009
0.53mm	0.10	40 to 370°C	17007	17010

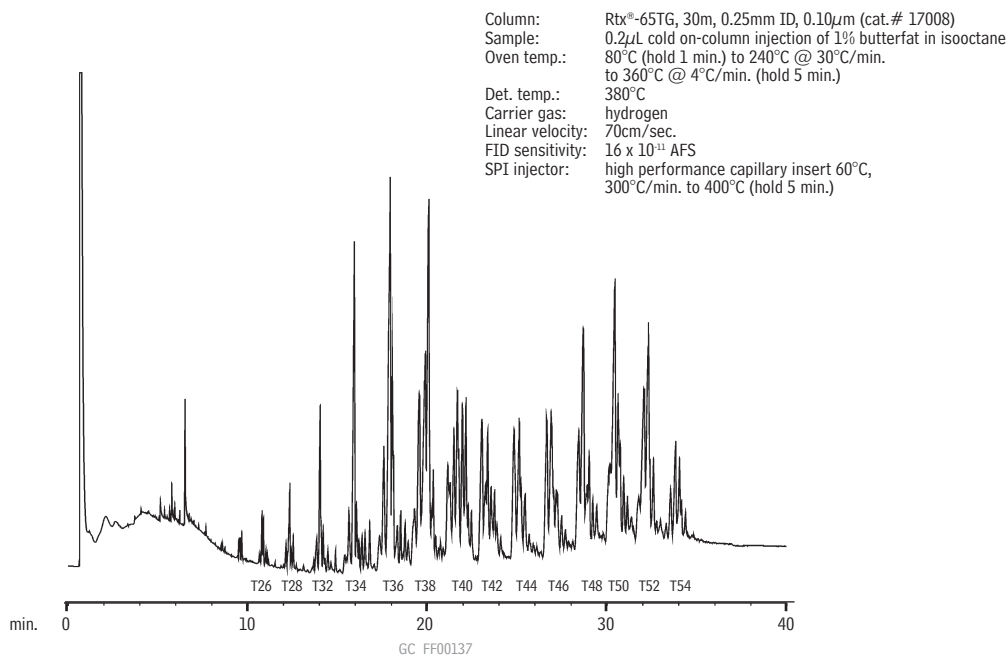
Rtx®-65TG Structure



save money!

Get six columns for the price of five. Call 800-356-1688, ext. 4, or your Restek representative for details!

Sharp resolution of butter triglycerides on an Rtx®-65TG column.



crossbond® technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

please note

Triglycerides are often injected via on-column injection. Use 0.53mm retention gaps and appropriate connectors.

- Vu2 Union®
- MXT™-Union Connector Kits for Fused Silica

Get More!

Food, Flavor & Fragrance
Related Articles Online

www.restek.com/FFF

Detailed Hydrocarbon Analysis (DHA)

please **note**

To achieve critical resolutions, a 5-meter tuning column is connected to the analytical column and adjusted to the needed length through a series of trial analyses.

Rtx®-1PONA (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns meet ASTM and CGSB requirements for detailed hydrocarbon analysis.
- Stable to 340°C.

The Rtx®-1PONA polymer was designed to offer the exact polarity necessary to resolve hydrocarbons in the specific order requested by petrochemical companies. In order to meet the demanding resolution and retention criteria of the American Society for Testing and Materials (ASTM) and the Canadian General Standards Board (CGSB), Restek has developed unique quality control tests and specifications for the Rtx®-1PONA column. The measured values for retention (k), efficiency (n), and stationary phase selectivity (RI) are controlled so that each column exceeds the requirements of the ASTM and CGSB methods.

Rtx®-1PONA Column (fused silica)

(Crossbond® 100% dimethyl polysiloxane—optimized for hydrocarbon analysis)

ID	df (μm)	temp. limits	100-Meter
0.25mm	0.50	-60 to 300/340°C	10195

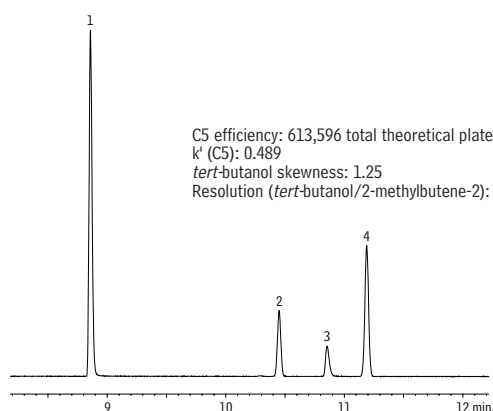
similar **phases**

Petrocol DH, DB-Petro,
HP-PONA

Rtx®-5PONA Tuning Column (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

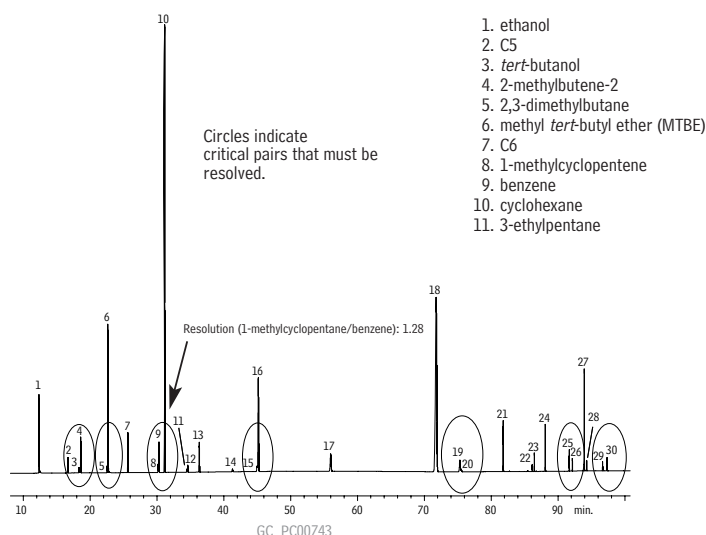
ID	df (μm)	temp. limits	5-Meter
0.25mm	1.0	-60 to 325°C	10196

Sharp, symmetric peak for ethanol (gasoline oxygenate), using an Rtx®-1PONA column.**

**Rtx®-1PONA column
produces near
symmetrical alcohol peaks!**

1. ethanol
2. C5
3. tert-butanol
4. 2-methylbutene-2

**P=paraffins; O=olefins; N=naphthenes; A=aromatics.
In alternate terminology: paraffins & isoparaffins = alkanes;
naphthenes = cyclic alkanes; olefins = alkenes.

Critical pairs of gasoline components resolved per ASTM specifications, using an Rtx®-1PONA column.

1. ethanol
2. C5
3. tert-butanol
4. 2-methylbutene-2
5. 2,3-dimethylbutane
6. methyl tert-butyl ether (MTBE)
7. C6
8. 1-methylcyclopentane
9. benzene
10. cyclohexane
11. 3-ethylpentane
12. 1-tert-2-dimethylcyclopentane
13. C7
14. 2,2,3-trimethylpentane
15. 2,3,3-trimethylpentane
16. toluene
17. C8
18. ethylbenzene
19. p-xylene
20. 2,3-dimethylheptane
21. C9
22. 5-methylnonane
23. 1,2-methylethylbenzene
24. C10
25. C11 (undecane)
26. 1,2,3,5-tetramethylbenzene
27. naphthalene
28. C12 (dodecane)
29. 1-methylnaphthalene
30. C13 (tridecane)

Column: Rtx®-1PONA, 100m, 0.25mm ID, 0.5μm (cat.# 10195)
plus Rtx®-5PONA tuning column, 2.62m, 0.25mm ID,
1.0μm, connected via Press-Tight® connector
(cat.# 20446)

Sample: custom detailed hydrocarbon analysis
(DHA) mix, neat

Inj.: 0.01μL, split (split ratio 150:1), 4mm cup
inlet liner (cat.# 20709)

Inj. temp.: 200°C

Carrier gas: helium, constant flow

Linear velocity: 28cm/sec. (2.3mL/min.)

Oven temp.: 5°C (hold 15 min.) to 50°C @ 5°C/min. (hold
50 min.) to 200°C @ 8°C/min. (hold 10 min.)

Det.: FID @ 250°C

Simulated Distillation (C5-C44) Analysis

Rtx®-2887 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns for simulated distillation.
- Stable to 360°C.

Rtx®-2887 columns' stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times.

Rtx®-2887 Column (fused silica)

(Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

ID	df (μm)	temp. limits	10-Meter
0.53mm	2.65	-60 to 360°C	10199

MXT®-2887 Column (Siltek® treated stainless steel)

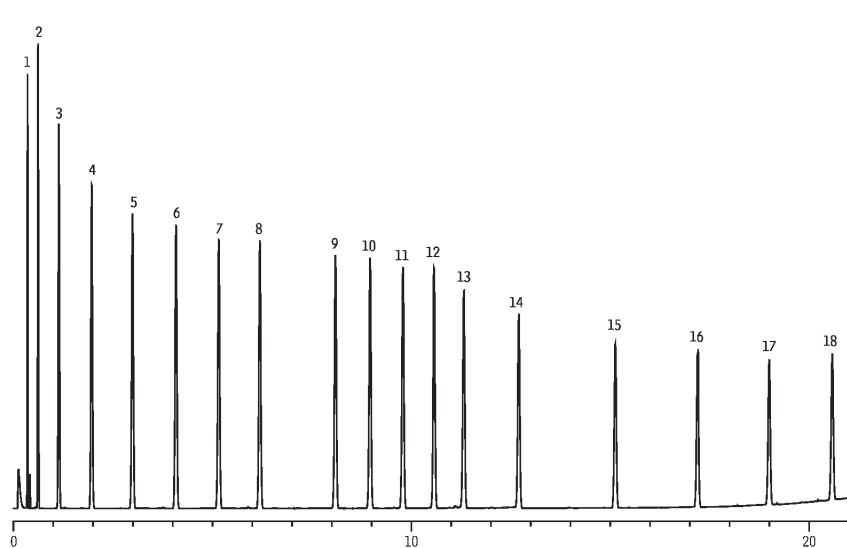
(Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

ID	df (μm)	temp. limits	10-Meter
0.53mm	2.65	-60 to 400°C	70199

similar **phases**

DB-2887, Petrocol EX2887

Negligible baseline rise for C5 to C44 hydrocarbons on an Rtx®-2887 column.



1. C5
2. C6
3. C7
4. C8
5. C9
6. C10
7. C11
8. C12
9. C14
10. C16
11. C18
12. C20
13. C24
14. C28
15. C32
16. C36
17. C40
18. C44

GC_PC00750

Column: Rtx®-2887, 10m, 0.53mm ID, 2.65μm (cat.# 10199)
 Sample: 1μL direct injection of 0.01-0.1 wt. % C5 to C44 hydrocarbon standard in carbon disulfide
 Inj. temp.: 360°C
 Det. temp.: 360°C
 Carrier gas: helium (constant flow)
 Linear velocity: 15mL/min. (112cm/sec.)
 Oven temp.: 35°C to 360°C @ 15°C/min. (hold 5 min.)

Simulated Distillation (C44-C100) Analysis

MXT®-1HT Sim Dist/MXT®-1 Sim Dist/MXT®-500 Sim Dist (nonpolar phases)

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-1HT Sim Dist and MXT®-1 Sim Dist phases offer true methyl silicone polarity; MXT®-500 Sim Dist phase is a carborane siloxane polymer.
- Stable to 430°C.

Manufactured from Siltek® treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available. As outlined in ASTM Method D6352, high temperature simulated distillation requires a column that can withstand temperatures to 430°C. MXT®-1HT Sim Dist and MXT®-500 Sim Dist columns exhibit excellent peak shape and low bleed, even at 430°C! The unique MXT®-1HT Sim Dist methyl silicone polymer gives the correct retention time/boiling point curve. The MXT®-500 Sim Dist carborane siloxane polymer offers a slight shift in the calculated boiling range distribution for petroleum samples containing aromatic hydrocarbons.

MXT®-1HT Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	5-Meter
0.53mm	0.10	-60 to 430°C	70100

MXT®-1 Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70101

MXT®-500 Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70104

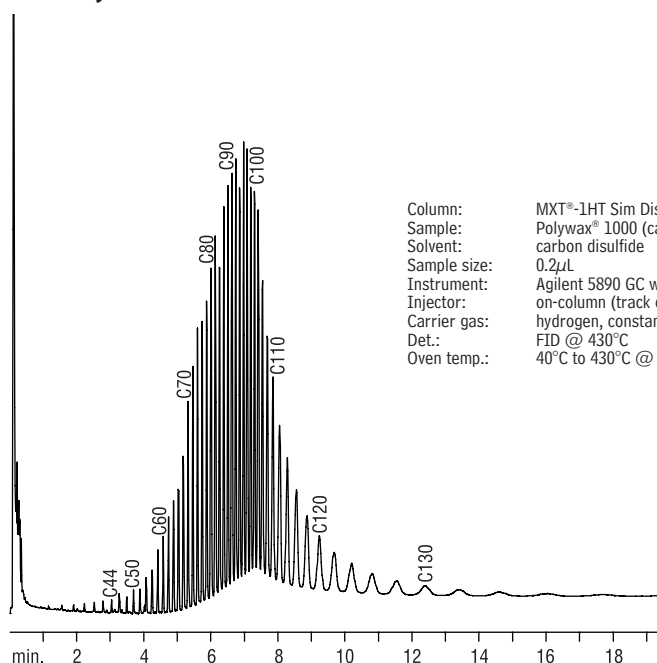
similar phases

DB-1HT, CP-HT-Simdist CB

Polywax® Calibration Materials

Description	qty.	cat.#
Polywax 655 calibration material	1g	36225
Polywax 1000 calibration material	1g	36227

C44-C130 hydrocarbons on an MXT®-1HT Sim Dist column.



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.10μm (cat.# 70100)
 Sample: Polywax® 1000 (cat.# 36227)
 Solvent: carbon disulfide
 Sample size: 0.2μL
 Instrument: Agilent 5890 GC w/GC Racer
 Injector: on-column (track oven)
 Carrier gas: hydrogen, constant pressure (1.0psi)
 Det.: FID @ 430°C
 Oven temp.: 40°C to 430°C @ 60°C/min. (hold 30 min.)

GC_PC00543

Aromatics & Oxygenates in Gasoline Analysis

Rt™-TCEP (highly polar phase; 1,2,3-tris[2-cyanoethoxy]propane—not bonded)

- General purpose columns, ideal for aromatics and oxygenates in gasoline.
- Temperature range: 0°C to 135°C.

Most gasolines contain aliphatic hydrocarbons up to *n*-dodecane (C12). To improve identification of the aromatics and oxygenates, it is desirable to elute benzene after C11 and toluene after C12. The extremely polar Rt™-TCEP stationary phase provides a retention index for benzene greater than 1100 and permits the separation of alcohols and aromatics from the aliphatic constituents in gasoline.

Rt™-TCEP columns have the same high polarity as TCEP packed columns (precolumns in ASTM Method D4815 for the analysis of petroleum oxygenates), with the efficiency of a capillary column. The result is a column that can separate a wide variety of compounds with an elution pattern unattainable using other high polarity siloxanes.

The Rt™-TCEP column incorporates a nonbonded stationary phase coated on a surface specialized for enhanced polymer stability and extended column lifetime. Solvent rinsing should be avoided. Conditioning is necessary only if the column is to be used at temperatures near the maximum operating temperature.

Rt™-TCEP Columns (fused silica)

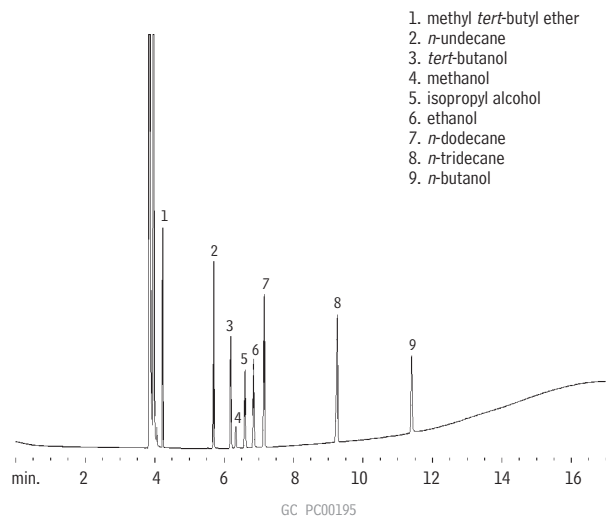
(1,2,3-tris[2-cyanoethoxy]propane)

ID	df (μm)	temp. limits	30-Meter	60-Meter
0.25mm	0.40	0 to 135°C	10998	10999

similar **phases**

SPB-TCEP, CP-TCEP

Petroleum oxygenates on an Rt™-TCEP column.

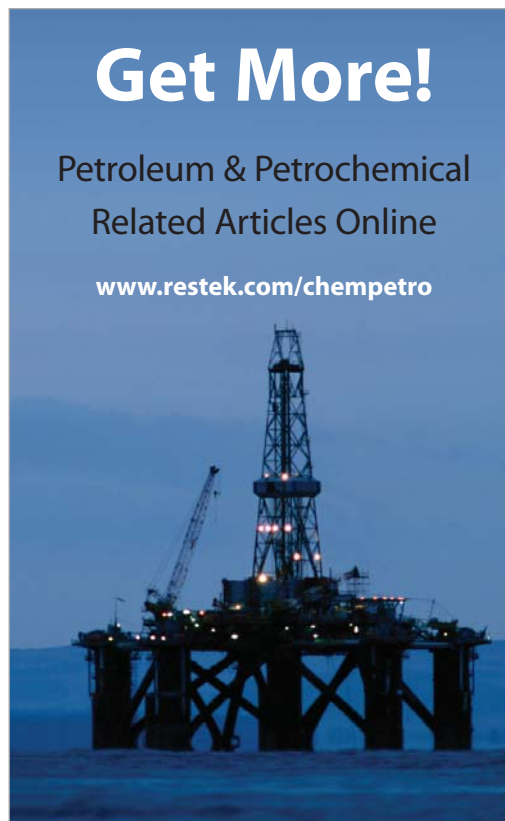


Column: Rt™-TCEP, 60m, 0.25mm ID, 0.4μm (cat.# 10999)
 Inj.: 1.0μL split injection, components @ 500ppm.
 Oven temp.: 60°C (hold 5 min.) to 100°C @ 5°C/min. (hold 10 min.)
 Inj./det. temp.: 200°C
 Carrier gas: helium
 Linear velocity: 30cm/sec. set @ 80°C
 FID sensitivity: 6.4 x 10⁻¹¹ AFS
 Split flow: 46mL/min.

Get More!

Petroleum & Petrochemical
 Related Articles Online

www.restek.com/chempetro



Biodiesel Fuels Analysis

new!**Rtx®-Biodiesel TG**

- Linearity for all reference compounds exceeds method requirements.
- Alumaseal™ connector provides leak-free connection; guard column extends column life.
- Low column bleed at high temperatures.
- For glycerine and glyceride analysis, according to ASTM D6584 and EN 14105 methods.

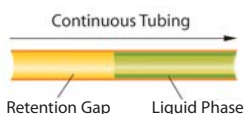
Rtx®-Biodiesel TG Columns (fused silica)

Description	temp. limits	cat.#
10m, 0.32mm ID, 0.10	to 330/380°C	10292
10m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	to 330/380°C	10291
15m, 0.32mm ID, 0.10	to 330/380°C	10294
15m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	to 330/380°C	10293

new!

Integra-Gap™ technology.

- Built-in retention gap
- Eliminates connector

**MXT®-Biodiesel TG**

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430°C for reliable, consistent performance.
- Integra-Gap™ built-in retention gap on 0.53mm ID column eliminates column coupling completely.

MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

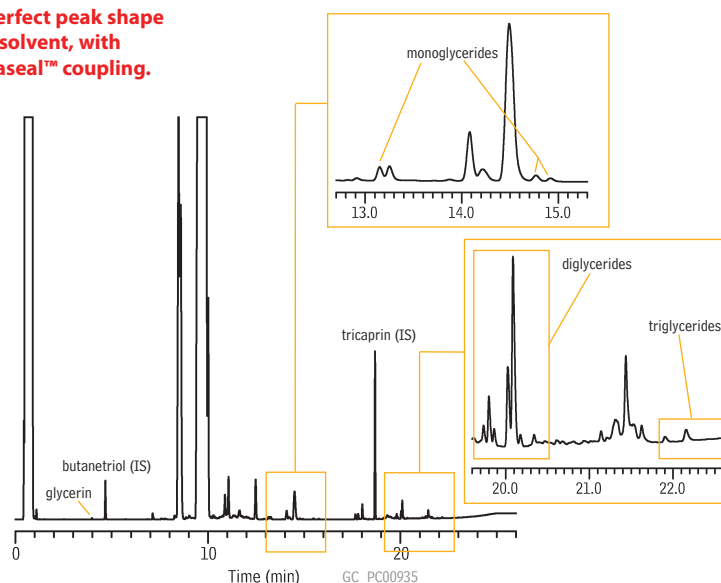
Description	temp. limits	cat.#
14m, 0.53mm ID, 0.16 w/2m Integra-Gap	-60 to 380/430°C	70289
10m, 0.32mm ID, 0.10	-60 to 380/430°C	70292
10m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	-60 to 380/430°C	70290
15m, 0.32mm ID, 0.10	-60 to 380/430°C	70293
15m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	-60 to 380/430°C	70291

*Total column length=16 meters.

**Connected with low-dead-volume Alumaseal™ connector.

Derivatized B100 and internal standards on an MXT®-Biodiesel TG column with 2m x 0.53mm ID retention gap, according to ASTM D6584.

Note perfect peak shape of solvent, with Alumaseal™ coupling.



Column: MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1µm with 2m x 0.53mm retention gap (cat.# 70290)
 Sample: B100 + IS Butanetriol & Tricaprin derivatized with MSTFA as per ASTM D-6584
 Inj.: 1.0µL cool on-column
 Inj. temp.: oven track
 Carrier gas: hydrogen, constant flow
 Flow rate: 4mL/min.
 Oven temp.: 50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)
 Det.: FID @ 430°C

Blood Alcohol Analysis

Rtx®-BAC1/Rtx®-BAC2 (proprietary Crossbond® phase)

- Application-specific columns for blood alcohol analysis—achieve baseline resolution in less than 3 minutes. Also excellent for abused inhalant anesthetics, γ -hydroxybutyrate (GHB)/ γ -butyrolactone (GBL), glycols, and common industrial solvents.
- Rtx®-BAC2 confirmation column provides four elution order changes under the same conditions.
- Stable to 260°C.

restek
innovation!

Baseline resolution in less than 3 minutes.

These columns separate to baseline all blood alcohol compounds in blood, breath, or urine, in less than 3 minutes, under isothermal conditions. Isothermal analysis increases productivity by eliminating the need for oven cycling. Confirmation is easily achieved with this tandem set because there are four elution order changes between the two columns.

similar **phases**

DB-ALC1, DB-ALC2

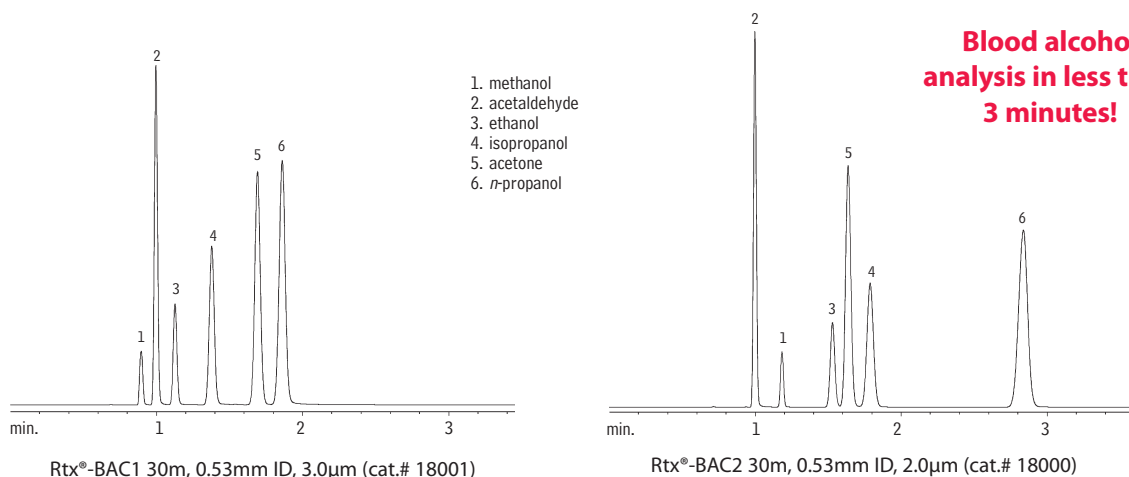
Rtx®-BAC1 Columns (fused silica)

ID	df (μ m)	temp. limits	30-Meter
0.32mm	1.80	-20 to 240/260°C	18003
0.53mm	3.00	-20 to 240/260°C	18001

Rtx®-BAC2 Columns (fused silica)

ID	df (μ m)	temp. limits	30-Meter
0.32mm	1.20	-20 to 240/260°C	18002
0.53mm	2.00	-20 to 240/260°C	18000

Rapid, reliable blood alcohol testing, using Rtx®-BAC 1 and Rtx®-BAC2 columns.



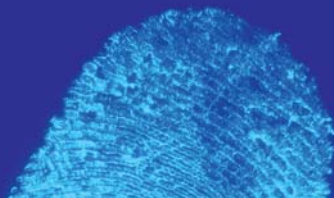
GC_PH00239

Inj.: 1.0mL headspace sample of a blood alcohol mix
Sample conc.: 0.1% per compound
Oven temp.: 40°C
Inj./det. temp.: 200°C
Carrier gas: helium
Linear velocity: 80cm/sec. set @ 40°C
FID sensitivity: 1.28 x 10⁻¹⁰ AFS

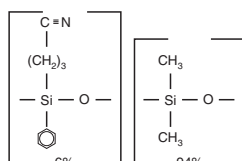
Get More!

Clinical/Forensics/Toxicology
Related Articles Online

www.restek.com/CFT



G43 phase

Rtx®-1301/Rtx®-624
Structure

Organic Volatile Impurities (OVI) Analysis

Rtx®-1301/Rtx®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

Many analysts feel the Rtx®-1301 column has the best cyanosilicone bonded stationary phase available, with no other column manufacturer providing lower bleed, longer lifetime, or better inertness. Our polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed—even with sensitive detectors such as ECDs and MSDs.

Rtx®-1301 (G43) Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	30-Meter	60-Meter
0.32mm	1.80	-20 to 240°C	16092	16093
0.53mm	3.00	-20 to 240°C	16085	16088

Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter
0.32mm	1.80	-20 to 240°C	10970

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

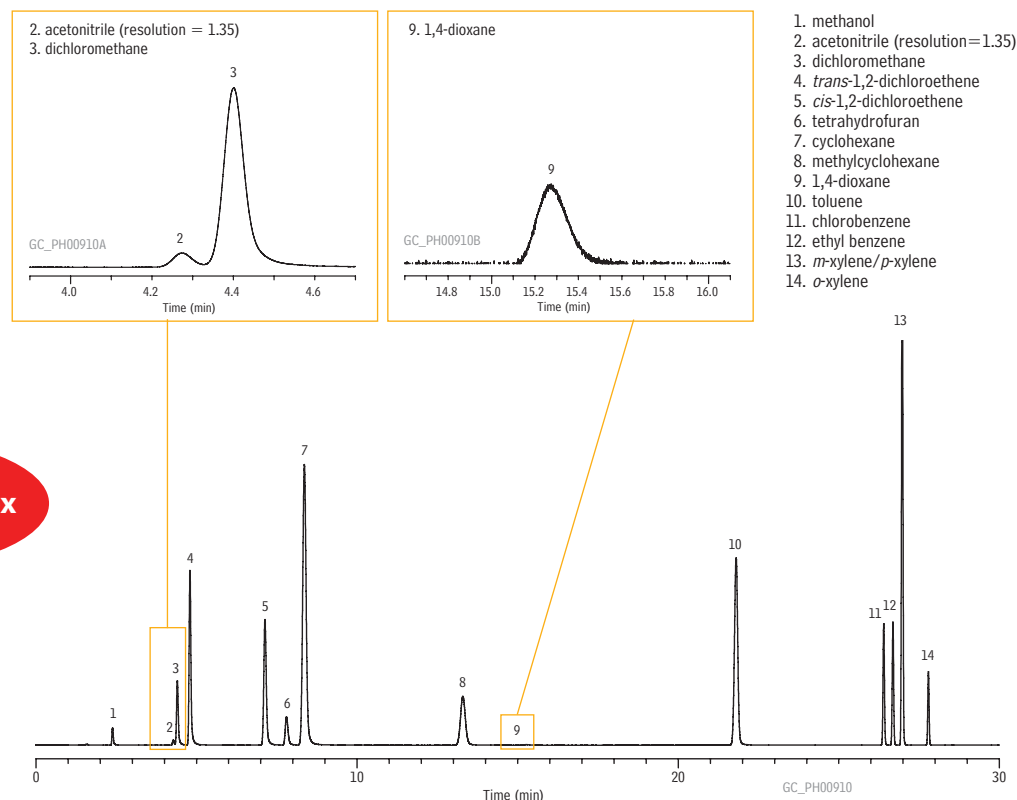
similar phases

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

please note

Rtx®-1301 and Rtx®-624 columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See [page 19](#) for descriptions and ordering information.

USP Residual Solvent Class 2 Mixture A standard solution on an Rtx®-1301 column.



See our
OVI Retention Index
on page 96.

Column: Rtx®-1301, 30m, 0.32 ID, 1.8μm (cat.# 16092)
Sample: USP <467> Class 2 Mixture A standard solution (cat.# 36271) in 20mL headspace vial
Inj.: headspace injection (split ratio 1:5), 1mm split liner, Siltek® deactivated (cat.# 20972-214.1)
Inj. temp.: 140°C
Carrier gas: helium, constant flow
Flow rate: 2.16mL/min., 35.3cm/sec.
Oven temp.: 40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)
Det.: FID @ 240°C

Headspace Conditions
Instrument: Tekmar HT3
Transfer line temp.: 105°C
Valve oven temp.: 105°C
Sample temp.: 80°C
Sample equil. time: 45 min.
Vial pressure: 10psi
Pressurize time: 0.5 min.
Loop fill pressure: 5psi
Loop fill time: 2.00 min.
Inject time: 1.00 min.

Organic Volatile Impurities (OVI) Analysis

Stabilwax® (polar phase; Crossbond® Carbowax® polyethylene glycol)

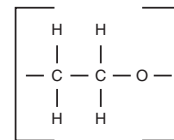
- General purpose columns for FAMES, flavor compounds, essential oils, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 250°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Our polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. The bonding mechanisms produce a column that can be rejuvenated by solvent washing. Compared to silicone stationary phases, PEG phases are more resistant to damage from strongly acidic or basic volatile compounds.

Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

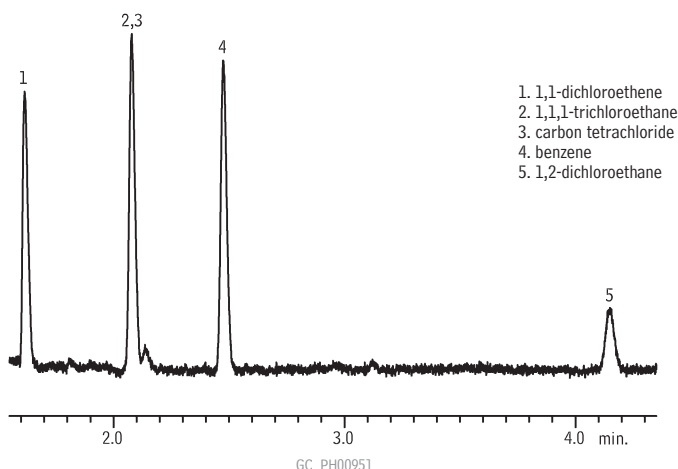
ID	df (μm)	temp. limits	30-Meter
0.32mm	0.25	40 to 250°C	10624
0.53mm	0.25	40 to 250°C	10625

G16 phase**Stabilwax® Structure**similar **phases**

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

ordering **note**

Stabilwax® columns are available with Integra-Guard™ built-in guard columns. Get the protection without the connection! See **page 19** for descriptions and ordering information.

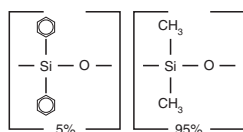
Residual solvents class 1 on a Stabilwax® (G16) column.

Column: Stabilwax®, 30m, 0.32mm ID, 0.25μm (cat. # 10624)
 Sample: USP Stock Mixture USP <467> Residual Solvents Class 1 Mix (cat. # 36279) in 20mL headspace vial (cat. # 24685), water diluent
 Inj.: headspace injection (split ratio 1:5), 2mm splitless liner IP deactivated (cat. # 20712)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.15mL/min., 35.2cm/sec.
 Oven temp.: 50°C for 20 min. to 165°C @ 6°C/min. (hold for 20 min.)
 Det.: FID @ 250°C

Headspace Conditions
 Instrument: Overbrook Scientific HT200H
 Syringe temp.: 100°C
 Sample temp.: 80°C
 Sample equil. time.: 45 min.
 Injection vol.: 1.0mL
 Injection speed: setting 8
 Injection dwell: 5 sec.

See our
OVI Retention Index
 on page 96.

G27 phase

Rtx®-5
Structure

Organic Volatile Impurities (OVI) Analysis

Rtx®-5 (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners or (e.g.) Aroclor mixes, essential oils, semivolatiles.
- Temperature range: -60°C to 350°C.
- Equivalent to USP G27 and G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

similar phases

DB-5, HP-5, HP-5MS, Ultra-2,
SPB-5, Equity-5, MDN-5

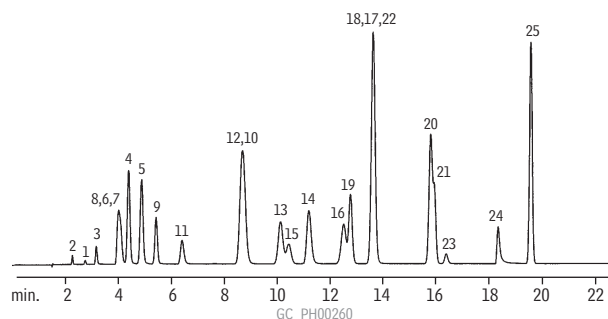
Rtx®-5 Columns (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	30-Meter
0.53mm	5.00	-60 to 270/290°C	10279

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Organic volatile impurities on an Rtx®-5 (Rtx®-G27) column.



1. ethylene oxide
2. methanol
3. ethanol
4. diethyl ether
5. 1,1-dichloroethene
6. acetone
7. isopropanol
8. acetonitrile
9. methylene chloride
10. n-hexane
11. n-propanol
12. methyl ethyl ketone
13. ethyl acetate
14. tetrahydrofuran
15. chloroform
16. 1,1,1-trichloroethane
17. carbon tetrachloride
18. benzene
19. 1,2-dichloroethane
20. heptane
21. trichloroethylene
22. n-butanol
23. 1,4-dioxane
24. pyridine
25. toluene

Rtx®-5 (Rtx®-G27) with 5m phenylmethyl Integra-Guard™ guard column,
30m, 0.53mm ID, 5.0μm (cat.# 10279-126)

Inj.: Headspace injection of common solvents for pharmaceutical processing. Prepared to equal about 500ppm in the bulk pharmaceutical. Samples shaken and heated at 90°C for 15 minutes, 1mL headspace injection.

Oven temp.: 35°C (hold 10 min.) to 100°C @ 5°C/min., to 240°C @ 25°C/min. (hold 5 min.)

Inj./det. temp.: 220°C/240°C

FID sensitivity: 1.05 x 10⁻¹¹ AFS

Carrier gas: helium, 35cm/sec. set @ 35°C

Split ratio: 2:1

it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rtx®-5ms columns! See pages 22-25, 27.

See our
OVI Retention Index
on page 96.

Organic Volatile Impurities (OVI) Analysis

Rtx®-G27 (Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

with Integra-Guard™ Guard Column

Rtx®-G43 (Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

with Integra-Guard™ Guard Column

- Analytical column with Integra-Guard™ guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290°C; Rtx®-G43 stable to 240°C.

please **note**

Analytical Reference Materials for USP <467> are available. See www.restek.com.

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard™ guard column)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column
0.53mm	5.00	-60 to 270/290°C	10279-126

Rtx®-G43 Column (fused silica with 5-meter Integra-Guard™ guard column)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column
0.53mm	3.00	-20 to 240°C	16085-126

free literature

A Technical Guide for Static Headspace Analysis Using GC

Download your free copy from www.restek.com.

Technical Guide
lit. cat.# 59895A

Searching for a chromatogram?

www.restek.com

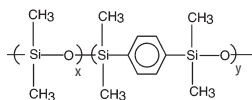
Get More!

Pharmaceutical
Related Articles Online

www.restek.com/pharmaceutical

Semivolatiles Analysis

new!

**Rxi®-5Sil MS
Structure**

Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60°C to 350°C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

Rxi®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

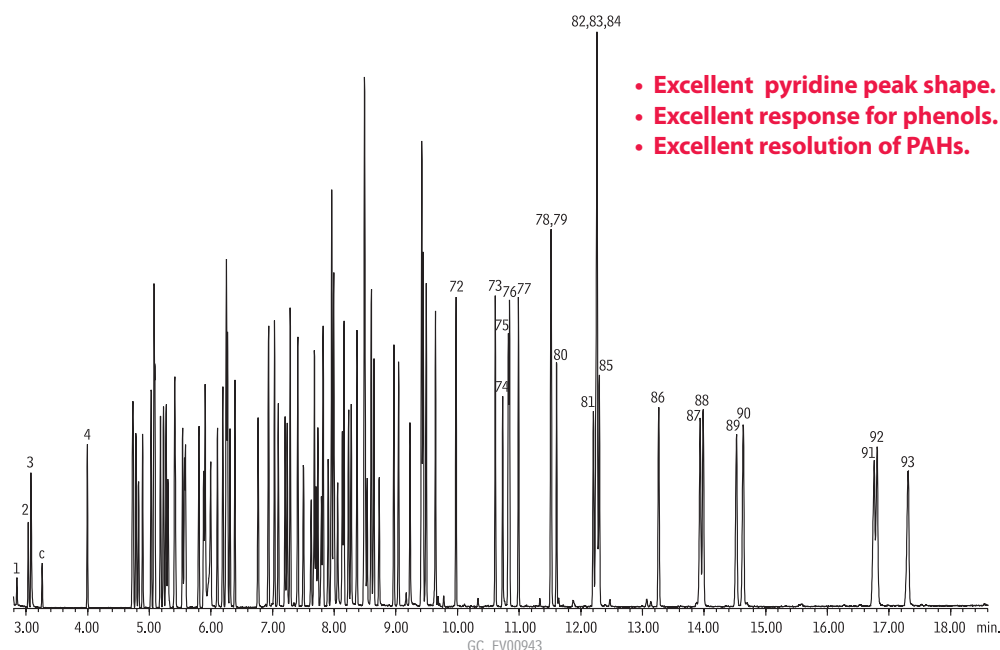
ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	13605	13608	
	0.25	-60 to 330/350°C	13620	13623	13626
	0.50	-60 to 330/350°C	13635	13638	
	1.00	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25	-60 to 330/350°C	13621	13624	
	0.50	-60 to 330/350°C		13639	
	1.00	-60 to 325/350°C		13654	
0.53mm	1.50	-60 to 310/330°C		13670	

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

similar phases

DB-5MS, VF-5ms, CP-Sil 8
Low-Bleed/MS

Rxi®-5Sil MS column
is recommended for
**US EPA Method
8270.**

Semivolatile organics by US EPA Method 8270 on an Rxi®-5Sil MS column.

- Excellent pyridine peak shape.
- Excellent response for phenols.
- Excellent resolution of PAHs.

Organophosphorus Pesticides Analysis

Rtx®-OPPesticides/Rtx®-OPPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organophosphorus pesticides; best column combination for US EPA Method 8141A.
- Low bleed—ideal for GC/FPD, GC/NPD, or GC/MS analyses.
- Stable to 330°C.

restek
innovation!

- Better separations
- Faster analysis

Using sophisticated computer modeling software, we created two stationary phases for separating the 55 organophosphorus pesticides (OPP) listed in EPA Method 8141A. Separation is improved, and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330°C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low bleed columns are a perfect match for sensitive detection systems.

Rtx®-OPPesticides Columns (fused silica)

ID	df (μm)	temp. limits	30-Meter
0.32mm	0.50	-20 to 310/330°C	11239
0.53mm	0.83	-20 to 310/330°C	11240

Rtx®-OPPesticides2 Columns (fused silica)

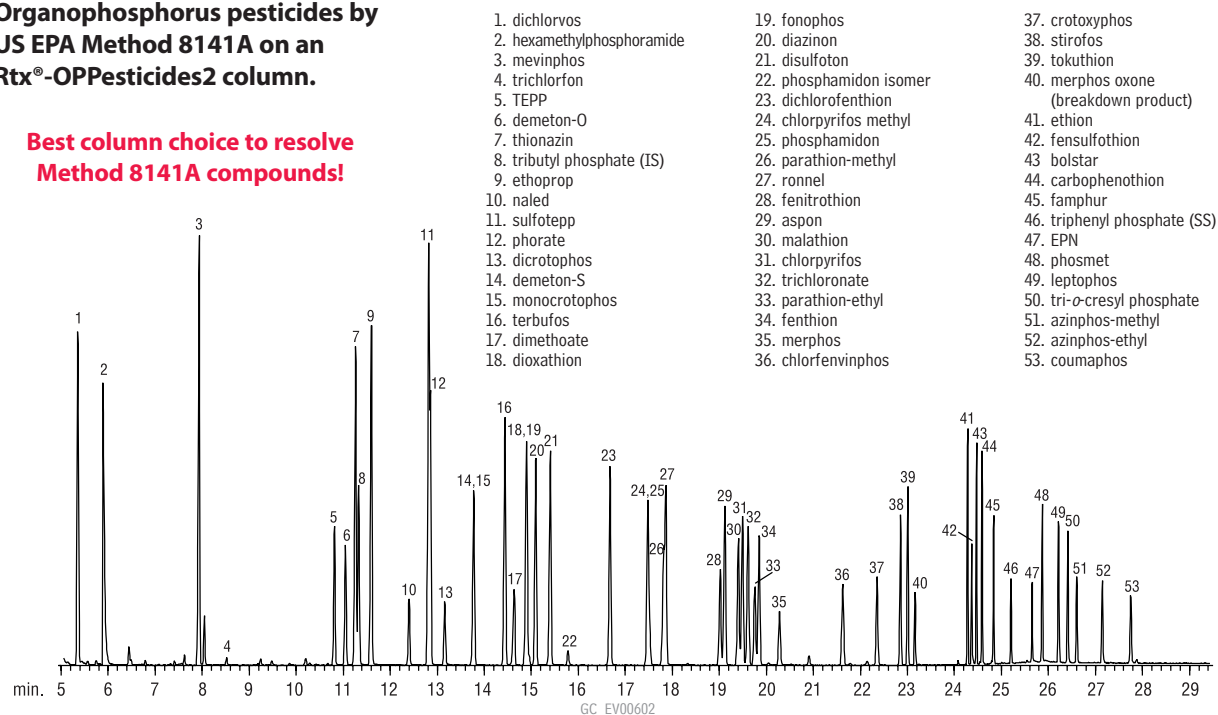
ID	df (μm)	temp. limits	20-Meter	30-Meter
0.18mm	0.20	-20 to 310/330°C	11244	
0.25mm	0.25	-20 to 310/330°C		11243
0.32mm	0.32	-20 to 310/330°C		11241
0.53mm	0.50	-20 to 310/330°C		11242

did you **know?**

These application-specific Restek columns give fast, efficient analysis of the OPPs listed in EPA Method 8141A

Organophosphorus pesticides by US EPA Method 8141A on an Rtx®-OPPesticides2 column.

Best column choice to resolve Method 8141A compounds!



Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25μm (cat.# 11243)
 Sample: US EPA Method 8141A Custom Standard Mix 1μL 100ppm
 (100ng on column)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
 8141 OP Pesticides Calibration Mix B (cat.# 32278)
 Custom Mixes: Call Restek for Information
 Inj.: 1.0μL splitless (hold 0.4 min.), 4mm double
 gooseneck inlet liner (cat.# 20785)

Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.0mL/min.
 Oven temp.: 80°C (hold 0.5 min.) to 140°C @ 20°C/min.
 to 210°C @ 4°C/min. (hold 1 min.) to
 280°C @ 30°C (hold 5 min.)
 Det: MS
 Transfer line temp.: 280°C
 Scan range: 35-400amu
 Ionization: EI

Chlorinated Pesticides Analysis

restek
innovation!

- Very low bleed
- Faster analysis

free literature

Fast GC Analysis of
Chlorinated Pesticides

Download your free copy from
www.restek.com

Flyer

lit. cat. # 59547A

ordering note

Add “-530” or “-535” to the
catalog number for the kit,
to save on the cost of the
reference mix.

Rtx®-CLPesticides/Rtx®-CLPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Low bleed—ideal for GC/ECD or GC/MS analyses.
- Baseline separations in less than 10 minutes.
- Stable to 340°C.

Improved resolution and faster analyses, compared to 1701 or phenyl phases, make these the pesticide columns of choice. Rtx®-CLPesticides columns are specially designed to overcome the coelutions and analyte breakdown typically encountered in chlorinated pesticide analyses for EPA Methods 8081, 608, and CLP. By achieving baseline resolution of the 20 target analytes, more accurate qualitative data can be obtained, providing reliable identification without GC/MS.

Rtx®-CLPesticides Columns (fused silica)

ID	df (μm)	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10	-60 to 310/330°C	43101				
0.18mm	0.18	-60 to 310/330°C	42101		42102		
0.25mm	0.25	-60 to 320/340°C		11120		11123	11126
0.32mm	0.32	-60 to 320/340°C			new! 11141		
	0.50	-60 to 320/340°C		11136		11139	
0.53mm	0.50	-60 to 300/320°C		11137		11140	

Rtx®-CLPesticides2 Columns (fused silica)

ID	df (μm)	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10	-60 to 310/330°C	43301		43302		
0.18mm	0.14	-60 to 310/330°C	42301		42302		
0.25mm	0.20	-60 to 320/340°C		11320		11323	11326
0.32mm	0.25	-60 to 320/340°C		11321		11324	
	0.50	-60 to 320/340°C				11325	
0.53mm	0.42	-60 to 300/320°C		11337		11340	

Rtx®-CLPesticides Column Kits

(Note: Columns are not preconnected in these kits.)

0.25mm ID Rtx®-CLPesticides Kit cat. # 11199 (kit),**Includes:**

	cat. #
30m, 0.25mm ID, 0.25μm Rtx-CLPesticides Column	11123
30m, 0.25mm ID, 0.20μm Rtx-CLPesticides2 Column	11323
Universal Angled “Y” Press-Tight Connector	20403
5m, 0.25mm ID Siltek Guard Column	10026

kit

new!

New column dimensions now
available.

0.32mm ID Rtx®-CLPesticides Kit cat. # 11196 (kit),**Includes:**

	cat. #
30m, 0.32mm ID, 0.32μm Rtx-CLPesticides Column	11141
30m, 0.32mm ID, 0.25μm Rtx-CLPesticides2 Column	11324
Universal Angled “Y” Press-Tight Connector	20403
5m, 0.32mm ID Siltek Guard Column	10027

kit

0.53mm ID Rtx®-CLPesticides Kit cat. # 11197 (kit),**Includes:**

	cat. #
30m, 0.53mm ID, 0.50μm Rtx-CLPesticides Column	11140
30m, 0.53mm ID, 0.42μm Rtx-CLPesticides2 Column	11340
Universal Angled “Y” Press-Tight Connector	20403
5m, 0.53mm ID IP Deactivated Guard Column	10045

kit

also available

For column connectors,
see www.restek.com.

Add a reference mix to your kit order and save!

Description	suffix #
Organochlorine Pesticide Mix AB #1 (cat. # 32291)	-530
Organochlorine Pesticide Mix AB #2 (cat. # 32292)	-535

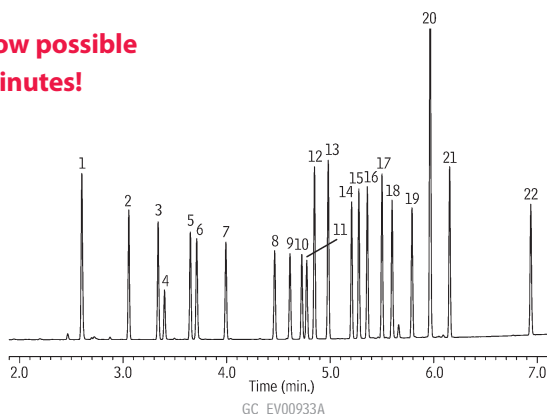
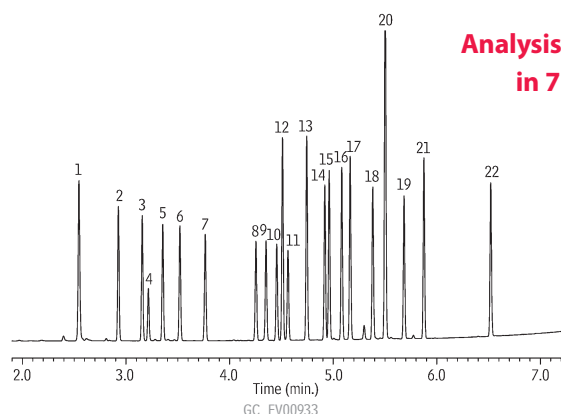
Chlorinated Pesticides Analysis

Fast GC analyses of chlorinated pesticides on Rtx®-CLPesticides and Rtx®-CLPesticides2 columns.

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.32mm ID)

Rtx®-CLPesticides

Rtx®-CLPesticides2



Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 μ m (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Linear velocity: 60cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 15°C/min. to 330°C (hold 2 min.) @ 30°C/min.

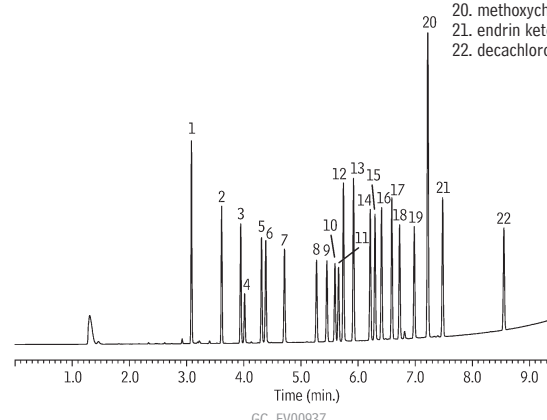
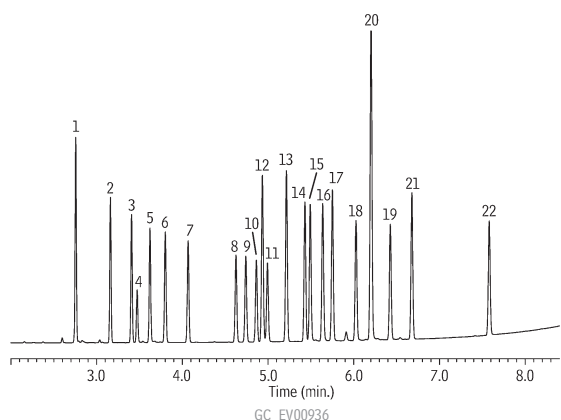
Det.: ECD @ 330°C

1. 2,4,5,6-tetrachloro-*m*-xylene (SS)
2. α -BHC
3. γ -BHC
4. β -BHC
5. δ -BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide (isomer B)
9. γ -chlordane
10. α -chlordane
11. endosulfan I
12. 4,4'-DDE
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. endosulfan sulfate
20. methoxychlor
21. endrin ketone
22. decachlorobiphenyl (SS)

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.53mm ID)

Rtx®-CLPesticides

Rtx®-CLPesticides2



Columns: Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50 μ m (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42 μ m (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Siltek® Treated Universal "Y" Press-Tight® connector (cat.# 20486)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Linear velocity: 45cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 325°C (hold 2 min.) @ 30°C/min.

Det.: ECD @ 330°C

Chlorinated Pesticides Analysis

restek
innovation!

Stx™-CLPesticides/Stx™-CLPesticides2 (proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Baseline separations in less than 10 minutes.
- Siltek® surface deactivation enhances responses for endrin, DDT, methoxychlor.
- Stable to 330°C.

Many laboratories analyzing organochlorine pesticides struggle with breakdown and adsorption of endrin, DDT, and methoxychlor caused by active sites throughout the analytical system. Siltek® passivation technology enables these columns to offer unsurpassed inertness and the highest responses for active pesticides.

Stx™-CLPesticides Columns (fused silica with Siltek® deactivation)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	-60 to 310/330°C	11540	11543
0.32mm	0.32	-60 to 310/330°C	new!	11546
	0.50	-60 to 310/330°C	11541	11544

Stx™-CLPesticides2 Columns (fused silica with Siltek® deactivation)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.20	-60 to 310/330°C	11440	11443
0.32mm	0.25	-60 to 310/330°C	11441	11444

Stx™-CLPesticides Kits

(Note: Columns are not preconnected in these kits.)

0.25mm ID Stx™-CLPesticides Kit cat.# 11190 (kit)**kit**

Includes:	cat.#
30m, 0.25mm ID, 0.25μm Stx-CLPesticides Column	11543
30m, 0.25mm ID, 0.20μm Stx-CLPesticides2 Column	11443
Universal Angled "Y" Press-Tight Connector	20403
5m, 0.25mm ID Siltek Guard Column	10026

0.32mm ID Stx™-CLPesticides Kit cat.# 11193 (kit)**kit**

Includes:	cat.#
30m, 0.32mm ID, 0.32μm Stx-CLPesticides Column	11546
30m, 0.32mm ID, 0.25μm Stx-CLPesticides2 Column	11444
Universal Angled "Y" Press-Tight Connector	20403
5m, 0.32mm ID Siltek Guard Column	10027

it's a **fact**

These columns are treated with Siltek® deactivation, which provides better responses for endrin, DDT, and methoxychlor.

ordering **note**

Kits include Siltek® deactivated guard column.

new!

New column dimensions now available.



Get More!

Environmental
Related Articles Online

www.restek.com/environmental

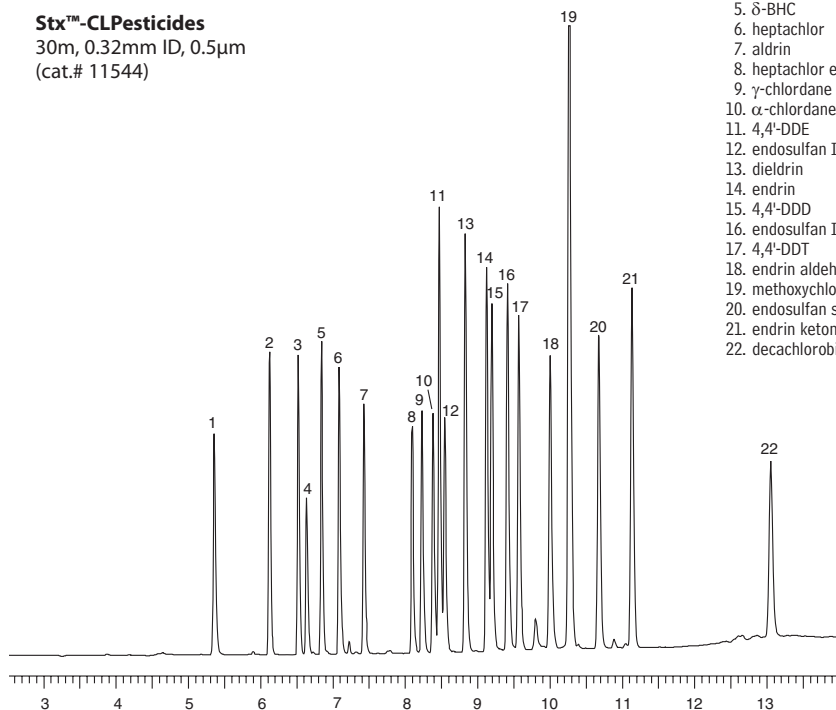
Chlorinated Pesticides Analysis

Excellent responses for all US EPA Method 8081
chlorinated pesticides: Stx™-CLPesticides columns.

Stx™-CLPesticides

30m, 0.32mm ID, 0.5µm
(cat.# 11544)

1. 2,4,5,6 tetrachloro-*m*-xylene (SS)
2. α -BHC
3. γ -BHC
4. β -BHC
5. δ -BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide
9. γ -chlordane
10. α -chlordane
11. 4,4'-DDE
12. endosulfan I
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. methoxychlor
20. endosulfan sulfate
21. endrin ketone
22. decachlorobiphenyl (SS)

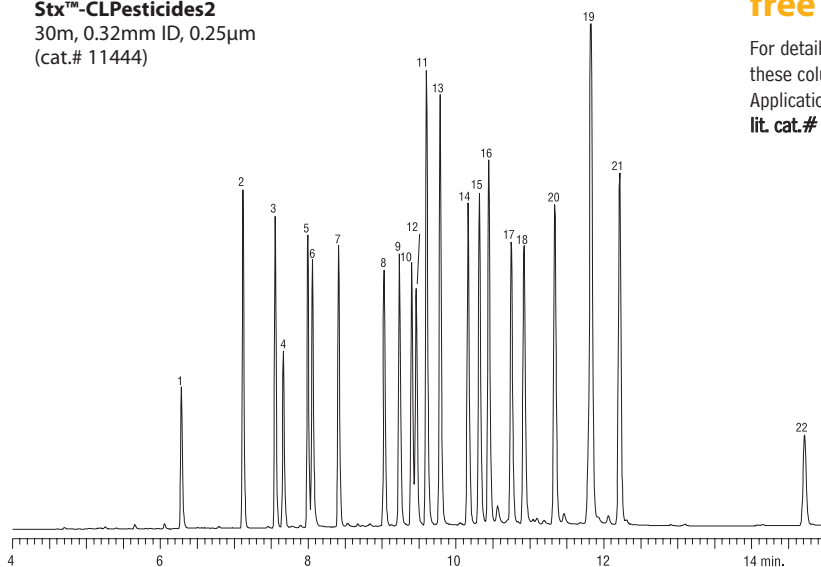


Stx™-CLPesticides2

30m, 0.32mm ID, 0.25µm
(cat.# 11444)

free literature

For detailed information about
these columns, request
Applications Note
lit. cat.# 59351B



GC_EV00512

Inj.: 1µL direct injection of 20/40/200ng/mL std. concentration in hexane
Oven temp.: 110°C (hold 1 min.) to 245°C @ 20°C/min. to 300°C @ 6°C/min.
Inj. & det. temp.: 210°C / 310°C
Carrier gas: helium
Dead time: 0.8min. @ 120°C
Inlet liner: Siltek® deactivated Drilled Uniliner® inlet liner (cat.# 21055-214.1)
Make-up gas: nitrogen

it's a fact

The Stx™-CLPesticides and Stx™-CLPesticides2 column pair will provide <10 minute analysis times if you use the same conditions used for the Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair listed on [page 67](#)!

restek
innovation!

PCB Congeners Analysis

Rtx®-PCB (proprietary Crossbond® phase)

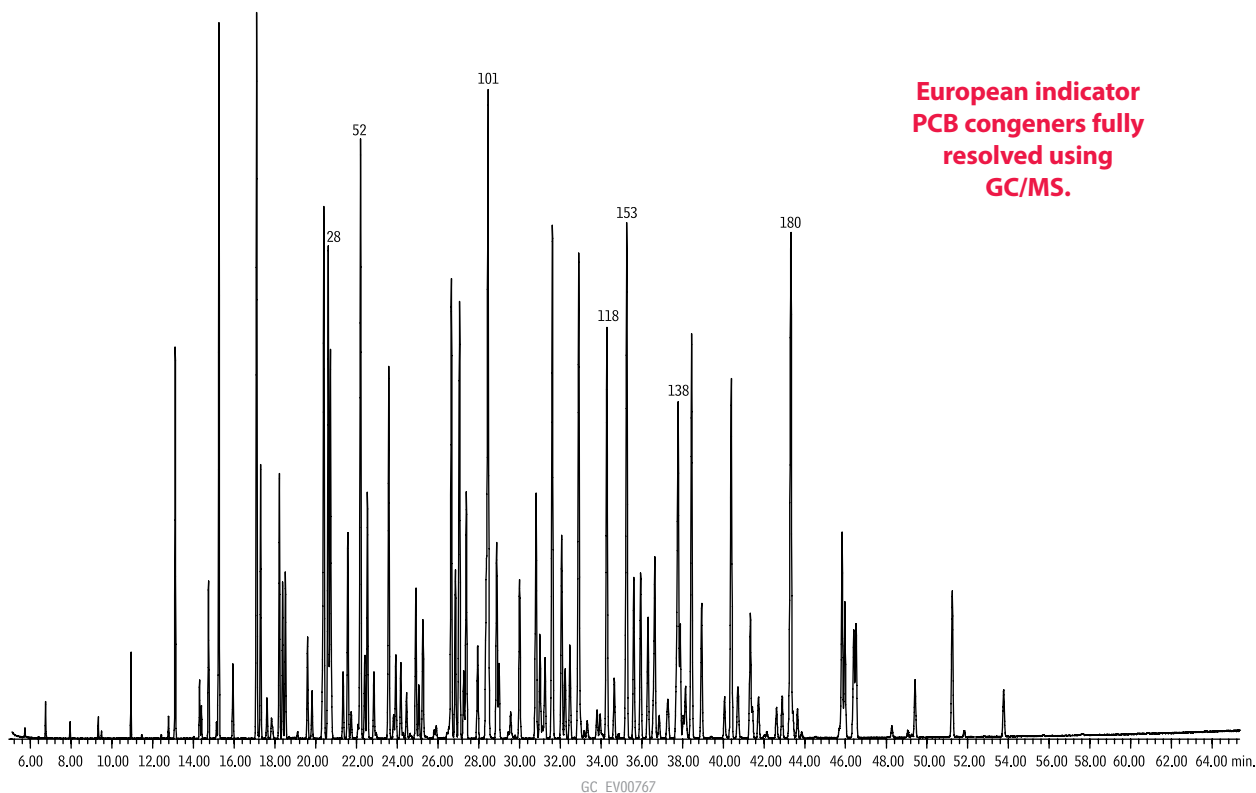
- Unique polymer for PCBs analysis by GC/ECD or GC/MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340°C.

Rtx®-PCB Columns (fused silica)

ID	df (μm)	temp. limits*	20-Meter	30-Meter	40-Meter	60-Meter
0.18mm	0.18	30°C to 320/340°C	41302		41303	41304
0.25mm	0.25	30°C to 320/340°C		13223		13226
0.32mm	0.50	30°C to 320/340°C		13239		

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Aroclor 1242/1254/1262 PCBs on Rtx®-PCB: best available resolution of individual congeners.



Column: Rtx®-PCB, 60m, 0.25mm ID, 0.25μm (cat.# 13226)
 Sample: Aroclor 1242 (cat.# 32009), 1254 (cat.# 32011), 1262 (cat.# 32409), 333ppm each
 Inj.: 1.0μL splitless (hold 0.75 min.), 4mm single gooseneck inlet liner w/wool (cat.# 22405)
 Inj. temp.: 280°C
 Carrier gas: helium, constant flow
 Flow rate: 1.1mL/min.
 Oven temp.: 100°C (hold 1 min.) to 200°C @ 30°C/min., to 320°C @ 2°C/min. (hold 1 min.)
 Det.: MS
 Transfer line temp.: 280°C
 Scan range: 50 to 550amu
 Ionization: EI
 Mode: scan

PCB Congeners Analysis

Rxi®-XLB (low polarity proprietary phase)

- General purpose columns exhibiting extremely low bleed. Ideal for many GC/MS applications, including pesticides, PCB congeners or (e.g.) Aroclor mixes, PAHs.
- Unique selectivity.
- Temperature range: 30°C to 360°C.

Improvements in polymer synthesis and tubing deactivation enable us to make inert, stable Rxi®-XLB columns especially well-suited for analyzing active, high molecular weight compounds with sensitive GC/MS systems, including ion trap detectors. Excellent efficiency, coupled with inertness, low bleed, and high thermal stability, make Rxi®-XLB columns ideal for analyzing semivolatile compounds in drinking water (e.g., US EPA Method 525).

Rxi®-XLB Columns (fused silica)

(low-polarity proprietary phase)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	30 to 340/360°C	13705	13708	
	0.25	30 to 340/360°C	13720	13723	13726
	0.50	30 to 340/360°C		13738	
	1.00	30 to 340/360°C	13750	13753	

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	30 to 340/360°C	43701	
0.18mm	0.18	30 to 340/360°C		43702

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

new!

also available

Other Dimensions!

See **page 30** for our complete listing of Rxi®-XLB columns.

similar phases

DB-XLB, VF-Xms



Quality Assurance Group

Shane Stevens, Corby Hillard, Glenn Gerhab, Chris Zucco,
Lenny Miller, Deb Conklin, Trisha Houser, John Kalmbach

We test every fused silica, PLOT, and MXT® column against stringent quality standards to ensure you get the best columns on the market.

restek
innovation!

Dioxin & Furan Congeners Analysis

Rtx®-Dioxin (proprietary Crossbond® phase)

- Replacement column for 5% diphenyl phases.
- Improved separations of dioxin or furan congeners.
- Greater thermal stability than 5% diphenyl phases or high-cyano confirmation columns.

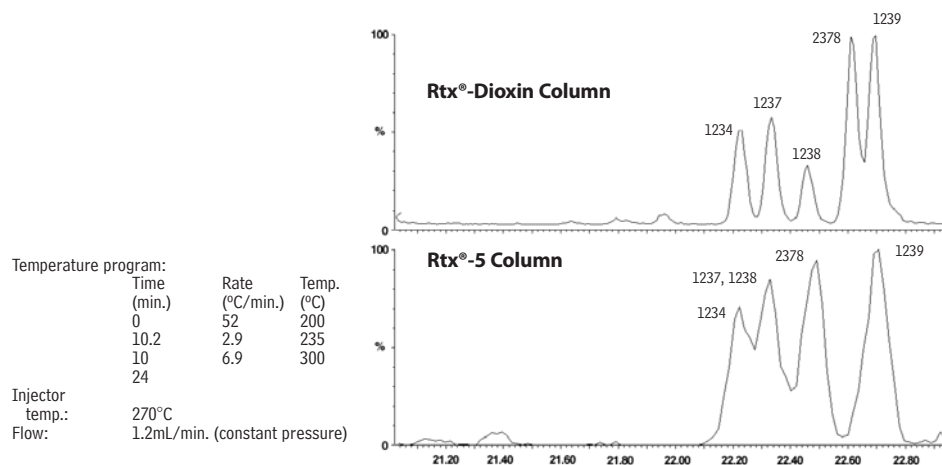
Rtx®-Dioxin Columns (fused silica)

ID	df (μm)	temp. limits	60-Meter
0.25mm	0.15	-60°C to 380°C	10755

also available

Rtx®-Dioxin2 columns.
See page 73.

Rtx®-Dioxin column separates all five components in the TCDD resolution check mixture.



Column: Rtx®-Dioxin, 40m, 0.18mm ID, 0.11μm
Initial temp.: 130°C
Instrument: Micromass Altima high resolution GC/MS

Chromatography courtesy of Karen MacPherson and Eric Reiner, Ontario Ministry of the Environment, Etobicoke, ON, Canada.

Get More!

Environmental
Related Articles Online

www.restek.com/environmental

Dioxin & Furan Congeners Analysis

Rtx®-Dioxin2 (proprietary Crossbond® phase)

- Isomer specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF achieved with one GC column.
- Thermally stable to 340°C for longer lifetime.
- Unique selectivity for toxic dioxin and furan congeners allow use as a primary or confirmation GC column.

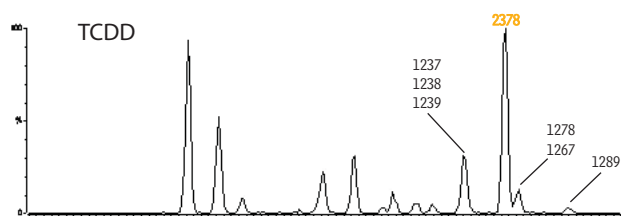
restek
innovation!

Excellent for dioxins or furans.

Rtx®-Dioxin2 Columns (fused silica)

ID	df (μm)	temp. limits	40-Meter	60-Meter
0.18mm	0.18	20°C to 340°C	10759	—
0.25mm	0.25	20°C to 340°C	—	10758

2,3,7,8-Tetrachlorodibenzodioxin resolved from other TCDD congeners, using an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

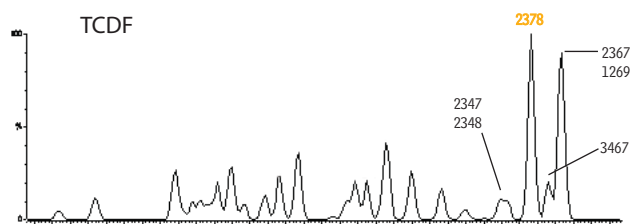
GC_EV00948

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25μm (cat.# 10758)
 Sample: WMS-01 Reference Material, Wellington Laboratories
 Inj.: Splitless
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.5mL/min.
 Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
 Det.: Micromass Ultima high-resolution mass spectrometer
 Ionization: EI
 Mode: SIR



Jack Cochran
Director of New Business & Technology

Tetrachlorodibenzofuran congeners on an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

GC_EV00949

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25μm (cat.# 10758)
 Sample: WMS-01 Reference Material, Wellington Laboratories
 Inj.: Splitless
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.5mL/min.
 Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
 Det.: Micromass Ultima high-resolution mass spectrometer
 Ionization: EI
 Mode: SIR

free literature

Rtx®-Dioxin2 Column:
2,3,7,8-TCDD and 2,3,7,8-TCDF
Specificity in One GC Column

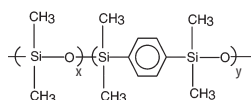
New data available—all 128 dioxin and furan tetra through octa congeners acquired on the Rtx®-Dioxin2 column.

Download your free copy from www.restek.com

Flyer
 lit. cat.# 580119A

Chromatograms courtesy of Terry Kolic, Karen MacPherson, Eric Reiner, Ontario Ministry of the Environment, Toronto, Ontario, Canada

new!

**Rxi™-5Sil MS
Structure**

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- Temperature range: -60°C to 350°C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

similar **phases**

DB-5MS, VF-5ms, CP-Sil 8
Low-Bleed/MS

Rxi®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	13605	13608	
	0.25	-60 to 330/350°C	13620	13623	13626
	0.50	-60 to 330/350°C	13635	13638	

also **available****Other Dimensions!**

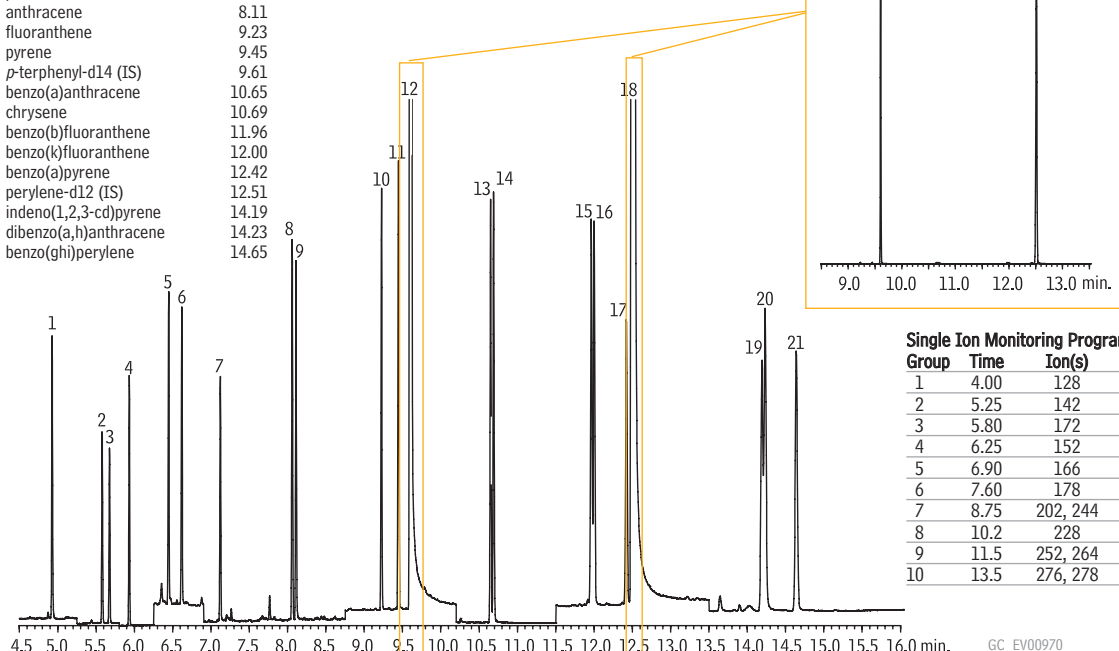
See **page 28** for our complete listing of Rxi®-5Sil MS columns.

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

Polycyclic aromatic hydrocarbons on an Rxi®-5Sil MS column.

Peak List	Retention Time
1. naphthalene	4.93
2. 2-methylnaphthalene	5.58
3. 1-methylnaphthalene	5.68
4. 2-fluorobiphenyl (SS)	5.93
5. acenaphthylene	6.45
6. acenaphthene	6.62
7. fluorene	7.12
8. phenanthrene	8.06
9. anthracene	8.11
10. fluoranthene	9.23
11. pyrene	9.45
12. p-terphenyl-d14 (IS)	9.61
13. benzo(a)anthracene	10.65
14. chrysene	10.69
15. benzo(b)fluoranthene	11.96
16. benzo(k)fluoranthene	12.00
17. benzo(a)pyrene	12.42
18. perylene-d12 (IS)	12.51
19. indeno(1,2,3-cd)pyrene	14.19
20. dibenzo(a,h)anthracene	14.23
21. benzo(ghi)perylene	14.65

**Outstanding peak
shape and response at
5pg on-column!**

**Single Ion Monitoring Program**

Group	Time	Ion(s)	Dwell (ms)
1	4.00	128	100
2	5.25	142	100
3	5.80	172	100
4	6.25	152	100
5	6.90	166	100
6	7.60	178	100
7	8.75	202, 244	100
8	10.2	228	100
9	11.5	252, 264	100
10	13.5	276, 278	100

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25μm (cat.# 13623)
Sample: PAH mix, 1μL of 0.005μg/mL (IS 2μg/mL)
SV Calibration Mix #5 (cat.# 31011)

1-methylnaphthalene (cat.# 31283)

2-methylnaphthalene (cat.# 31285)

2-fluorobiphenyl (cat.# 31091)

Inj.: 1.0μL (5pg on-column concentration),
4mm Drilled Uniliner® (hole near top) inlet liner w/wool (cat.# 21055-200.5),
pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.

Inj. temp.: 300°C

Carrier gas: helium, constant flow

Flow rate: 1.4mL/min.

Oven temp.: 50°C (hold 0.5 min.) to 290°C @ 25°C/min. to 320°C @ 5°C/min.

Det.: MS

Transfer line

temp: 290°C

Ionization: EI

Mode: SIM

GC_EV00970

Volatile Organics Analysis

Rtx®-VMS (proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants by GC/MS.
- Complete separation of US EPA Method 8260 compounds in less than 18 minutes.
- Stable to 260°C.
- No known equivalent phases.

Rtx®-VMS columns offer lower bleed, better selectivity, and overall faster analysis for separating volatile organic compounds, such as those listed in US EPA Method 8260. The Rtx®-VMS stationary phase is a highly stable polymer that provides outstanding analysis of volatile compounds, in combination with sensitive ion traps and Agilent 5973 mass spectrometers. 0.18 and 0.25mm ID columns allow sample splitting at the injection port, eliminating the added expense and maintenance of a jet separator. A 0.45mm or 0.53mm ID column can be directly connected to the purge & trap transfer line in a system equipped with a jet separator.

Rtx®-VMS Columns (fused silica)

ID	df (μm)	temp. limits	30-Meter	60-Meter	75-Meter
0.25mm	1.40	-40 to 240/260°C	19915	19916	
0.32mm	1.80	-40 to 240/260°C	19919	19920	
0.45mm	2.55	-40 to 240/260°C	19908	19909	
0.53mm	3.00	-40 to 240/260°C	19985	19988	19974

ID	df (μm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-40 to 240/260°C	49914	49915

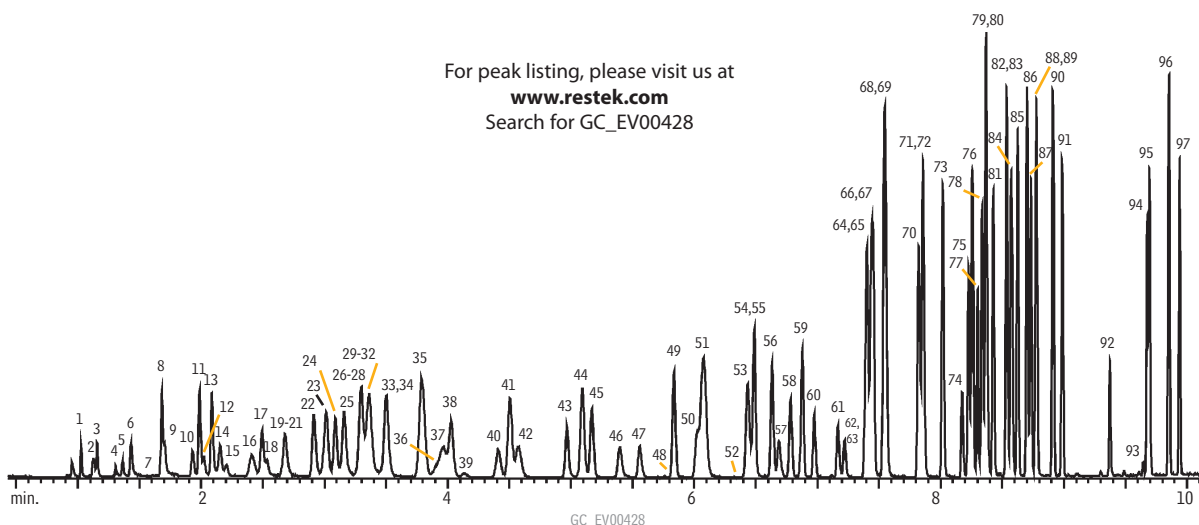
restek innovation!

- First choice for use with dual purge & traps¹
- EPA recommended surrogates used.

¹A.L. Hilling and G. Smith, Environmental Testing & Analysis, 10(3), 15-19, 2001.

Rapid analysis of volatile organics in US EPA Method 8260B, on an Rtx®-VMS column.

For peak listing, please visit us at
www.restek.com
 Search for GC_EV00428



Column: Rtx®-VMS, 20m, 0.18mm ID, 1.00μm (cat.# 49914)
 Conc.: 10ppb in 5mL of RO water
 unless otherwise noted; ketones at 2.5X
 Concentrator: Tekmar LSC-3100 Purge and Trap
 Trap: Vocab 3000 (type K)
 Purge: 11 min. @ 40mL/min. (ambient temperature)
 Dry purge: 1 min. @ 40mL/min.
 Desorb preheat: 245°C
 Desorb: 250°C for 2 min., flow 40mL/min.
 Bake: 260°C for 8 min.
 Interface: 0.53mm ID Silcosteel® tubing transfer line
 1:40 split at injection port. 1mm ID liner.
 Oven temp.: 50°C (hold 4 min.) to 100°C @ 18°C/min. (hold 0 min.)
 to 230°C @ 40°C/min. (hold 3 min.)
 Carrier gas: helium @ ~1.0mL/min. constant flow
 Adjust dichlorodifluoromethane to a retention time of 1.03 min. @ 50°C.
 Detector: Agilent 5973 MSD
 Scan range: 35-300amu

Volatile Organics Analysis

Rtx®-502.2 (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants. The Rtx®-502.2 column is cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks.
- Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Stable to 270°C.

similar **phase**

DB-502.2

An Rtx®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-502.2 stationary phase provides low bleed and thermal stability to 270°C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling. Narrow bore columns can interface directly in GC/MS systems.

Rtx®-502.2 Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (μm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-20 to 250/270°C	10915	10916		
0.32mm	1.80	-20 to 250/270°C	10919	10920		10921
0.45mm	2.55	-20 to 250/270°C			10986	
0.53mm	3.00	-20 to 250/270°C	10908	10909		10910

ID	df (μm)	temp. limits	20-Meter	40-Meter
0.18mm	1.00	-20 to 250/270°C	40914	40915

also **available****MXT® Columns**

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **pages 92 and 93** for our MXT®-502.2 and MXT® Volatiles columns.

Rtx®-Volatiles (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Stable to 280°C.

similar **phase**

VOCOL®

Rtx®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-Volatiles stationary phase provides low bleed and thermal stability to 280°C. Narrow bore columns can interface directly in GC/MS systems.

Rtx®-Volatiles Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (μm)	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	1.00	-20 to 270/280°C	10900	10903	
0.32mm	1.50	-20 to 270/280°C	10901	10904	
0.53mm	2.00	-20 to 270/280°C	10902	10905	10906

Volatile Organics Analysis

Rtx®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

The unique polarity of the Rtx®-624 column makes it ideal for analyzing volatile organic pollutants. Although the Rtx®-502.2 column is recommended in many methods, the Rtx®-624 column offers better resolution of early eluting compounds. The Rtx®-624 phase produces greater than 90% resolution of the first six gases in EPA Methods 8260 and 524.2. This stationary phase is especially well-suited for EPA Method 524.2 revision IV since it resolves 2-nitropropane from 1,1-dichloropropanone, which share quantification ion m/z 43 and must be separated chromatographically.

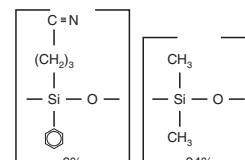
Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40	-20 to 240°C	10968	10969		
0.32mm	1.80	-20 to 240°C	10970	10972		
0.45mm	2.55	-20 to 240°C			10982	
0.53mm	3.00	-20 to 240°C	10971	10973	10974	10975

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	1.00	-20 to 240°C		40924	40925

Rtx®-624 Structure



similar phases

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

also available

MXT® Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 93](#) for our MXT®-624 columns.

custom standards

Restek is your #1 source for custom analytical reference materials!

- Made to your exact specifications.
- Quick quotations.
- Most orders shipped within 5–10 working days.

Call our reference materials department, visit www.restek.com/solutions, or contact your Restek representative for more information.

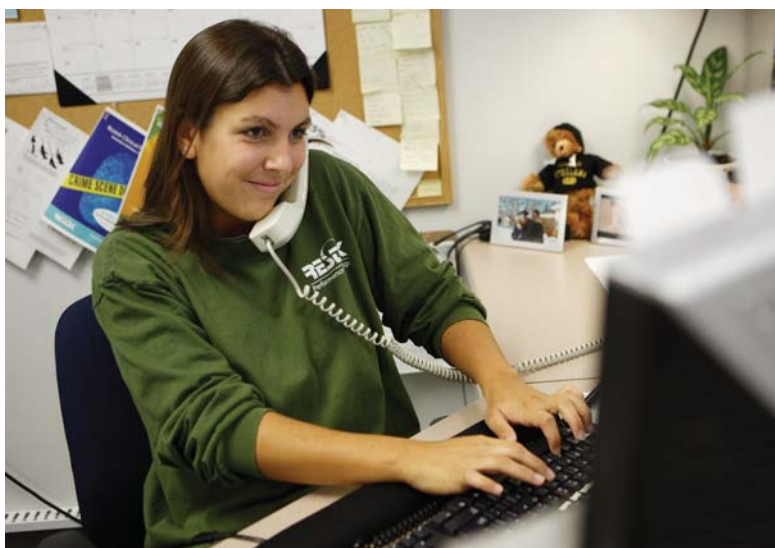


PLOT Columns



Top: Tim Herring, Technical Service Specialist

Bottom: Stephanie Sunner, International
Customer Service Representative



Features & Benefits of Restek PLOT Columns

Features

Benefits

Highest quality porous materials.**The most consistent and efficient analyses obtainable.**

Consistency in porosity and uniformity in particle and pore size are major concerns in designing the solid stationary phase. We developed a unique synthesis and selection technology to yield uniform, small diameter particles that are ideal for a specific separation.

Particles are 100% bonded to the tubing.**No need for particle traps because particle generation is eliminated.**

Restek coating and bonding techniques produce strong, uniform particle adherence to the inside of the capillary tubing. Customers have described Restek's Rt™-M sieve 5A PLOT column as "bulletproof," meaning that the stationary phase is bonded so strongly that particle generation is completely eliminated.

Reproducible quality.**Reproducible performance.**

Because we use advanced technology to make these columns, the entire manufacturing process is simple and stable. Each step of the column-making process is meticulously quality-checked, allowing Restek to offer the best quality PLOT columns.

Quick Reference Chart

PLOT Column	Application	Page
Rt™-Alumina	C1–C5 hydrocarbons. purity analysis of ethylene, propylene, butenes, butadiene	80-81
Rt™-M sieve 5A	Permanent gas analysis. He, Ne, Ar, O ₂ , N ₂ , Xe, Rn, SF ₆ , and CH ₄ , C ₂ H ₆ , Co	82
Rt™-QPLOT	Nonpolar porous polymer. High retention for volatiles, CO ₂ , sulfur, and ppm water in solvents	83
Rt™-QS-BOND	Intermediate polarity porous polymer. Baseline separation of ethane, ethene, acetylene	new! 83
Rt™-SPLOT	Intermediate polarity porous polymer. Light gases in ethylene and propylene, ketones, esters	83
Rt™-UPLOT	Polar porous polymer. More retention for polar compounds	83

PLOT Column Phase Cross-Reference: Similar Selectivity

Restek	Porous Layer	Agilent/J&W	Supelco	Alltech	Varian/Chrompack	Quadrex
Rt™-Alumina	Aluminum oxide	GS-Alumina, HP PLOT S, HP PLOT M	Alumina-PLOT	AT-Alumina	CP-A1.0 ₂ /NA ₂ SO ₄	—
Rt™-M sieve 5A	Molecular sieve 5A	GS-Molsieve, HP PLOT/Molesieve	Molsieve 5A PLOT	AT-Molesieve	CP-Molesieve 5A	PLT-5A
Rt™-QPLOT	DVB porous polymer	—	Supel-Q-PLOT	AT-Q	CP-PoraPlot Q, PoraBond Q	—
Rt™-QS-BOND	Intermediate polarity porous polymer	GS-Q	—	—	—	—
Rt™-SPLOT	DVB vinylpyridine polymer	—	—	—	CP-PoraPlot S	—
Rt™-UPLOT	DVB ethyleneglycol- dimethylacrylate polymer	HP-UPLOT	—	—	CP-PoraPlot U, PoraBond U	—

new!

Rt™-Alumina PLOT Column Characteristics

1. Highly selective adsorbent for C1-C5 hydrocarbons; separates all unsaturated hydrocarbon isomers at temperatures far above ambient.
2. Reactivity of aluminum oxide stationary phase is minimized so that column response for polar unsaturates, such as dienes, is optimized. Column sensitivity or response ensures a linear and quantitative chromatographic analysis for these compounds.
3. Strong bonding prevents particle generation. The column can be used in valve switching operations, without release of particles that can harm the injection and detection systems.
4. The Rt™-Alumina PLOT column is stable up to 200°C. If water is adsorbed on the column, it can be regenerated by conditioning at 200°C. Full efficiency and selectivity will be restored.

did you know?

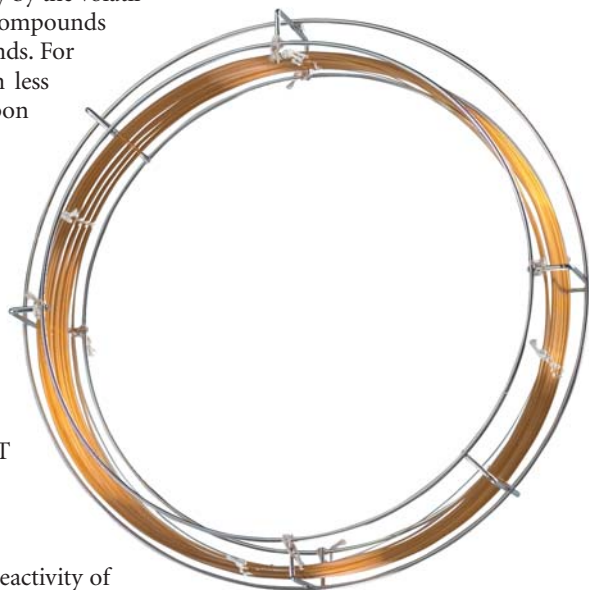
Rt™-Alumina PLOT columns show unique retention characteristics for hydrocarbons.

Selectivity

The selectivity of the Rt™-Alumina PLOT column is measured by the retention indices for acetylene and propadiene. These two components are extremely sensitive for a change in selectivity.

For saturates, retention is determined mainly by the volatility of the compound, with less volatile compounds retained longer than more volatile compounds. For example, isoparaffins are less retained than less volatile normal paraffins of similar carbon number.

For unsaturates, retention is strongly influenced by polarity or degree of unsaturation. In general, hydrocarbons having a higher degree of unsaturation are more polar. This polarity comes from the presence of π electrons; the more π electrons present in a compound, the more polar its behavior and the more strongly it is retained. Retention indices for some unsaturates separated on the Rt™-Alumina PLOT column are listed in Table I.

**Sensitivity**

Proper deactivation is critical to minimize reactivity of the aluminum oxide stationary phase and maximize column sensitivity. Quantitation can be done only if the column exhibits linear response, which results from good stationary phase inertness. Rt™-Alumina PLOT columns are specially deactivated and provide high inertness for unsaturates and saturates. In fact, Rt™-Alumina PLOT columns are almost four times more sensitive for unsaturates than other brands on the market. Column sensitivities for various unsaturated hydrocarbons, measured by the peak height ratio based on *n*-butane, are shown in Table I.

Table I: Retention indices and column response for unsaturates on an Rt™-Alumina PLOT column at 80°C.

	Ethylene	Acetylene	Propylene	Propadiene
Retention Index	255	421	372	407
Peak Ratio (vs. <i>n</i> -butane)	0.65	0.72	0.84	0.54

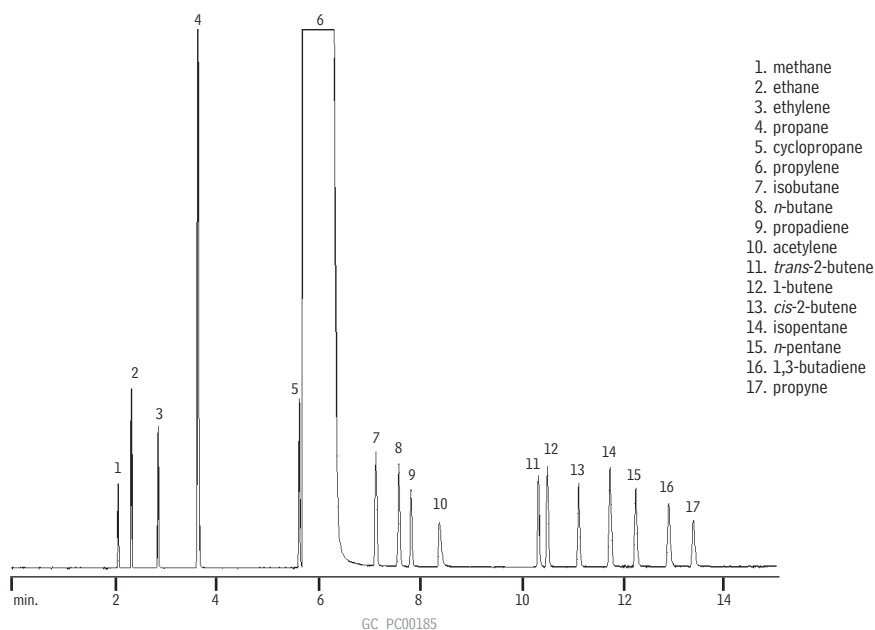
Guaranteed Reproducibility

Each Rt™-Alumina PLOT column is tested with a hydrocarbon test mix to ensure proper phase thickness and deactivation (see figure). Pentane is used to calculate *k* (capacity factor), which is a measure of phase thickness. The ratio of isobutane to acetylene retention is measured to ensure proper deactivation of the alumina oxide layer. The plates per meter value is calculated to evaluate column efficiency.

Restek's Rt™-Alumina PLOT columns offer fast and reproducible hydrocarbon stream and purity analyses. The 0.32mm ID Rt™-Alumina PLOT column provides fast and efficient analysis of C1 to C5 hydrocarbons. The higher capacity of the 0.53mm ID Rt™-Alumina PLOT column makes it ideal for purity analysis of many common petrochemicals, such as 1,3-butadiene, ethylene, and propylene.

Rt™-Alumina Columns (fused silica PLOT)(Na₂SO₄ deactivation)

ID	df (μm)	temp. limits	30-Meter	50-Meter	60-Meter
0.32mm	3	to 200°C	19702	—	19703
0.53mm	6	to 200°C	19700	19701	—

Propylene purity on an Rt™-Alumina PLOT column.

Column: Rt™-Alumina, 50m, 0.53mm ID (cat.# 19701)
 Inj.: 100μL hydrocarbon mix (gas-tight syringe)
 Oven temp.: 40°C (hold 3 min.) to 120°C @ 10°C/min. (hold 5 min.)
 Inj./det. temp.: 200°C
 Carrier gas: helium
 Linear velocity: 37.5cm/sec. set @ 80°C
 Split flow: 60mL/min.
 FID sensitivity: 1.28 x 10⁻¹⁰ AFS

tech tip

Trace water in the carrier gas can affect the selectivity and retention of the Rt™-Alumina PLOT column. The column can be regenerated by baking out the water (50°C to 200°C @ 8°C/min., 50cm/sec. flow rate). Periodic conditioning ensures excellent run-to-run retention time reproducibility.

The maximum programmable temperature for an Rt™-Alumina PLOT column is 200°C. Higher temperatures cause irreversible changes to the porous layer adsorption properties.

Searching for a chromatogram?

www.restek.com

please **note**

Rt™-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, and CO.

Rt™-Msieve 5A PLOT Columns

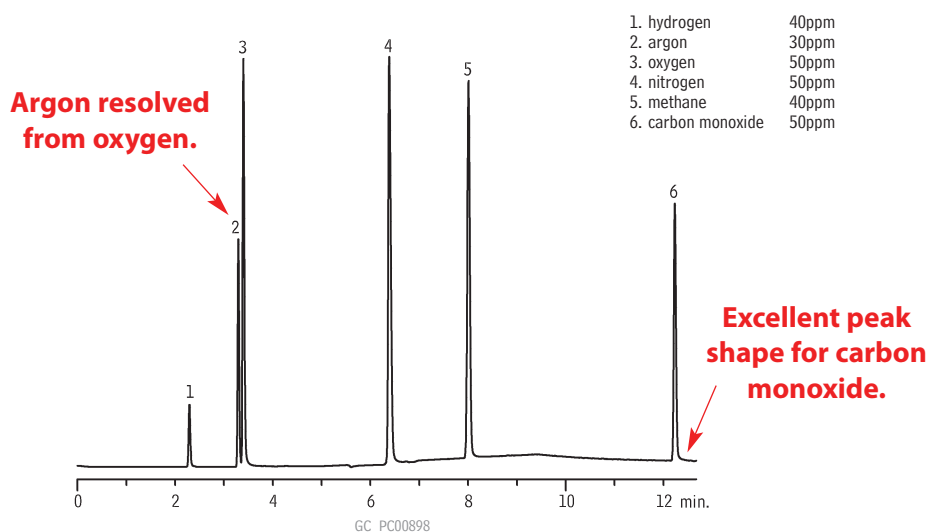
Rt™-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, and CO. Special coating and deactivation procedures ensure chromatographic efficiency and the integrity of the porous layer coating. The high surface area of the Rt™-Msieve is generated by the pore structure present in the molecular sieve. Only compounds that can enter the pores will be exposed to this surface and will be retained. Molecular sieves have very high retention, allowing separations of permanent gases at temperatures above ambient. Additionally, Restek's unique immobilization process guarantees that the uniform particles remain adhered to the tubing—even after continuous valve-cycling.

Our revolutionary molecular sieve 5A PLOT columns separate Ar/O₂ and H₂/He at ambient temperature or above (see figure). These columns also are an excellent choice for rapid separation of permanent gases in refinery or natural gas.

Our deactivation technology also allows the CO peak to elute as a sharp peak. This is in contrast with other suppliers where CO often tails badly and cannot be quantified below % levels.

tech tip

Because molecular sieve materials are very hydrophilic, they will adsorb water from the sample or carrier gas. Water contamination can have a detrimental effect on peak symmetry and can reduce the resolution of all compounds. If water contamination occurs, reactivate your Rt™-Msieve 5A PLOT column by conditioning at 300°C with dry carrier gas flow for 3 hours.

Permanent gases on an Rt™-Msieve 5A PLOT column.did you **know?**

ShinCarbon ST micropacked columns are another alternative for analyzing permanent gases.

See www.restek.com for information.

Rt™-Msieve 5A Columns (fused silica PLOT)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	30	to 300°C	19720	19722
0.53mm	50	to 300°C	19721	19723

Porous Polymers: Rt™-QPLOT, Rt™-QS-BOND, Rt™-SPLOT, and Rt™-UPLLOT Columns

Restek has developed unique polymer technology and coating processes, to make excellent porous polymer PLOT columns. Selectivity is similar to that of Porapak and HayeSep® packings. Unlike molecular sieve and alumina columns, porous polymer PLOT columns are not moisture sensitive, making them particularly useful for applications in which moisture is of major concern.

Chromatographic selectivity, in terms of polarity or chemical functionality, can be modified by incorporating polar functional groups in the styrene/divinylbenzene matrix. The least polar, or nonpolar, Rt™-QPLOT columns are made with divinylbenzene. Rt™-SPLOT columns incorporate 4-vinylpyridine, providing intermediate polarity. The new Rt™-QS-BOND column has been engineered to have a polarity between the Rt™-QPLOT and Rt™-SPLOT columns. The Rt™-QS-BOND column fully resolves ethylene, acetylene, and ethane. Highly-polar Rt™-UPLLOT columns are modified with an ethylene glycol/dimethylacrylate functional group to provide excellent selectivity for unsaturated compounds.

Use these porous PLOT columns for a wide variety of separations. Permanent gases can be separated at subambient temperatures. Inorganic gases such as CO₂ can be easily analyzed on porous polymer columns. For hydrocarbon analysis, tremendous versatility based on a choice of selectivity is advantageous. These columns also are designed for analysis of various polar and nonpolar solvents.

Rt™-SPLOT Columns (fused silica PLOT)

divinylbenzene 4-vinylpyridine

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 250°C	19711	19710
0.53mm	20	to 250°C	19713	19712

Rt™-QS-BOND Columns (fused silica PLOT)

porous divinyl benzene homopolymer

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 250°C	19739	19740
0.53mm	20	to 250°C	19737	19738

Rt™-QPLOT Columns (fused silica PLOT)

100% divinylbenzene

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 250°C	19717	19718
0.53mm	20	to 250°C	19715	19716

Rt™-UPLLOT Columns (fused silica PLOT)

divinylbenzene ethylene glycol/dimethylacrylate

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 190°C	19725	19724
0.53mm	20	to 190°C	19727	19726

did you know?

New purification techniques have improved the peak shapes for polar compounds on our Rt™-QPLOT columns.

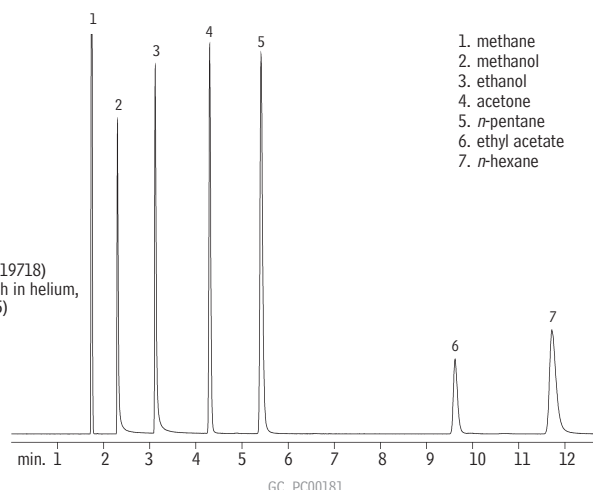
new!

Intermediate polarity porous polymer Rt™-QS-BOND Columns—100% resolution of ethylene, acetylene, and ethane.

please note

Our porous polymer PLOT columns are not moisture sensitive, making them ideal for applications in which moisture is of major concern.

Solvents on the nonpolar Rt™-QPLOT column.



Column: Rt™-QPLOT, 30m, 0.32mm ID (cat.# 19718)
Sample: 20μL split injection, 50ppm (w/v) each in helium, Cyclosplitter® inlet liner (cat.# 20755)
Oven temp.: 150°C
Inj./det. temp.: 200°C
Carrier gas: hydrogen
Det.: FID
Split ratio: 20/1

Metal (MXT®) Capillary Columns



Top: Joe Conway, Shipping Technician

Bottom: Linda Holden, Caging Technician

What is an MXT® column?

MXT® columns are made from stainless steel tubing that has had the internal surface treated with our exclusive Siltek® surface treatment. The Siltek® layer makes the surface as inert as deactivated fused silica. The unique Siltek® process enables us to offer MXT® columns in a wide range of internal diameters, including 0.18mm, 0.25mm, 0.32mm, and 0.53mm. Because the Siltek® layer permeates the stainless steel surface, rather than simply coating it, the layer is exceptionally flexible, so the tubing can be coiled to very small diameters. The standard coil diameter for MXT® columns is 4.5 inches. The minimum coil diameter for 0.53mm ID columns is 2.5 inches, and the minimum coil diameter for 0.25mm ID columns is 1.5 inches.

The unique properties of the Siltek® treated surface enable us to treat the tubing with a wide variety of polymer phases. The many choices of MXT® columns include:

- MXT®-1
- MXT®-5
- MXT®-1HT Sim Dist
- MXT®-2887
- MXT®-20
- MXT®-35
- MXT®-50
- MXT®-65
- MXT®-65TG
- MXT®-1301
- MXT®-1701
- MXT®-200
- MXT®-WAX
- MXT®-502.2
- MXT®-Volatiles
- MXT®-624
- MXT®-Biodiesel TG
- Guard tubing



did you know?

MXT® columns are ideal for high-temperature gas chromatography.

Compare MXT® columns and fused silica columns:

- Metal tubing allows MXT® columns to be used to higher temperatures (430°C) than fused silica columns (standard rating is 360°C). This is because the polyimide resin that encases the fused silica becomes brittle over time at high temperatures. MXT® columns do not become brittle over time.
- Inertness of MXT® columns and fused silica columns is similar, due to the unique properties of the Siltek® surface treatment in MXT® columns.
- Coating efficiency (plates/meter) of MXT® columns is equivalent to that of fused silica.
- MXT® columns will not break under stress, and they can be coiled to small diameters.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles compared to high-temperature fused silica columns which breakdown under the same conditions.



MXT®-Biodiesel TG columns are undamaged by high thermal cycles.



HT fused silica columns, labeled as stable to 430°C, show pitting and breakdown.

100 temperature cycles to 430°C totaling 500 minutes at maximum temperature.

MXT® columns are your best choice for:

- Situations in which the potential for column breakage is high:
 - field instruments
 - process GC
 - GCs with small ovens, such as portable instruments, requiring tightly coiled columns.
- High temperature chromatography. Siltek® deactivated stainless steel tubing can withstand temperatures exceeding 430°C; the only limitation to oven temperature is the polymer itself.

Custom MXT® columns

We are able to supply 0.18, 0.25, 0.28, 0.32, and 0.53mm ID columns with the phases listed above in many different configurations. If you do not see the column you need listed in the following pages, call us or your Restek representative, and we will be happy to help.

MXT® and Hydroguard™ Guard/Retention Gap Columns

Intermediate-Polarity Deactivated Guard/Retention Gap Columns/Transfer Lines

- Useful for a wide range of applications.
- Use with most common solvents.
- Maximum temperature: 430°C

Intermediate-Polarity Deactivated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter
0.28mm	0.53 ± 0.025mm	70044	70044-600	70046
0.53mm	0.74 ± 0.025mm	70045	70045-600	70047

Hydroguard™ Guard/Retention Gap Columns/Transfer Lines

- Extend analytical column lifetime by preventing degradation by harsh “steam-cleaning” water injections.
- Maximum temperature: 325°C.

When transfer lines from purge & trap systems, air monitoring equipment, or other instruments carry condensed water vapor, deactivated column tubing quickly becomes active because of the creation of free silanol groups. These silanol groups adsorb active oxygenated compounds such as alcohols and diols.

Restek chemists have addressed this concern and found a solution—the Hydroguard™ deactivation process. A unique deactivation chemistry creates a high-density surface that is not readily attacked by aggressive hydrolysis. The high-density surface coverage of the Hydroguard™ deactivation layer effectively prevents water vapor from reaching the fused silica surface beneath. Use Hydroguard™ tubing for connecting GCs to:

- Purge & trap systems.
- Headspace analyzers.
- Air analysis equipment and concentrator units.

Hydroguard™ Treated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

Nominal ID	Nominal OD	5-Meter	10-Meter	30-Meter*	60-Meter*†
0.28mm	0.53 ± 0.025mm	70080	70083	70086	70089
0.53mm	0.74 ± 0.025mm	70081	70084	70087	70090

*30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion.

References

- ¹Sternberg, R., C. Szopa, D. Coscia, S. Zubrzycki, F. Raulin, C. Vidal-Madjar, H. Niemann and G. Israel *J. Chromatogr.*, 846, 307-315, (1999)
- ²C. Szopa, R. Sternberg, F. Raulin and H. Rosenbauer *Planetary and Space Science*, 51 (13) 863-877 (2003)
- ³Cabane, M., P. Coll, C. Szopa, G. Israël, F. Raulin, R. Sternberg, P. Mahaffy, A. Person, C. Rodier, R. Navarro-Gonzalez, H. Niemann, D. Harpold and W. Brinckerhoff *Adv. Space Research*, 33, 2240-2245 (2004)
- ⁴Zampolli, M-G., D. Meunier, R. Sternberg, C. Szopa., F. Raulin, M. C. Pietrogrande, F. Dondi *Chirality* 18 (5):383-394 (2006)
- ⁵C. Szopa, U.J. Meierhenrich, D. Coscia, L. Janin, F. Goesmann, R. Sternberg, J.-F. Brun, G. Israel, M. Cabane, R. Roll, F. Raulin, W. Thiemann and C. Vidal-Madjar and H. Rosenbauer *J. Chromatogr. A*, 982 303-312 (2002)

a plus 1 story

“Since now almost 15 years, the Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA) of the University of Paris XII has been developing GC subsystems for on-board space probe GCMS experiments dedicated to the *in situ* analysis of extraterrestrial environments. Most of the capillary columns used in these subsystems were and still are provided by the Restek company.

One capillary column, MXT-1701¹, was aboard the Huygens probe of the Cassini-Huygens mission which explored successfully in 2005 the atmosphere of Titan, the largest moon of Saturn. Four columns, MXT-1, 20, 1701 and MXT-UPLOT², are “en route” towards the comet Churyumov-Gerasimenko in the frame of the ESA Rosetta mission launched in 2004 to be arrived by 2014. They will be used for the first time *in situ* analysis of a cometary nucleus. And finally, so far, 4 other PLOT (MXT U) and WCOT^{3,4} (MXT-1, 20 and CLP) columns have been selected and are currently being built in the GC of the Sample Analysis at Mars (SAM) Pyr/GCMS instrument, part of the payload of the NASA MSL 2009 Mars exploratory mission.

I would like to mention that all the columns selected for space mission are Silcosteel Treated metallic capillary columns and they have all been submitted successfully to space qualification tests such as vibration, radiation and thermal cycles⁵, which demonstrated their robustness for space application.

Since the beginning, the Restek company has been more than a manufacturer providing LISA with columns. Indeed, it has been strongly collaborating and helping LISA to develop custom-made columns able to meet the requirements of such an unusual scientific goal for chromatographic columns. That is why LISA is very grateful to Restek for being this ideal partner without the help of which the study and development of chromatographic columns for space use could not have been possible.”

Robert STERNBERG

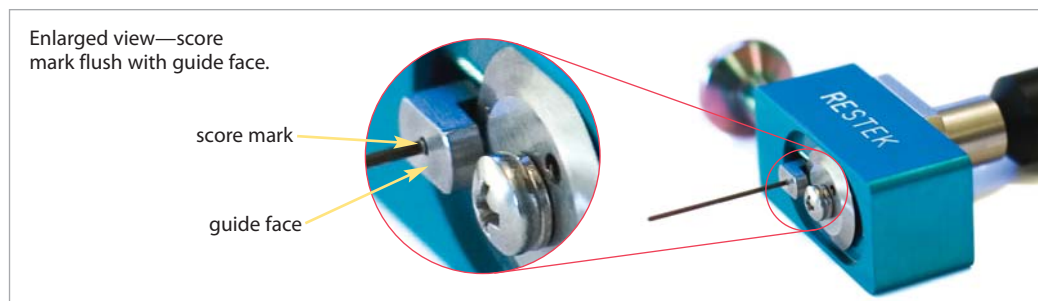
Responsible for the space GC team at LISA (Paris, France)



Restek Tubing Scorer for MXT® Columns

- Makes perfect cuts every time.
- Easy to use.
- Leaves column entrance perfectly round.

Metal MXT® columns are easy to cut. Scoring wafers can be used, but may leave the column end irregularly shaped. The Restek tubing scorer is designed to make a perfect cut every time, leaving the column entrance perfectly round.



Description	qty.	cat.#
Restek Tubing Scorer for MXT Columns (0.25-0.53mm ID & 0.5-0.8mm OD)	ea.	20523
Replacement Scoring Wheel	ea.	20522

MXT®-1 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for solvent impurities, PCB congeners or (e.g.) Aroclor mixes, simulated distillation, drugs of abuse, gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, and oxygenates.
- Temperature range: -60°C to 430°C.
- Equivalent to USP G1, G2, G38 phases.

MXT®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

MXT®-1 Columns (Siltek® treated stainless steel)

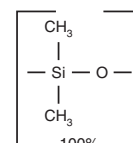
(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	6-Meter	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10	-60 to 330/430°C		70105	70116	70117	70114
	0.25	-60 to 430°C		70120	70123	70126	70129
	0.50	-60 to 400°C		70135	70138	70141	70144
	1.00	-60 to 340°C		70150	70153	70156	70159
0.28mm	0.10	-60 to 430°C	70102	70106	70109		
	0.25	-60 to 430°C		70121	70124	70127	
	0.50	-60 to 400°C		70136	70139	70142	
	1.00	-60 to 320°C		70151	70154	70157	
	3.00	-60 to 285°C		70181	70184	70187	
0.53mm	0.15	-60 to 430°C	70101*	70107			
	0.25	-60 to 430°C		70122	70125	70128	
	0.50	-60 to 400°C		70137	70140	70143	
	1.00	-60 to 320°C		70152	70155	70158	
	1.50	-60 to 310°C		70167	70170	70173	
	3.00	-60 to 285°C		70182	70185	70188	70189
	5.00	-60 to 270°C		70177	70179	70183	
	7.00	-60 to 250°C		70191	70192	70193	
ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter		
0.18mm	0.20	-60 to 330/430°C	71811	71812	71813		
	0.40	-60 to 320/400°C	71814	71815	71816		

Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

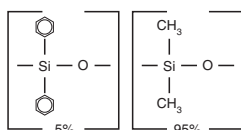
*For simulated distillation.

MXT®-1 Structure



similar phases

DB-1, DB-1MS, HP-1, HP-1MS, Ultra-1, SPB-1, Equity-1, MDN-1, CP-Sil 5 CB, VF-1ms

**MXT®-5
Structure****similar phases**

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5, CP-Sil 8 CB

Note: DB-5MS is a silarylene based polymer equivalent to Rxi®-5Sil MS.

MXT®-5 (low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners or (e.g.) Aroclor mixes, essential oils, and semivolatiles.
- Temperature range: -60°C to 430°C.
- Equivalent to USP G27, G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the MXT®-5 polymer, providing a tight monomodal distribution and extremely low bleed.

MXT®-5 Columns (Siltek® treated stainless steel)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 430°C	70205	70208	70211
	0.25	-60 to 430°C	70220	70223	70226
	0.50	-60 to 400°C	70235	70238	70241
	1.00	-60 to 340°C	70250	70253	70256
0.28mm	0.25	-60 to 430°C	70221	70224	70227
	0.50	-60 to 400°C	70236	70239	70242
	1.00	-60 to 325°C	70251	70254	70257
	3.00	-60 to 290°C	70281	70284	70287
0.53mm	0.25	-60 to 430°C	70222	70225	70228
	0.50	-60 to 400°C	70237	70240	70243
	1.00	-60 to 325°C	70252	70255	70258
	1.50	-60 to 300°C	70267	70270	70273
	3.00	-60 to 290°C	70282	70285	70288
	5.00	-60 to 270°C	70277	70279	70283

ID	df (μm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20	-60 to 325/430°C	71821	71822	71823
	0.40	-60 to 325/400°C	71824	71825	71826

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-2887 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns for simulated distillation.
- Stable to 400°C.

MXT®-2887 columns' stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times. Manufactured from Siltek®-treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available.

MXT®-2887 Column (Siltek® treated stainless steel)

(Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

ID	df (μm)	temp. limits	10-Meter
0.53mm	2.65	-60 to 400°C	70199

new!**MXT®-Biodiesel TG**

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430°C for reliable, consistent performance.
- Integra-Gap™ built-in retention gap on 0.53mm ID column eliminates column coupling completely.

MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

Description	temp. limits	cat. #
14m, 0.53mm ID, 0.16 w/2m Integra-Gap	-60 to 380/430°C	70289
10m, 0.32mm ID, 0.10	-60 to 380/430°C	70292
10m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	-60 to 380/430°C	70290
15m, 0.32mm ID, 0.10	-60 to 380/430°C	70293
15m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap**	-60 to 380/430°C	70291

*Total column length = 16 meters.

**Connected with low-dead-volume Alumaseal™ connector.

MXT®-1HT Sim Dist, MXT®-1 Sim Dist, MXT®-500 Sim Dist, MXT®-20

MXT®-1HT Sim Dist/MXT®-1 Sim Dist/MXT®-500 Sim Dist (nonpolar phases)

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-1HT Sim Dist and MXT®-1 Sim Dist phases offer true methyl silicone polarity; MXT®-500 Sim Dist phase is a carborane siloxane polymer.
- Stable to 430°C.

Manufactured from Siltek® treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available. As outlined in ASTM Method D6352, high temperature simulated distillation requires a column that can withstand temperatures to 430°C. MXT®-1HT Sim Dist and MXT®-500 Sim Dist columns exhibit excellent peak shape and low bleed, even at 430°C! The unique MXT®-1HT Sim Dist methyl silicone polymer gives the correct retention time/boiling point curve. The MXT®-500 Sim Dist carborane siloxane polymer offers a slight shift in the calculated boiling range distribution for petroleum samples containing aromatic hydrocarbons.

MXT®-1HT Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	5-Meter
0.53mm	0.10	-60 to 430°C	70100

MXT®-1 Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70101

MXT®-500 Sim Dist Column (Siltek® treated stainless steel)

ID	df (μm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 430°C	70104

Polywax® Calibration Materials

Description	qty.	cat.#
Polywax 655 calibration material	1g	36225
Polywax 1000 calibration material	1g	36227

MXT®-20 (low to midpolarity phase; Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

- General purpose columns for volatile compounds, flavor compounds, and alcoholic beverages.
- Temperature range: -20°C to 320°C.
- Equivalent to USP G28, G32 phases.

MXT®-20 polymer is synthesized to exacting standards. All residual catalysts and low molecular weight fragments are removed from the polymer, providing a tight monomodal distribution and extremely low bleed.

MXT®-20 Columns (Siltek® treated stainless steel)

(Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

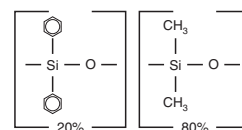
ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-20 to 320°C	70320	70323	70326
	1.00	-20 to 300°C	70350	70353	70356
0.28mm	0.25	-20 to 310°C	70321	70324	70327
	1.00	-20 to 295°C	70351	70354	70357
	3.00	-20 to 260°C	70381	70384	70387
0.53mm	0.25	-20 to 310°C	70322	70325	70328
	1.00	-20 to 295°C	70352	70355	70358
	3.00	-20 to 260°C	70382	70385	70388

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

similar phases

DB-1HT, CP-HT-Simdist CB

MXT®-20 Structure

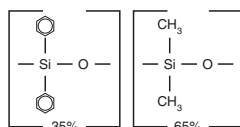


similar phases

SPB-20, VOCOL

MXT®-35, MXT®-50, MXT®-65 and MXT®-65TG

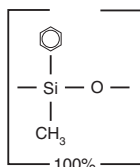
MXT®-35 Structure



similar phases

DB-35, HP-35, SPB-35, SPB-608

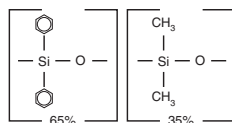
MXT®-50 Structure



similar phases

HP-17, SPB-50, SP-2250

MXT®-65/MXT®-65TG Structure



similar phases

TAP-CB, 400-65HT, 007-65HT

MXT®-35 (midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- General purpose columns for organochlorine pesticides, PCB congeners or (e.g.) Aroclor mixes, herbicides, pharmaceuticals, sterols, rosin acids, and phthalate esters.
- Temperature range: 0°C to 310°C.
- Equivalent to USP G42 phase.

MXT®-35 Columns (Siltek® treated stainless steel)

(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.50	0 to 310°C	70435	70438	
	1.00	0 to 300°C	70450	70453	
0.53mm	1.00	0 to 260/280°C	70452	70455	70458
	1.50	0 to 250/270°C	70467	70470	70473
	3.00	0 to 240/260°C	70482	70485	70488

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-50 (midpolarity phase; Crossbond® 100% methylphenyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, and sterols.
- Temperature range: 0°C to 290°C.
- Equivalent to USP G3 phase.

MXT®-50 Columns (Siltek® treated stainless steel)

(Crossbond® 100% methylphenyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.53mm	0.83	0 to 270/290°C		70569	
	1.00	0 to 260/280°C	70552	70555	70558
	1.50	0 to 250/270°C	70567	70570	70573

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-65 (mid to high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- General purpose columns for phenols and fatty acids.
- Temperature range: 50°C to 300°C.
- Equivalent to USP G17 phase.

MXT®-65 Columns (Siltek® treated stainless steel)

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	50 to 300°C	77020	77023
	0.50	50 to 300°C	77035	77038
	1.00	50 to 280°C	77050	77053

MXT®-65TG (high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- Application-specific columns, specially tested for triglycerides.
- Stable to 370°C.

The MXT®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370°C thermal stability, an MXT®-65TG column should not be used for analyses of compounds that contain active oxygenated groups.

MXT®-65TG Columns (Siltek® treated stainless steel)

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.25mm	0.10	20 to 370°C	77005	77008
0.53mm	0.10	20 to 370°C	77007	77010

MXT®-1301 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G43 phase.

MXT®-1301 Columns (Siltek® treated stainless steel)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-20 to 280°C	76020	76023	76026
	1.00	-20 to 260°C	76050	76053	76056
0.28mm	0.25	-20 to 280°C	76021	76024	76027
	1.00	-20 to 260°C	76051	76054	76057
0.53mm	1.50	-20 to 250°C	76066	76069	76072
	0.25	-20 to 280°C	76022	76025	76028
	1.00	-20 to 260°C	76052	76055	76058
	1.50	-20 to 250°C	76067	76070	76073
	3.00	-20 to 240°C	76082	76085	76088

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-1701 (midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

- General purpose columns for alcohols, oxygenates, PCB congeners or (e.g.) Aroclor mixes, and pesticides.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G46 phase.

MXT®-1701 Columns (Siltek® treated stainless steel)

(Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-20 to 280°C	72020	72023	72026
	1.00	-20 to 260°C	72050	72053	72056
0.28mm	0.25	-20 to 280°C	72021	72024	72027
	1.00	-20 to 260°C	72051	72054	72057
0.53mm	1.50	-20 to 250°C	72066	72069	72072
	0.25	-20 to 280°C	72022	72025	72028
	0.50	-20 to 270°C	72037	72040	72043
	1.00	-20 to 260°C	72052	72055	72058
	1.50	-20 to 250°C	72067	72070	72073
	3.00	-20 to 240°C	72082	72085	72088

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-200 (midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

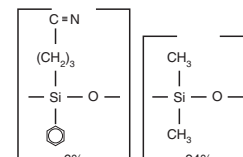
- General purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, and glycols. Excellent confirmation column with an Rtx®-5 column, for phenols, nitrosamines, organochlorine pesticides, chlorinated hydrocarbons, and chlorophenoxy herbicides.
- Temperature range: -20°C to 400°C.
- Equivalent to USP G6 phase.

MXT®-200 Columns (Siltek® treated stainless steel)

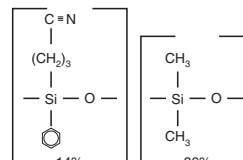
(Crossbond® trifluoropropylmethyl polysiloxane)

ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.50	-20 to 400°C	75035	75038	
	1.00	-20 to 310°C	75050	75053	
0.53mm	1.00	-20 to 290/310°C	75052	75055	75058
	1.50	-20 to 280/300°C	75067	75070	75073
	3.00	-20 to 260/280°C	75082	75085	75088

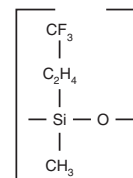
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-1301 Structuresimilar **phases**

DB-1301, DB-624, HP-1301, SPB-1301, SPB-624

MXT®-1701 Structuresimilar **phases**

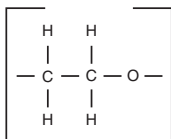
DB-1701, HP-1701, SPB-1701

MXT®-200 Structuresimilar **phases**

DB-200, DB-210

MXT®-WAX and MXT®-502.2

MXT®-WAX Structure



similar phases

DB-WAX, DB-WAXetr, HP-Wax,
HP-Innowax, Supelcowax 10,
CP-Wax 52 CB

MXT®-WAX (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, flavor compounds, essential oils, amines, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 260°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

MXT®-WAX Columns (Siltek® treated stainless steel)

(Crossbond® Carbowax® polyethylene glycol—provides oxidation resistance)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	40 to 260°C	70605	70608	70611
	0.25	40 to 260°C	70620	70623	70626
	0.50	40 to 260°C	70635	70638	70641
0.28mm	0.25	40 to 250°C	70621	70624	70627
	0.50	40 to 250°C	70636	70639	70642
	1.00	40 to 240°C	70651	70654	70657
0.53mm	0.25	40 to 250°C	70622	70625	70628
	0.50	40 to 250°C	70637	70640	70643
	1.00	40 to 240°C	70652	70655	70658
	1.50	40 to 230°C	70666	70669	70672
	2.00	40 to 220°C	70667	70670	

MXT®-502.2 (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants, cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks. Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Stable to 270°C.

An MXT®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-502.2 stationary phase provides low bleed and thermal stability to 270°C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling.

similar phase

DB-502.2

MXT®-502.2 Columns (Siltek® treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (μm)	temp. limits	30-Meter	60-Meter	105-Meter
0.25mm	1.40	-20 to 270°C	70915	70916	
0.28mm	1.60	-20 to 250°C	70919	70920	70921
0.53mm	3.00	-20 to 270°C	70908	70909	70910

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.18mm	1.00	-20 to 270°C	71891	71892

MXT®-Volatiles (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Stable to 280°C.

MXT®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-Volatiles stationary phase provides low bleed and thermal stability to 280°C.

MXT®-Volatiles Columns (Siltek® treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

ID	df (μm)	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	1.00	-20 to 280°C	70900	70903	
0.28mm	1.25	-20 to 280°C	70924	70926	70928
0.53mm	2.00	-20 to 280°C	70925	70927	70929
	3.00	-20 to 250°C	70922	70923	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20°C to 240°C.
- Equivalent to USP G43 phase.

The unique polarity of “624” columns makes them ideal for analyses of volatile organic pollutants. Although the MXT®-502.2 column is recommended in many methods, MXT®-624 columns offer the best separation of the early-eluting gases.

MXT®-624 Columns (Siltek® treated stainless steel)

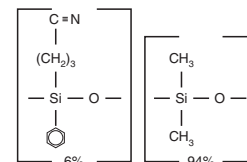
(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

ID	df (μm)	temp. limits	30-Meter	60-Meter
0.25mm	1.40	-20 to 240°C	70968	70969
0.53mm	3.00	-20 to 240°C	70971	70973

ID	df (μm)	temp. limits	10-Meter	20-Meter
0.18mm	1.00	-20 to 240°C	71893	71894

similar **phase**

VOCOL®

MXT®-624 Structuresimilar **phases**

DB-624, HP-624

**Technical Service Specialists**

Al Carusone, Tom Bloom, Jonathan Keim, Tim Herring, Alan Sensue, Terry Reid

We help novice and veteran chemists alike solve tough analytical problems everyday. How can we help you?

Domestic: support@restek.com – International: intltechsupp@restek.com



For Fast GC, Windows® 95, 98, 2000, NT, ME, or XP.

Pro ezGC Methods Development Software

- Optimize temperature and flow programs with a single analysis.
- Reduce analysis time and improve sample resolution.
- Model retention gap and guard column applications, including Restek Integra-Guard™ columns.
- Optimize dual-column run conditions, columns in parallel or in series.

Take the guesswork out of selecting the best column and conditions for your GC analysis. Pro ezGC software accurately predicts separations on any capillary column, and is useful for selecting a column and conditions from a single GC run. Using your retention data, or the extensive library, you can automatically evaluate thousands of combinations of column dimensions, oven temperature programs, and carrier gas pressure programs to determine the best separation with the fastest analysis time.

Increase productivity by improving separations and shortening analysis time with optimized temperature and carrier gas programs. Pro ezGC software for Windows® operating systems accurately models analyses when using guard columns and capillary restrictors, even when their IDs differ from the analytical column. The power of Pro ezGC software is especially helpful when modeling two columns connected in series or two columns connected in parallel to two separate detectors.

Pro ezGC includes a master set of retention index libraries at no extra charge! These libraries contain more than 3,000 compounds analyzed on the most commonly used stationary phases, in ten application areas, including pesticides, PCBs, dioxins/furans, flavor and fragrance compounds, drugs of abuse, FAMES, semivolatile and volatile pollutants, petroleum hydrocarbons, and solvents and chemicals. The libraries permit computer simulation without entering actual laboratory data.

Description	qty.	cat.#
Pro ezGC Method Development Software CD-ROM	ea.	21487

Restek Electronic Leak Detector

Ever have a small leak turn into a costly repair?

Protect your data and analytical column by using a Restek Leak Detector.

- Optimized sample flow path.
- A sleek, new ergonomic, hand-held design.
- Rugged side grips for added durability.
- Handy probe storage for cleanliness.
- Longer lasting battery, up to 6 hours of continuous use.
- Automatic shut-off capabilities.
- A convenient carrying and storage case.
- A universal charger set (US, European, UK, and Australian plugs included).



Leak Detector Facts

Detectable gases:

helium, nitrogen, argon,
carbon dioxide, hydrogen

Battery:

Rechargeable Ni-MH
internal battery pack
(6 hours normal operation)

Operating Temp. Range:

32°–120°F (0°–48°C)

Humidity Range:

0–97%

Warranty:

one year

Certifications:

CE, Japan

Compliance:

WEEE, RoHS



Carrying/storage case
included with purchase
of unit.



Optional soft-side
storage case is ideal
for storing your leak
detector in smaller
spaces such as your
tool box.



Verify hard-to-reach
leaks using the small
probe adaptor.

Description	qty.	cat.#
Leak Detector with Universal Charger Set (US, UK, European, Australian)	ea.	22839
Soft-Side Carry/Storage Case	ea.	22657
Small Probe Adaptor	ea.	22658

Avoid using liquid leak detectors on a capillary system! Liquids can be drawn into the system.

Caution: The Restek Electronic Leak Detector is NOT designed for determining leaks in a combustible environment. A combustible gas detector should be used for determining combustible gas leaks under any condition. The Restek Electronic Leak Detector may be used for determining trace amounts of hydrogen in a GC environment only.

Thermolite® Septa

- Precision molding assures consistent, accurate fit.
- Usable to 340°C inlet temperature.
- Excellent puncturability.
- Preconditioned and ready to use.
- Do not adhere to hot metal surfaces.
- Packaged in precleaned glass jars.



Septum Diameter	25-pk.	50-pk.	100-pk.
5mm ($\frac{1}{8}$ "	27120	27121	27122
6mm ($\frac{1}{4}$ "	27123	27124	27125
7mm	27126	27127	27128
8mm	27129	27130	27131
9mm	27132	27133	27134
9.5mm ($\frac{3}{8}$ "	27135	27136	27137
10mm	27138	27139	27140
11mm ($\frac{7}{16}$ "	27141	27142	27143
11.5mm	27144	27145	27146
12.5mm ($\frac{1}{2}$ "	27147	27148	27149
17mm	27150	27151	27152
Shimadzu Plug	27153	27154	27155

Capillary Ferrules—For $\frac{1}{16}$ -Inch Compression-Type Fittings

Available in Vespel®, graphite, or Vespel®/graphite.

Vespel® Ferrules

- 100% high-temperature polyimide.
- Stable to 350°C.
- Durable, leak-tight.

Vespel®/Graphite Ferrules

- 60%/40% Vespel®/graphite blend, offering the best combination of sealing and ease of workability.
- Seal with minimal torque, reusable, and preferred for vacuum and high-pressure uses.
- Stable to 400°C.
- Recommended for mass spec transfer lines.

Graphite Ferrules

- Preconditioned to eliminate out-gassing.
- High-purity, high-density graphite.
- Smoother surface and cleaner edges than conventional graphite ferrules.
- Contain no binders that can off-gas or adsorb analytes.
- Stable to 450°C.

Ferrule ID	Fits Column ID	qty.	Vespel®	Graphite	Vespel®/Graphite
0.3mm	< 0.18mm	10-pk.	22213	20233	20275
0.4mm	0.18/0.25/0.28mm	10-pk.	22214	20200	20211
0.4mm	0.18/0.25/0.28mm	50-pk.	—	20227	20229
0.5mm	0.32mm	10-pk.	22215	20201	20212
0.5mm	0.32mm	50-pk.	—	20228	20231
0.6mm	0.28mm**	10-pk.	—	—	20232
0.8mm	0.45/0.53mm	10-pk.	22216	20202	20213
0.8mm	0.45/0.53mm	50-pk.	—	20224	20230
1.0mm	0.75mm*	10-pk.	22217	21058	24912
1.2mm	0.75mm	10-pk.	22218	—	—
1.6mm	1.00mm*	10-pk.	—	21060	—

*For micropacked columns.

**For 0.28mm MXT® columns.

**Encapsulated Ferrules—For $\frac{1}{16}$ -Inch Compression Fittings**

- Reusable—will not deform and stick in fittings.
- Less torque needed to seal ferrule.
- Restek's unique blend of graphite minimizes fragmentation and outgassing.

Ferrule ID	Fits Column ID	qty.	cat.#
0.4mm	0.25mm	10-pk.	21036
0.5mm	0.32mm	10-pk.	21037
0.8mm	0.53mm	10-pk.	21038



Reusable!

For our complete listing of GC Accessories, please see our annual Chromatography Products Guide or visit www.restek.com.

Organic Volatile Impurities: Retention Time Index

Organic Volatile Impurities Retention Time Index

Retention time data collected using the following conditions:

G16 Stabilwax®: 30m, 0.25mm ID, 0.5µm df, Phase ratio: 125, Oven program: 40°C, hold 1 min., to 190°C @ 4°C/min., hold 15 min., Carrier flow: 1.2mL/min., Dead time: 1.38 min. @ 45°C

G16 Rb®-WAX: 30m, 0.25mm ID, 0.5µm df, Phase ratio: 125, Oven program: 40°C, hold 1 min., to 190°C @ 4°C/min., hold 15 min., Carrier flow: 1.2mL/min., Dead time: 1.40 min. @ 45°C

G43 Rb®-1301: 30m, 0.25mm ID, 1.0µm df, Phase ratio: 63, Oven program: 40°C, hold 1 min., to 190°C @ 4°C/min., hold 15 min., Carrier flow: 1.2mL/min., Dead time: 1.40 min. @ 45°C

G27 Rb®-5ms: 30m, 0.25mm ID, 1.0µm df, Phase ratio: 63, Oven program: 40°C, hold 1 min., to 190°C @ 4°C/min., hold 15 min., Carrier flow: 1.1mL/min., Dead time: 1.49 min. @ 45°C

G1 Rb®-L: 60m, 0.53mm ID, 3.00µm df, Phase ratio: 43, Oven program: 30°C, hold 4 min., to 220°C @ 4°C/min., Carrier flow: 6.3mL/min., Dead time: 2.54 min. @ 35°C

Rb®-200: 60m, 0.53mm ID, 3.00µm df, Phase ratio: 43, Oven program: 30°C, hold 4 min., to 220°C @ 4°C/min., Carrier flow: 7.8mL/min., Dead time: 2.22 min. @ 35°C

Carrier gas: helium	ICH Class	G16 Stabilwax®	G16 Rb®-WAX	G43 Rb®-1301	G27 Rb®-5ms	G1 Rb®-L	NA Rb®-200
Compound	Retention Time	Retention Time	Retention Time	Retention Time	Retention Time	Retention Time	Retention Time
1,1,1-trichloroethane	1	3.96	3.49	5.43	5.40	10.82	8.35
1,1,2-trichloroethane	2	15.72	14.28	10.99	9.77	16.75	14.94
1,1-dichloroethane	1	2.23	2.04	2.79	4.41	5.73	4.16
1,2-dichloroethane	1	8.80	7.68	6.15	5.46	10.38	9.74
cis-1,2-dichloroethane	2	6.50	5.65	4.79	2.88	8.71	7.11
trans-1,2-dichloroethane	2	3.63	3.20	3.55	3.54	7.17	5.16
1,2-dimethoxyethane	2	4.80	4.18	6.03	5.54	10.98	10.63
1,4-dioxane	2	8.55	7.49	7.86	7.26	13.54	14.34
1-butanol	3	11.13	10.08	7.18	5.76	11.49	10.13
1-pentanol	3	14.95	13.75	11.19	9.44	16.99	14.95
1-propanol	3	7.69	6.80	4.20	3.37	6.81	6.13
2-butanol	3	7.25	6.44	5.08	4.16	8.51	7.69
2-ethoxyethanol	2	13.99	12.70	8.69	7.36	13.91	13.99
2-methoxyethanol	2	12.42	11.11	6.02	5.14	9.83	10.74
2-methyl-1-propanol	3	9.32	8.40	6.00	4.79	*	*
2-propanol	3	4.81	4.25	3.00	2.55	4.91	4.69
3-methyl-1-butanol	3	13.42	12.25	9.86	8.26	15.28	13.55
acetic acid	3	22.47	20.34	6.52	4.61	8.84	8.96
acetone	3	3.02	2.64	2.89	2.50	4.64	7.68
acetonitrile	2	6.91	5.83	3.28	2.47	4.32	8.89
anisole	3	18.65	17.09	17.12	16.28	25.00	22.84
benzene	1	5.23	4.54	5.98	3.83	11.63	9.17
butyl acetate	3	8.86	7.88	12.12	11.38	19.43	19.63
carbon tetrachloride	1	3.96	3.49	5.61	5.90	11.89	7.42
chlorobenzene	2	13.91	12.54	13.55	13.14	21.56	18.48
chloroform	2	7.31	6.41	5.23	4.64	9.18	6.66
cumene	3	12.36	11.17	16.66	16.69	25.88	20.90
cyclohexane	2	2.16	2.01	5.37	5.89	*	*
dichloromethane	2	5.01	4.33	3.31	3.06	5.87	4.88
dimethylsulfoxide	3	26.47	24.43	16.62	13.01	18.81	30.95
ethanol	3	4.98	4.37	2.52	2.19	4.03	3.80
ethyl acetate	3	4.08	3.56	4.87	4.44	9.04	10.35
ethyl benzene	2	10.72	9.58	13.86	13.81	22.54	18.18
ethyl ether	3	1.72	1.63	2.58	2.67	5.34	3.87
ethyl formate	3	3.16	2.78	3.00	2.78	5.46	6.48
ethylene glycol	2	28.06	26.23	10.77	6.63	12.59	13.86
formamide	2	32.99	30.93	11.85	7.30	12.72	19.93
formic acid	3	24.64	22.09	5.19	2.60	5.59	5.06
heptane	3	1.98	1.86	6.34	6.98	14.18	7.84
hexane	2	1.65	1.58	3.77	4.11	9.06	4.86
isobutyl acetate	3	6.99	6.18	10.39	9.69	17.35	18.02
isopropyl acetate	3	4.26	3.74	6.19	5.71	11.47	12.38
methanol	2	4.23	3.64	1.96	1.80	3.14	2.93
methyl acetate	3	3.19	2.80	3.17	2.93	5.80	7.10
methylbutyl ketone	2	9.10	8.05	11.81	10.50	17.94	20.81
methylcyclohexane	2	2.50	2.30	7.31	7.95	15.49	9.21
methylethyl ketone	3	4.33	3.76	4.90	4.09	7.99	11.55
methylisobutyl ketone	3	6.84	5.97	9.64	8.49	15.35	18.41
m-xylene	2	11.21	10.04	15.46	14.17	23.01	18.78
N,N-dimethylacetamide	2	20.75	19.01	12.95	13.96	21.42	30.00
N,N-dimethylformamide	2	18.04	16.26	13.09	10.23	16.52	26.19
nitromethane	2	11.82	10.31	4.84	3.53	6.30	12.01
N-methylpyrrolidone	2	29.84	27.86	25.09	21.85	29.99	38.08
o-xylene	2	12.79	11.51	15.46	15.26	24.23	20.33
pentane	3	1.49	1.45	2.39	2.62	5.36	3.29
propyl acetate	3	5.98	5.29	8.03	7.44	*	*
p-xylene	2	10.98	9.82	14.29	15.27	22.99	18.69
pyridine	2	12.64	11.24	9.60	8.57	15.40	16.45
sulfolane	2	47.62	43.31	34.02	28.90	36.76	48.67
tert-butylmethyl ether	3	1.94	1.82	3.50	3.59	7.52	5.73
tetrahydrofuran	3	3.63	3.19	5.12	4.90	9.81	9.48
tetralin	2	25.12	23.48	27.49	27.44	37.27	31.72
toluene	2	7.86	6.91	9.80	9.66	17.36	14.00
1,1-diethoxypropane	—	5.42	4.84	11.39	11.38	19.82	15.08
2,2-dimethoxypropane	—	3.11	2.79	5.48	5.55	11.37	8.67
2-chloropropane	—	1.96	1.82	2.67	2.66	5.20	4.61
2-methylpentane	—	1.58	1.52	3.22	3.56	7.72	4.32
acetaldehyde	—	2.05	1.85	1.86	1.84	3.14	3.90
chloroethane	—	1.83	1.71	2.14	2.10	3.97	3.55
chloromethane	—	1.63	1.55	1.70	1.70	3.01	2.73
ethylene oxide	—	2.05	1.86	1.89	2.02	3.59	3.92
formaldehyde	—	2.25	1.57	1.68	1.58	2.66	2.59
isoamyl acetate	—	10.51	9.43	14.84	14.18	22.80	22.62
isooctane	—	1.85	1.75	5.84	6.59	13.66	8.07
isopropyl ether	—	1.86	1.76	4.03	4.23	9.03	5.83
methyl cyclopentane	—	1.91	1.79	4.50	4.93	10.41	5.81
methyl isopropyl ketone	—	4.93	4.29	6.58	5.69	11.04	14.47
methylal	—	2.26	2.06	2.84	2.82	5.65	5.09
trichloroethene	—	6.50	5.70	7.07	7.05	13.58	9.75
water	—	8.24	7.18	1.74	1.68	2.75	2.57

* Not determined

Improve your analyses with Restek!



Visit www.restek.com to search our chromatogram database and download free technical literature—24/7!

AND, find industry- and application-specific solutions that will save you time and money!



Environmental



Clinical/Forensics/Toxicology



Pharmaceutical



Bioanalytical



Foods/Flavors/Fragrances

Restek International—Here to Help You!

Restek recognizes that exceptional customer service is what separates us from the rest. We promise to provide you with the best support in the industry.

Restek International Customer Service Representatives

Restek's customer service representatives provide dedicated service to our subsidiaries and distributors to ensure that customers throughout the world get the products they order when they need them.



Emily Dillon

Phone: 814-353-1300, ext. 2328
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com



Nicole Bartley

Phone: 814-353-1300, ext. 2391
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com



Ken Poorman

Phone: 814-353-1300, ext. 2378
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com



Velvet Rossman

Phone: 814-353-1300, ext. 2416
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com



Stephanie Sunner

Phone: 814-353-1300, ext. 2189
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com

Restek International Technical Support



Tom Bloom

Phone: 814-353-1300, ext. 2105
Fax: 814-353-1568
e-mail: intltechsupp@restek.com



Tim Herring

Phone: 814-353-1300, ext. 2374
Fax: 814-353-1568
e-mail: intltechsupp@restek.com

Export Compliance



Kristy Myers

Phone: 814-353-1300, ext. 2304
Fax: 814-353-1309 / 1310
e-mail: IntlPlusOne@restek.com

Intl. GC Specialist



Jaap de Zeeuw

Phone: + 31 118 63151
e-mail: jaap.dezeeuw@restek.com



Lit. Cat.# GNMC1034-INT

© 2008 Restek Corporation.

Restek U.S. • 110 Benner Circle • Bellefonte, PA 16823 • 814-353-1300 • 800-356-1688 • fax: 814-353-1309 • www.restek.com

Restek France • phone: 33 (0)1 60 78 32 10 • fax: 33 (0)1 60 78 70 90 • e-mail: restek@restekfrance.fr

Restek Ireland • phone: 44 2890 814576 • fax: 44 2890 814576 • e-mail: restekeuropa@aol.com

Thames Restek U.K. LTD • phone: 44 1494 563377 • fax: 44 1494 564990 • e-mail: sales@thamesrestek.co.uk

Restek GmbH • phone: +49 (0) 6172 2797 0 • fax: +49 (0) 6172 2797 77 • e-mail: info@restekgmbh.de

