Chromatography Solutions

Avantor® Hichrom gas chromatography columns

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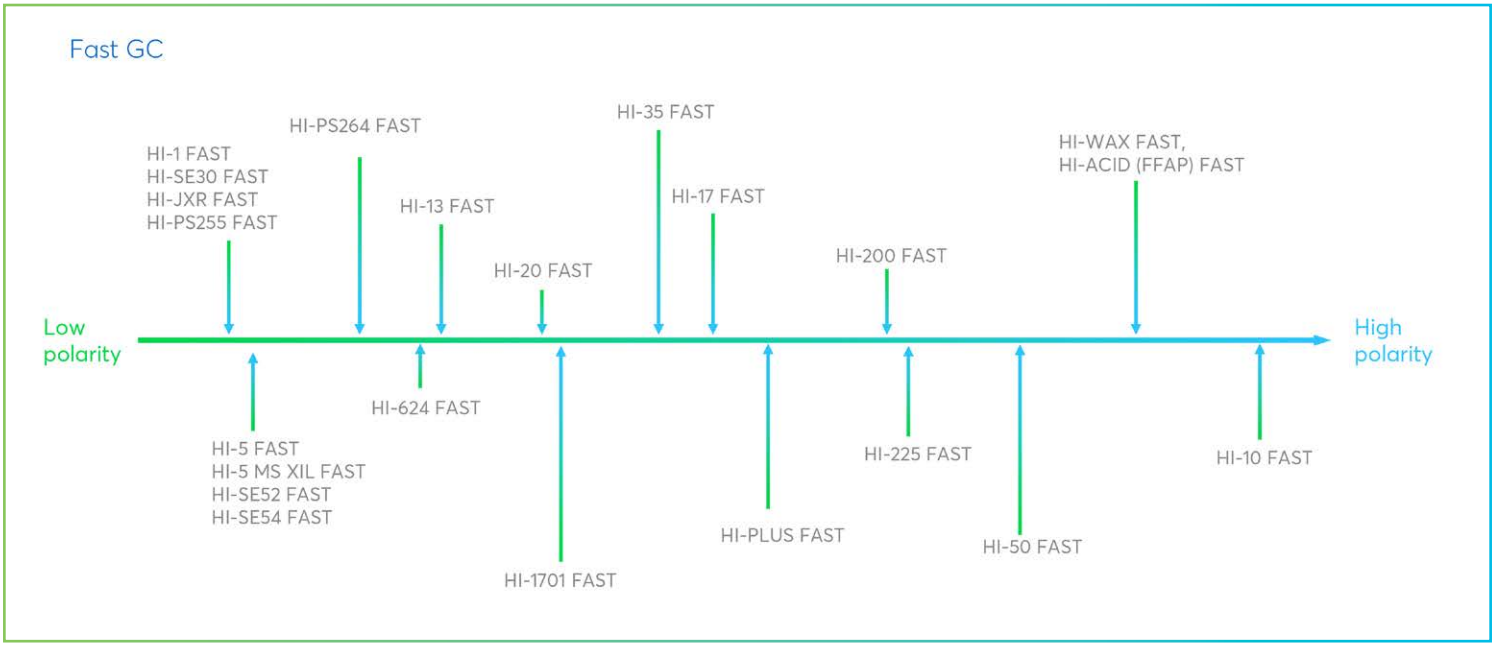
Gas chromatography employs a partition between a gas phase and a functionalised immobilised liquid phase to achieve separation. Owing to the length of the capillary columns, high resolution can be achieved. GC is used across a range of industries in many different application areas, from the analysis of fragrances and flavours, to the quantification of residual solvents in pharmaceuticals.

Owing to this broad application range, we offer over 50 different phases. This allows you to have access to the widest range of chemistries on the market, with all you need to achieve the desired separation of your mixture.

RANGE OF COMMON PHASES ACCORDING TO POLARITY

DIFFERENT PHASES & FORMATS



UNIQUE PHASES

In addition to our standard phases, we offer specially developed unique phases, which have been designed and developed to solve specific GC separation problems and give superior performance to other products on the market.

Avantor® Hichrom GC columns formats and dimensions

We cover many formats and phases as shown below:

- Length: 1 to 150 m
- Internal diameter: 0.05 to 0.53 mm
- Film thickness: 0.05 to 7.00 µm
- Temperature max. limits: 150 to 400 °C (dependant on phase and film thickness)

For the most widely used phases, a range of formats are available. For example, the HI-5, 5% polysiloxane is available in the following formats:

- HI-5 Standard
- HI-5 HT High temperature
- HI-5 MS Low bleed for mass spec.
- HI-5 MS XIL Ultra-low bleed for sensitive mass spec.

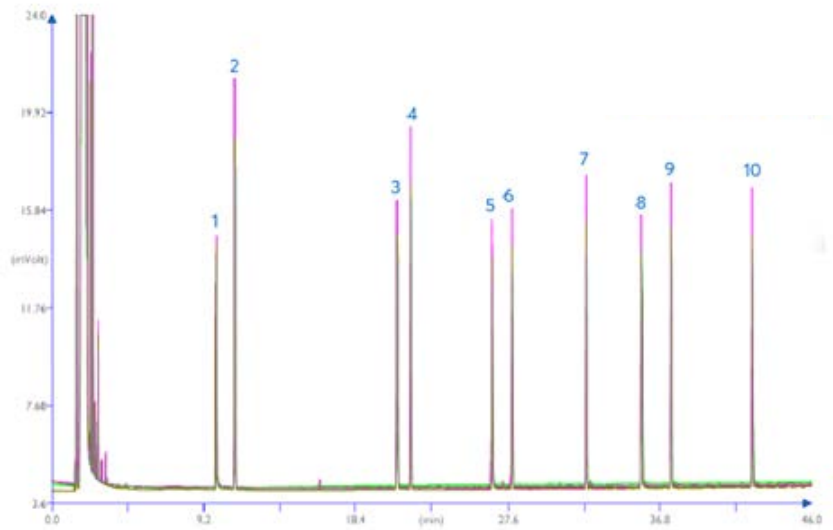
The High Temperature (HT) format is for applications that require a higher maximum temperature at the end of a temperature gradient run to be sure that less volatile compounds are volatilised for separation on the column. The following phases give the following corresponding maximum temperature limits. The maximum temperature for the column is dependent upon the type of phase and the film thickness.

MAXIMUM TEMPERATURES FOR THE HIGH TEMPERATURE FORMATS OF COMMONLY USED PHASES

HT phase	Max. temp./ °C
HI-1 HT	400
HI-WAX HT	300
HI-5 HT	400
HI-17 HT	370
HI-SE54 HT	400
HI-8 HT	400
HI-65 HT	370
HI-1701 HT	320
HI-35 HT	370

QUALITY / REPRODUCIBILITY

With Avantor® Hichrom branded products, you can be sure that you are buying the high quality you need for your analytical laboratories to meet stringent regulatory requirements. Our GC columns provide demonstrable reproducibility so that you can be confident that a method developed on one of our columns will perform the same batch-to-batch, year-on-year.



Purple trace: 5 different batches of capillary tubing

Green trace: 5 different batches of phase

Orange trace: 5 different manual injections

Blue trace: 5 different production years

1 2,3-Butanediol
2 Decane
3 1-Octanol
4 2,6-Dimethylphenol
5 2,6-Dimethylaniline
6 Methyl Decanoate
7 Dicyclohexylamine
8 Methyl Undecanoate
9 Methyl Laurate

Avantor® Hichrom GC phases cross reference guide

AVANTOR® HICHROM GC PHASES	AGILENT / VARIAN	ALLTECH	MACHEREY-NAGEL	PHENOMENEX	QUADREX	RESTEK	SGE	SUPELCO	USP METHOD CLASSIFICATION
HI-1	DB-1, HP-1, CP-Sil 5 CB	AT-1(+), EC-1(+)	OPTIMA-1	ZB-1	007-1	Rtx-1	BP1	SPB-1, Equity-1	G1, G2, G9
HI-5	DB-5, HP-5, CP-Sil 8 CB	AT-5(+), EC-5(+)	OPTIMA-5	ZB-5	007-5	Rtx-5	BP5	SPB-5, Equity-5	G27, G36
HI-1701	DB-1701, HP-1701, DB-1701P, CP-Sil 19 CB	AT-1701(+)	OPTIMA-1701	ZB-1701	007-1701	Rtx-1701	BP10	SPB-1701, Equity-1701	G46
HI-17	DB-17, HP-17, DB-608, CP-Sil 24 CB	AT-50(+)	OPTIMA-17	ZB-50	007-17	Rtx-50	BPX50	SPB-50	G3
HI-624	DB-624, HP-624	AT-624(+)	OPTIMA-1301, OPTIMA-624	ZB-624	007-624, 007-1301	Rtx-1301, Rtx-624	BP624	SPB-624	G43
HI-WAX	DB-Wax, HP-Wax, CP Wax 52 CB	AT-Wax(+), EC-Wax(+)	OPTIMA-WAX	ZB-Wax	007-CW	Rtx-Wax	BP20	-	G14, G15, G16
HI-ACID (FFAP)	DB-FFAP	AT-1000(+), EC-1000(+)	-	ZB-FFAP	007-FFAP	Stabilwax-DA	BP21	Nukol	G14, G15, G16, 25, G35, G39
HI-1 MS	DB-1 ms (UI), HP-1 ms, VF-1 ms	AT-1 ms(+)	OPTIMA-1 MS (accent)	ZB-1 ms	007-1 ms	Rxi-1 ms	BP1	Equity-1	G1, G2, G9, G38
HI-5 MS	DB-5 ms (UI), HP-5 ms	AT-5 ms(+)	OPTIMA-5 MS (accent)	ZB-5 ms	007-5 ms	Rtx-5 MS, Rxi-5 MS	BPX5	Equity-5	G27, G36, G41
HI-5 MS Xil	DB-5 ms (UI), VF-5 ms	-	OPTIMA-5 MS (accent)	ZB-5 ms	-	Rxi-5 Sil MS	-	SLB-5 ms	G27, G36, G41
HI-XMLB	DB-XLB	-	OPTIMA-XLB	ZB-XLB (HT)	-	Rtx-XLB	-	MDN-12	-
HI-35 MS	DB-35 ms (UI), VF-35 ms	-	OPTIMA-35 MS	-	007-35 ms	Rxi-35 Sil MS	BPX35	SPB-35	G28, G32, G42
HI-17 MS	DB-17 ms, VF-17 ms	-	OPTIMA-17 MS	-	-	Rxi-17 Sil MS	BPX50	-	G3
HI-624 MS	VF-1301 ms, VF-624 ms	-	OPTIMA-624 LB	-	-	Rxi-624 Sil MS	-	-	G43
HI-WAX MS	InnoWax, VF-Wax ms	AT-Wax ms(+)	-	ZB-Wax plus	-	Stabilwax MS	-	-	G14, G15, G16
HI-10	HP-88, CP-Sil 88	AT-Silar 10(+)	-	ZB-FAME	-	Rtx-2560	BPX70	SP-2560	G5, G8, G48
HI-200	DB-200, DB-210, VF-200 ms	AT-210(+)	OPTIMA-210	-	007-210	Rtx-200	-	-	G6
HI-225	DB-225, HP-225	AT-225(+)	OPTIMA-225	-	007-225	Rtx-225	BP225	SPB-225	G7, G19, G26
HI-35	DB-35, HP-35	AT-35(+)	-	ZB-35	007-11, 007-35	Rtx-35	-	SPB-35, SPB-608	G28, G32, G42
HI-50	DB-23, VF-23 ms	AT-Silar 90(+)	-	-	-	Rtx-2330	BPX70	SP-2330, SP2331, SP2380	G8
HI-FFAP EXT	DB-FFAP	AT-1000(+), EC-1000(+)	-	ZB-FFAP	007-FFAP	Stabilwax-DA	BP21	Nukol	G14, G15, G16, 25, G35, G39

This is a general phase-to-phase cross reference which holds for the vast majority of GC applications. It is possible that owing to differences in manufacturing process small differences in selectivity could occur.

vwr.com/hichromgc

HOW TO ACHIEVE SHORTER GC ANALYSIS TIMES USING FAST GC

By selecting the Fast GC format for your required phase, it is possible to decrease the run time, thereby generating results faster. Fast GC allows the GC user to reduce the analysis time while keeping an adequate resolution power, thus increasing your throughput. Fast GC can be applied to the analysis of complex mixtures and can shorten analysis time by up to 10 times compared to conventional GC.

To carry out Fast GC, a shorter column with a smaller internal diameter (so-called 'narrow bore' column) is required. A high temperature rate (usually more than 15 °C/min) and a high acquisition rate on the GC detector is required to make sure that peak shape does not deteriorate.

Internal diameter	Length	Film thickness (µm)	Theoretical plates (N)
	2.5 m	0.05	50000
50 µm	5 m	0.10	100000
	5 m	0.10	50000
100 µm	10 m	0.20	100000

HI-VOC 2 FAST: ALTERNATIVE FOR HI-624 FOR FASTER SEPARATIONS OF RESIDUAL SOLVENTS ACCORDING TO ICH Q3C (R6)

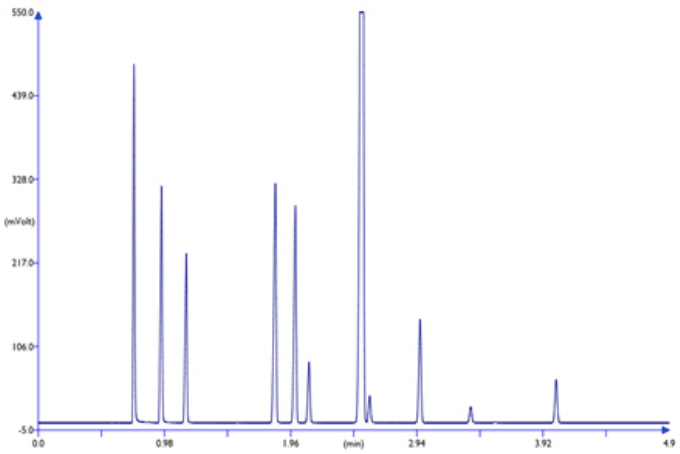


FIGURE 1: Gas chromatogram: Separation of residual solvents – headspace GC using Avantor® Hichrom HI-VOC 2 FAST columns.

Proprietary phases

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Find out more about the range of GC Columns: **vwr.com/hichromgc**

STATIONARY PHASE NAME	STATIONARY PHASE COMPOSITION	APPLICATIONS
HI-BASIC	Proprietary Phase developed for aliphatic and aromatics Amines	C-12992
HI-BIODIESEL 103	Proprietary Phase developed for Biodiesel EN14103 analysis	C-13027
HI-BIODIESEL 105	Proprietary Phase developed for Biodiesel EN14105, D6584 analysis	C-13028
HI-DAI 1 & HI-DAI 2	Proprietary Phase developed for Direct Aqueous Injections	C-13065
HI-LAP	Proprietary Phase developed for Lipid Analysis Phase, Saturated and Unsaturated Triglycerides, Sterols and Lipid analysis	C-12985
HI-PAH and HI-PAH 2	Proprietary Phase developed for PAHs analysis	C-13062
HI-POF 1 and HI-POF 2	Proprietary Phase developed for pesticides	C-12997
HI-SOLVE 1 and HI-SOLVE 2	Proprietary Phase developed for complex solvent mix	C-13066
HI-VOC 1 and HI-VOC 2	Proprietary Phase developed for Volatile Organic Compounds	C-13022
HI-XMLB	Proprietary Phase developed for semi-volatiles environmental - low bleeding	C-13067
HI-ALC 1 and HI-ALC 2	Proprietary Phase developed for blood alcohol analysis	C-13068

EXAMPLES OF PROPRIETARY PHASES:

HI-LAP PHASE

A range of phases have been developed to enable superior separation for specific applications. For example, the LAP (Lipids Analysis Phase) is a dedicated stationary phase. The phase is optimised for lipids, sterols and saturated and unsaturated triglyceride separations, stable over 370 °C. The HI-LAP is predominantly used for the classification of natural oils mapping lipids and triglycerides which is important in understanding the origin of oils for preventing counterfeit products.

HI-OVW PHASE

Specifically for food ingredient manufacturers such as those doing analysis of waxes often present in edible oils. It is important to remove these waxes as these negatively affect the product. This phase could be useful where other GC columns are unable to provide the required separation.

CHIRAL GC

Chiral GC is an important technique, especially in the development and manufacture of flavours and fragrances but it is also useful in other application areas such as pharmaceuticals. We offer both standard and novel cyclodextrin-based chiral phases.

STANDARD CHIRAL PHASES

Avantor® Hichrom GC standard cyclodextrin chiral phases are available with the cyclodextrin in either beta or gamma configuration with seven or eight glucose subunits respectively. Four different modifications to the -OH group are available giving rise to six different chiral phases.

STATIONARY PHASE NAME	STATIONARY PHASE COMPOSITION
HI-DEX DAC Beta	Diacetyl TBS Beta Cyclodextrin based
HI-DEX DAC Gamma	Diacetyl TBS Gamma Cyclodextrin based
HI-DEX DET Beta	Diethyl TBS Beta Cyclodextrin based
HI-DEX DET Gamma	Diethyl TBS Gamma Cyclodextrin based
HI-DEX DMP Beta	Dimethyl-pentyl Beta Cyclodextrin based
HI-DEX DMT Beta	Dimethyl TBS Beta Cyclodextrin based

PROPRIETARY CHIRAL PHASES

These phases use unique modifications to the cyclodextrin phase to give differentiated performance for the separation of enantiomers. As the full mechanism of chiral separations is still not fully understood, having access to unique chiral phases is helpful to solve such analytical problems.

UNIQUE CHIRAL PHASES

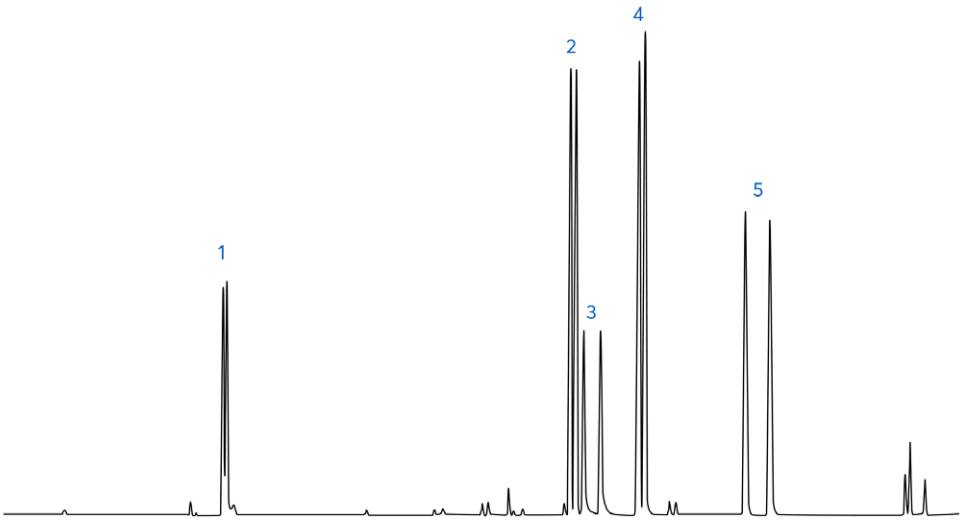
STATIONARY PHASE NAME	STATIONARY PHASE COMPOSITION	APPLICATIONS
HI-DEX B-SE and HI-DEX B-03	Proprietary Cyclodexstrin-Beta based chrial phase	**C-12990**
HI-DEX G-01 and HI-DEX G-03	Proprietary Cyclodexstrin-Gamma based chrial phase	**C-12993**

Please contact the technical team for information on applications about additional unique phases for specific applications.

Chiral GC is predominantly required in the development and manufacture of flavours and fragrances because the human olfactory system is capable of discerning between two different enantiomers of the same molecule. Indeed, the manufacture of the incorrect enantiomer can give rise to very undesirable odours.

Below is a separation of two enantiomers of five different compounds as may be found in a typical fragrance mixture. The HI-DEX G-01 phase clearly separates each enantiomer giving a very satisfactory chromatogram.

CHIRAL GC SEPARATION USING THE AVANTOR® HICHROM HI-DEX G-01 PHASE



Oven program: 50 °C, 2 °C/min

Carrier gas: Hydrogen, 0.6 ml/min constant flow

Injector: Split, 250 °C

Detector: FID, 250 °C

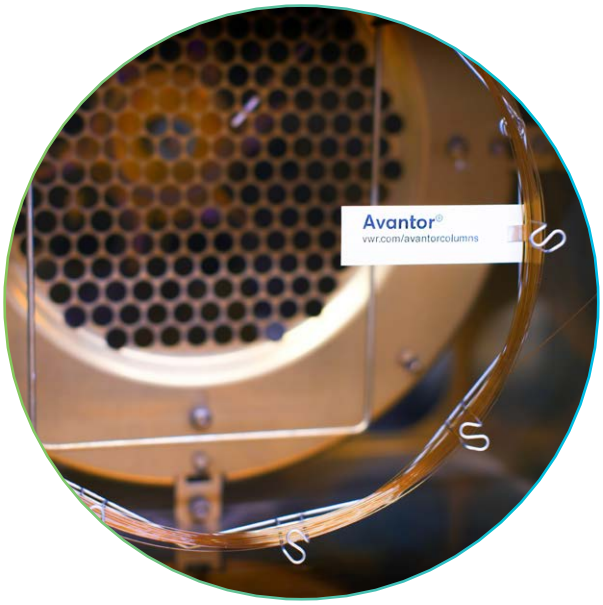
1 2-Octanol enantiomers
2 Linalyl Acetate enantiomers
3 Menthol enantiomers
4 Isobornyl Acetate enantiomers
5 Camphor enantiomers

RETENTION GAPS

A retention gap is a section of uncoated fused silica capillary which is inserted between the injector port and the column to give a section of no retention and, therefore, no separation. The length of the retention gap should be sufficient to ensure that all the liquid solvent is retained within it, and only enters the separation column as vapour.

Retention gaps, therefore, provide the following advantages:

- Act as a guard column
- Cold on-column injections possible
- Large injections possible with a long retention gap
- Direct insert with large syringe



Retention gap	Application	High temp.	Lengths (m)	IDs (mm)
CW retention gap / pre-column	Deactivation mainly for polar solvents	-	1 to 60	0.05 to 0.53
DPTMDS retention gap / pre-column	General purpose deactivation for both a-polar and polar solvents	Available		
HMDS retention gap / pre-column	Deactivation mainly for a-polar solvents	Available		

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