



GAS CHROMATOGRAPHIC COLUMN



INNOVATIVE



REPRODUCIBLE



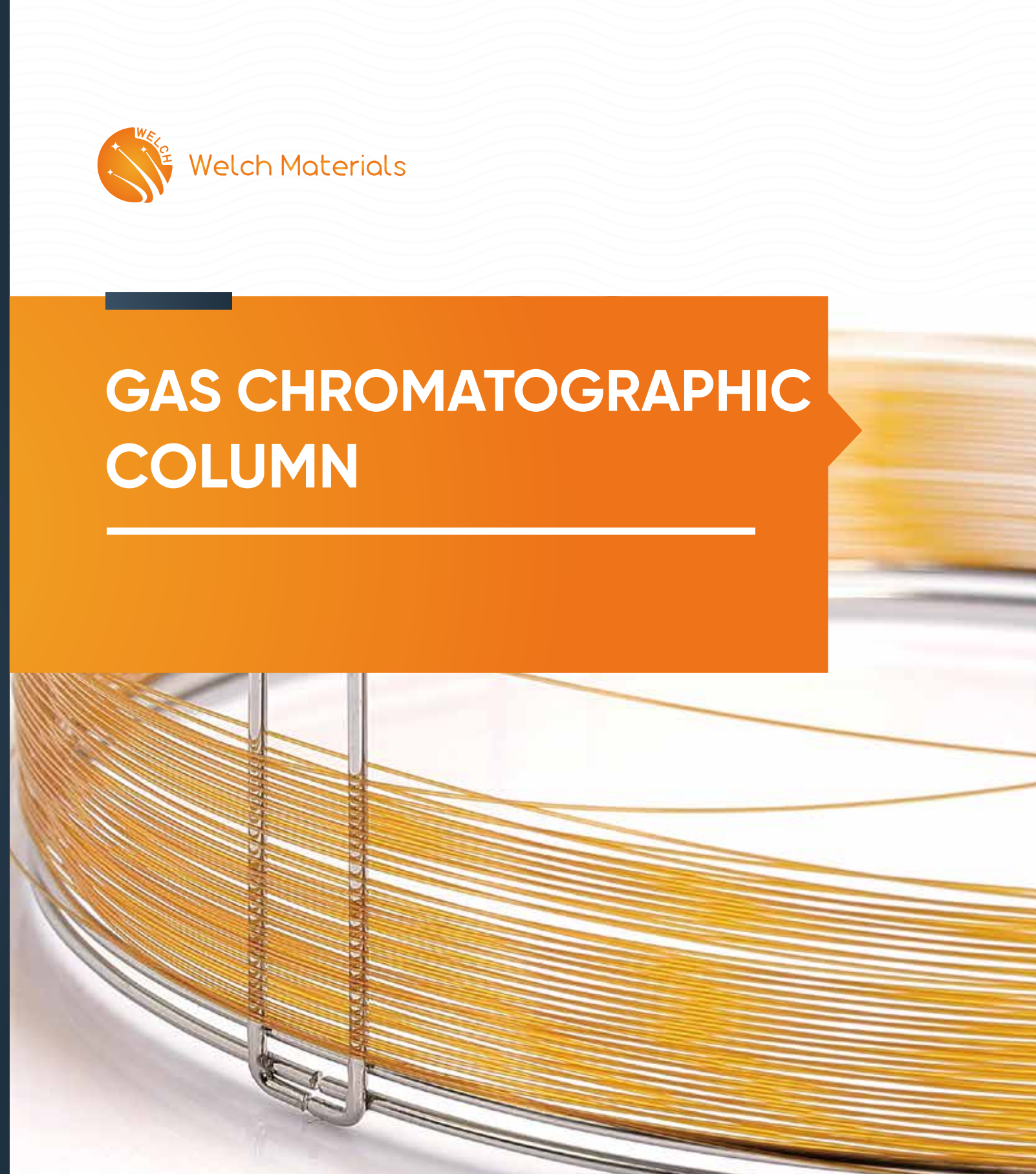
RUGGED

WELCH MATERIALS, INC.

WEB: WWW.WELCH-US.COM
EMAIL: INFO@WELCHMAT.COM



WELCH MATERIALS, INC.



COMPANY PROFILE

Welch Materials is a multinational company specializing in the development and manufacturing of laboratory products. Our extensive range of offerings includes HPLC columns, GC columns, chromatographic packing materials, sample preparation products, protein purification products, laboratory instruments, and general consumables.

Established in August 2003, Welch Materials, Inc. has its headquarters in Songjiang, Shanghai. In addition to our main office, we operate production and research facilities in Jinhua, Zhejiang, and Nanjing, Jiangsu. Furthermore, we have established subsidiary branches in the United States, India, and Canada.

At Welch Materials, Inc., we seamlessly integrate research, production, sales, and service to provide comprehensive laboratory solutions worldwide. Our products have wide-ranging applications in vital industries such as biomedicine, food safety testing, environmental monitoring, and fine chemicals, making a significant contribution to improving people's lives. In 2018, we proudly obtained the ISO 9001:2015 international quality management system certification, reaffirming our unwavering commitment to maintaining the highest quality standards. Through the implementation of rigorous quality inspection processes and strict adherence to standards, we ensure that each product we produce complies with the most stringent laboratory requirements.



CONTENT

OUTLINE OF GC COLUMN

01/25

1.1 WM Series High Performance GC Column	02
1.2 WEL Series Economical GC Column	16
1.3 Dedicated GC Column	22
1.4 GC Packed Column	25

APPLICATION OF GC COLUMN

26/54

2.1 Application in Chemical Energy	27
2.2 Application in Brewing Field	31
2.3 Application in Environmental Analysis	34
2.4 Application in Food	36
2.5 Applications in Pharmacopoeia	39
2.6 Application in Other Fields	48

01

02

GC ACCESSORIES

55/58

3.1 Gas Generator	56
3.2 GC Column Accessories	56
3.2.1 Injection Septa	56
3.2.2 Graphite Ferrule	57

OVERALL SOLUTIONS FOR PESTICIDE RESIDUE DETECTION

59/68

4.1 Method A: Determination of Organochlorine Pesticide Residue	60
4.2 Method B: Determination of Organophosphorus Pesticide Residues	63
4.3 Method C: Determination of Pyrethroid Pesticide Residues	65
4.4 Method D: Determination of Multiple Pesticide Residues	66
4.5 Method E: Determination of Pesticide Residue	67

TECHNICAL REFERENCE

69/85

5.1 Selection of GC Column	70
5.2 Installation of GC Column	75
5.3 GC Column Troubleshooting	78

03

04

05

01 OUTLINE OF GC COLUMN

OUTLINE OF GC COLUMN

Welch Materials has concentrated on GC R&D and production for many years, and each column would be tested strictly before selling with attached column report. Welch columns are characterized by stable properties, high column efficiency and good reproducibility. Welch GC column can be divided into two series: WM Series High Performance GC Column and WEL Series Economical GC Column, which can meet the analysis requirements of various customers.

Welch also provides services such as sample analysis, method development, column recommendation, after-sales support and training for customers.

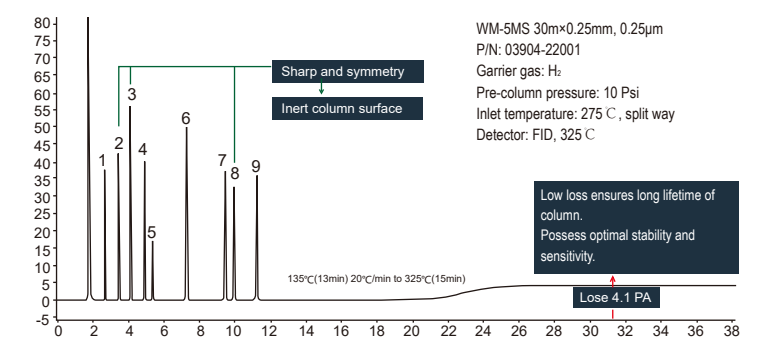
With good product performance and perfect after-sales service system, our GC columns have been widely used in universities, research institutes, pharmaceutical, petrochemical, brewing, environmental protection or other industries.

1.1 WM SERIES HIGH PERFORMANCE GC COLUMN

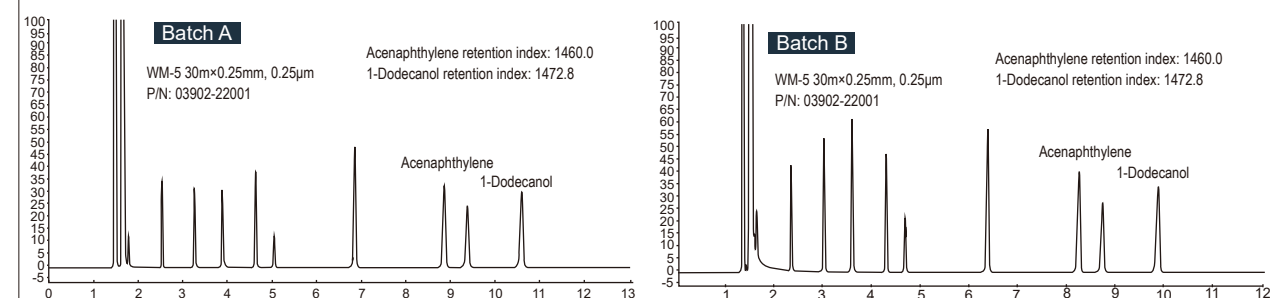
WM series capillary columns adopt strict technique and performance detection with strength in super inertness, low loss, high column efficiency, high selectivity, stable reproducibility and long lifetime.

(1) Super Inertness and Low Loss GC/MS Column

- The unique surface deactivating technique ensures the super high inertness of column, and the peak type of separation component is sharp and symmetrical.
- Unique bonding and cross-linking technology allow the column to keep a low loss level at higher temperature with good stability and long lifetime.



(2) Exceptional lot-to-lot reproducibility

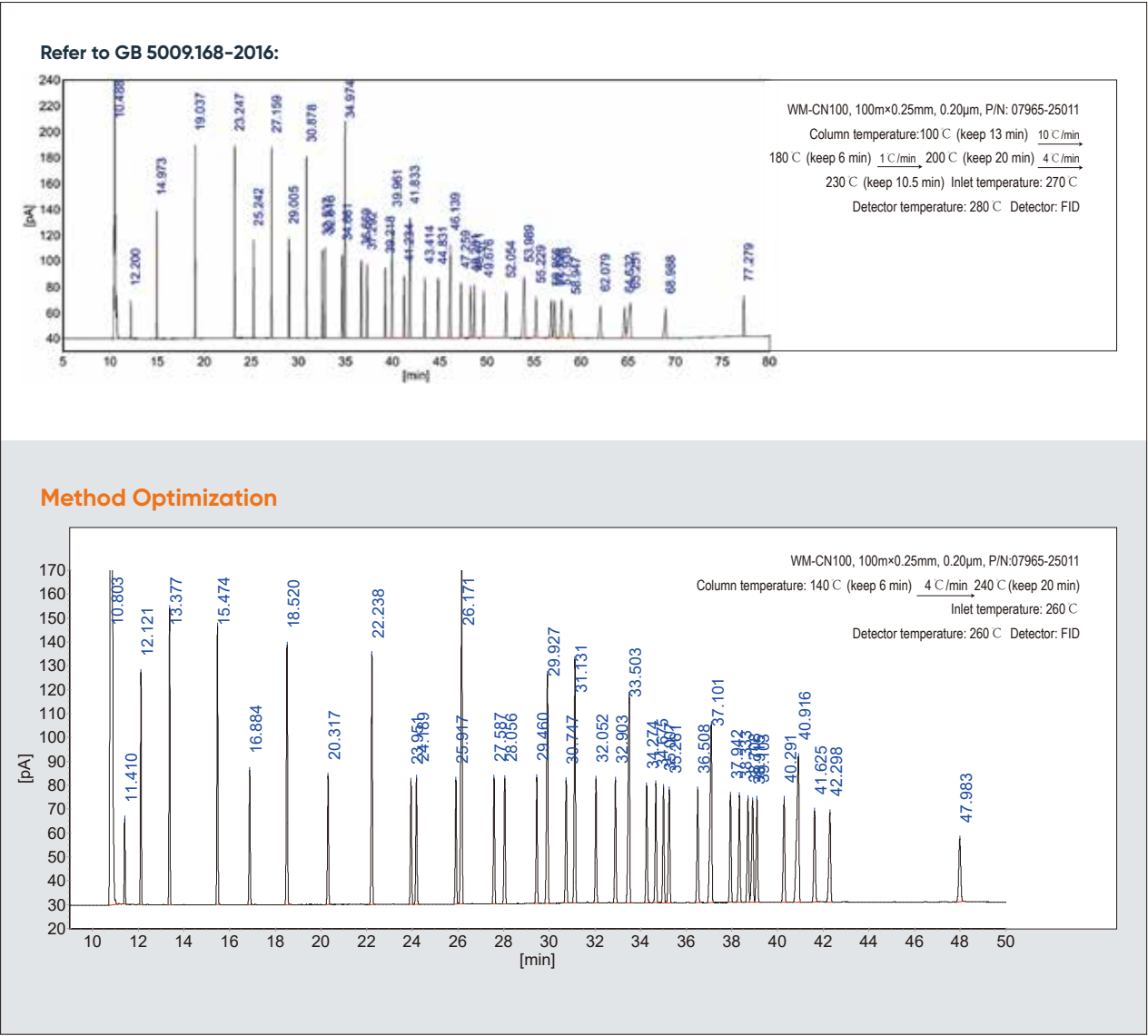


- The consistency of column inertness and superior inter-column reproducibility can be guaranteed by mixed standards samples test.
- Higher detection sensitivity and more accurate analysis results.

(3) Cases of Excellent Performance of WM Column

Determination of 37 fatty acids:

Welch has released dedicated columns for 37 fatty acids with excellent separation performance and reproducibility. Benefited from the optimized method, the analysis time can be greatly shortened without losing the resolution and the customer's analysis cost can be saved.

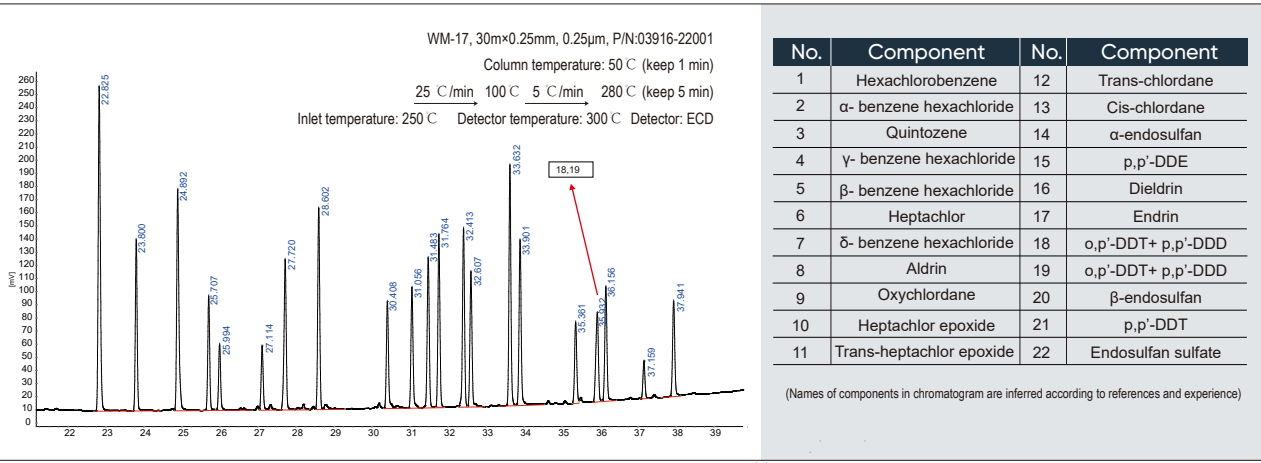


Determination of 22 Kinds of Organochlorine Pesticide Residues:

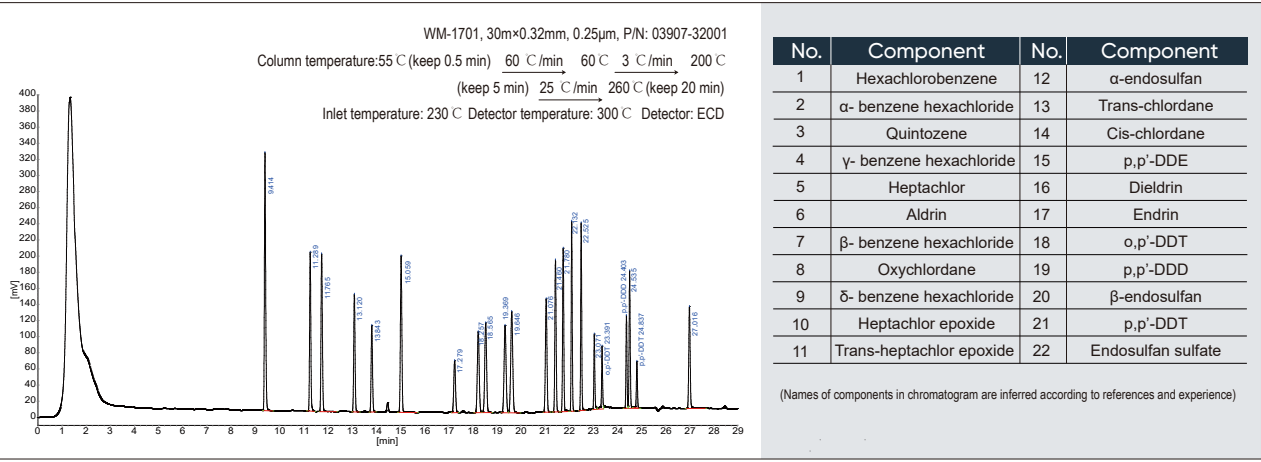
Welch provides an overall solution for the determination of 22 kinds of organochlorine pesticide residues, including sample pretreatment, chromatographic analysis, a complete set of products and technical support. The corresponding chromatographic analysis column and verification column are ideal substitution for named columns of the same specification.

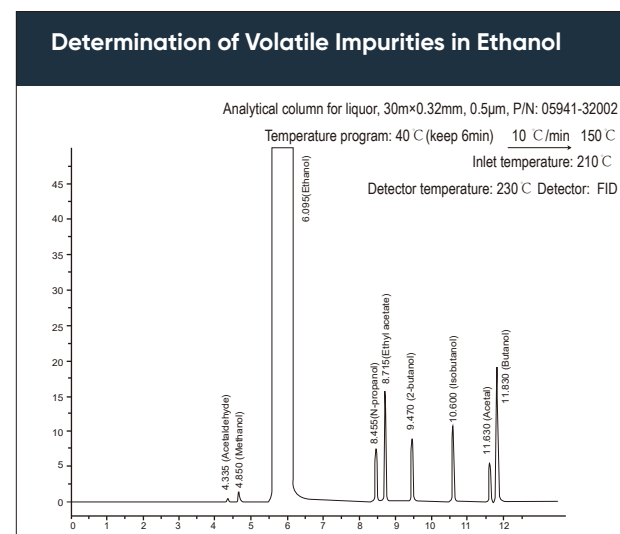
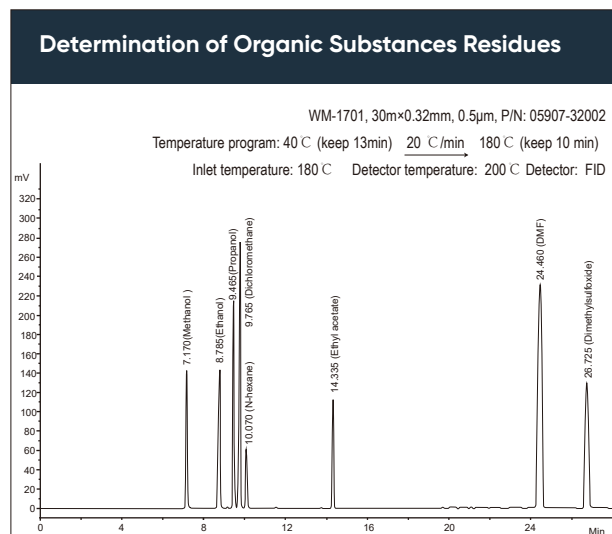
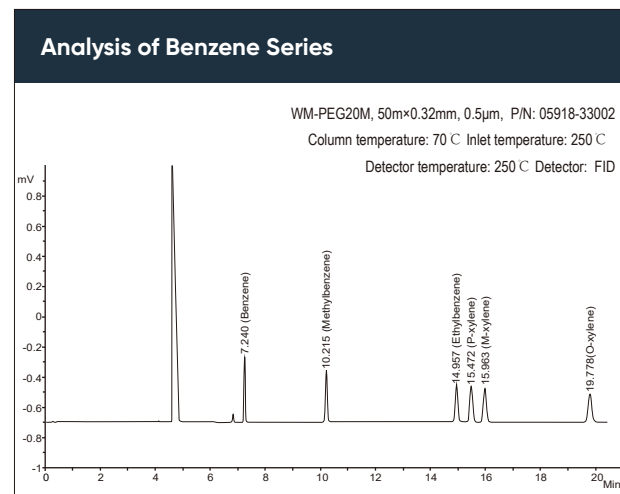
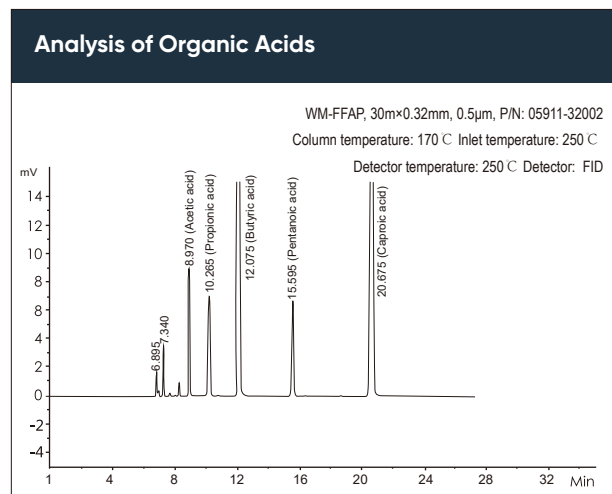
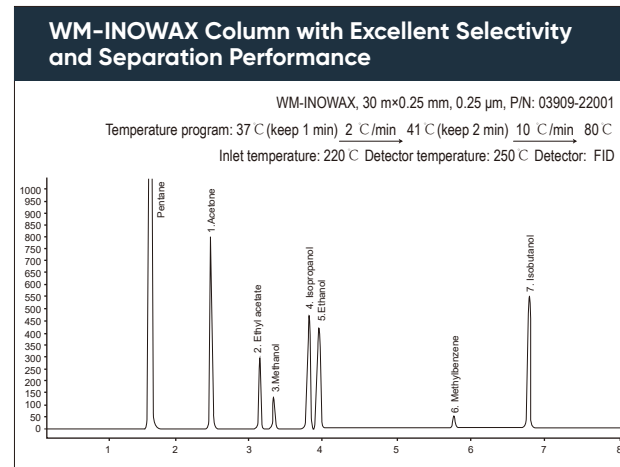
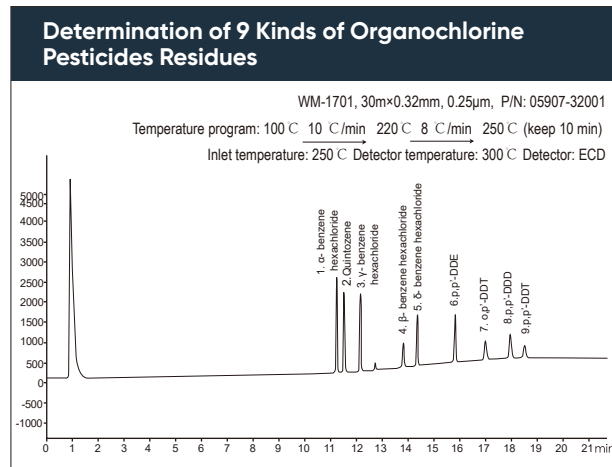
P/N	Specification	Note
03916-22001	WM-17 30m×0.25mm, 0.25μm	Analysis column
03901-22001	WM-1 30m×0.25mm, 0.25μm	Verificaiton column

Refer to the 2020 edition of the "Chinese Pharmacopoeia":



Reference to the 2020 edition of the "Chinese Pharmacopoeia" (Part One):





Cross Reference

Stationary Liquid	USP	Similar Stationary Liquid
WM-1	G2	DB-1, HP-1, OV-1, BP-1, Rtx-1, OV-101, SPB-1, CP-Sil 5CB
WM-1MS	G2	DB-1MS, HP-1MS, OV-1MS, OV-1MS
WM-5	G27	BP-5, ZB-5, CP-Sil 8CB, DB-5, HP-5, SPB-5, Rtx-5, OV-5
WM-5MS	G27	ZB-5MS, DB-5MS, HP-5MS, OV-5MS
WM-35	G42	DB-35, HP-35, SPB-35, Rtx-35, PE-35, AT-35
WM-1301	G43	DB-1301, HP-1301, PE-1301, Rtx-1301
WM-1701	G46	BP-10, CB-1701, CP-Sil 19CB, DB-1701, Rtx-1701
WM-225	G7	007-225, DB-225, BP-225, HP-225, CP-Sil 43CB, Rtx-225
WM-624	G43	007-624, AT-624, CP-624, DB-624, HP-624, Rtx-502.2, VOCOL
WM-INOWAX	G16	CP-Wax, DB-Wax, HP-Innowax, PE-Wax, Rtx-Wax
WM-FFAP	G35	BP-21, HP-FFAP, PE-FFAP, CP-FFAP, DB-FFAP, Nukol
WM-17	G3	DB-17, HP-17, HP-50, Rtx-50, AT-50, SPB-50, SP-2250

Guideline of Selecting WM Series High Performance Capillary Column

WM Series	Stationary Phase Type	Polarity	Temp. limit (°C)	Application Range
WM-1, WM-1MS	100% Dimethyl Polysiloxan	Nonpolarity	-60 to 325/350	Hydrocarbons, Aromatics, Pesticides, Phenols, Herbicides, Amines, Fatty Acid Methyl Esters, etc.
WM-5, WM-5MS	5% Phenyl 95% Dimethyl Polysiloxane	Weak polarity	-60 to 325/350	Semi-volatile compounds, Alkaloids, Pharmaceuticals Biodiesel (FAME stands for Fatty Acid Methyl Ester), Halogenated compounds, Insecticides
WM-1301	6% Cyanopropyl-phenyl 94% Dimethyl Polysiloxane	Moderate polarity	-20 to 280/300	Alcohols, Pesticides, VOCs, iodines, Pesticide Residues, etc.
WM-35, WM-35MS	35% Phenyl 65% Dimethyl Polysiloxane	Moderate polarity	40 to 300/320	Alcohols, Pesticides, Drugs
WM-17, WM-17MS	50% Phenyl 50% Dimethyl Polysiloxane	Moderate polarity	40 to 300/320	Drugs, ethylene glycol, steroids, herbicides, pesticides
WM-1701	14% Cyanopropyl-phenyl 86% Dimethyl Polysiloxane	Moderate polarity	-20 to 280/300	Aromatic chlorine, insecticide, herbicide
WM-624	6% Cyanopropyl-phenyl 94% Dimethyl Polysiloxane	Moderate polarity	-20 to 260	Solvent residual, volatile compounds
WM-225	50% Cyanopropyl-phenyl 50% Dimethyl polysiloxane	Moderate polarity	40 to 220/240	Neutral sterols, sugar alcohol acetate
WM-INOWAX	Polyethylene glycol	Strong polarity	40 to 260/280	Alcohol, Solvent, Mineral oil, Flavoring agent, Spice / Flavoring
WM-FFAP	Polyethylene glycol modified by p-Phthalic acid	Strong polarity	50 to 260	Alcohol, Organic acid, Aldehyde, Acrylic ester

WM-1, WM-1MS

- 100% Dimethyl polysiloxane stationary liquid
 - General nonpolar stationary phase
 - Thermal stability is up to 350 °C
 - Chemically bonded crosslinked columns can be flushed with solvent
- Polarity is similar to stationary phases of DB-1, SPB-1, HP-1, SE-30
 - Comply with USP G2 specific stationary liquid
 - As a kind of low-loss column, WM-1MS can be used with MS detector

WM-1 capillary column which formed by the crosslink of 100% polydimethylsiloxane can separate samples by boiling point, so it is suitable in a wide range of temperature. Due to the covalent crosslinking method, WM-1 column is able to tolerate large injection volume while keeping a long lifetime.

Through a more rigorous manufacturing technique, WM-1MS capillary column has low loss rate. Before being a qualified product, each column needs to be strictly tested, which is assuring. With good inertness to active compounds, Ultra-low loss WM-1MS column can effectively improve the detection performance of MS, ECD and NPD.

WM-1 Ordering Information

P/N	Specification	P/N	Specification
03901-80018	WM-1 10m×0.18mm×0.18µm	03901-18021	WM-1 25m×0.2mm×0.33µm
03901-89018	WM-1 20m×0.18mm×0.18µm	03901-18002	WM-1 25m×0.2mm×0.5µm
03901-89028	WM-1 20m×0.18mm×0.36µm	03901-22007	WM-1 30m×0.25mm×0.1µm
03901-89022	WM-1 20m×0.18mm×0.4µm	03901-22001	WM-1 30m×0.25mm×0.25µm
03901-18029	WM-1 25m×0.2mm×0.11µm	03901-22002	WM-1 30m×0.25mm×0.5µm
03901-33030	WM-1 50m×0.32mm×0.17µm	05901-12002	WM-1 30m×0.2mm×0.5µm
05901-11001	WM-1 15m×0.2mm×0.25µm	05901-22001	WM-1 30m×0.25mm×0.25µm
05901-11002	WM-1 15m×0.2mm×0.5µm	05901-22002	WM-1 30m×0.25mm×0.5µm
05901-21001	WM-1 15m×0.25mm×0.25µm	05901-32001	WM-1 30m×0.32mm×0.25µm
05901-21002	WM-1 15m×0.25mm×0.5µm	05901-32002	WM-1 30m×0.32mm×0.5µm
05901-31001	WM-1 15m×0.32mm×0.25µm	05901-32003	WM-1 30m×0.32mm×1µm
05901-31002	WM-1 15m×0.32mm×0.5µm	05901-52002	WM-1 30m×0.53mm×0.5µm
05901-51002	WM-1 15m×0.53mm×0.5µm	05901-52003	WM-1 30m×0.53mm×1.0µm
05901-12001	WM-1 30m×0.2mm×0.25µm		

WM-1MS Ordering Information

P/N	Specification	P/N	Specification
03903-89018	WM-1MS 20m×0.18mm×0.18µm	03903-22003	WM-1MS 30m×0.25mm×1.0µm
03903-89028	WM-1MS 20m×0.18mm×0.36µm	03903-24001	WM-1MS 60m×0.25mm×0.25µm
03903-89022	WM-1MS 20m×0.18mm×0.4µm	03903-31001	WM-1MS 15m×0.32mm×0.25µm
03903-11021	WM-1MS 15m×0.20mm×0.33µm	03903-38024	WM-1MS 25m×0.32mm×0.52µm
03903-18021	WM-1MS 25m×0.20mm×0.33µm	03903-32007	WM-1MS 30m×0.32mm×0.1µm
03903-21001	WM-1MS 15m×0.25mm×0.25µm	03903-32001	WM-1MS 30m×0.32mm×0.25µm
03903-22007	WM-1MS 30m×0.25mm×0.1µm	03903-32003	WM-1MS 30m×0.32mm×1.0µm
03903-22001	WM-1MS 30m×0.25mm×0.25µm	03903-34001	WM-1MS 60m×0.32mm×0.25µm
03903-22002	WM-1MS 30m×0.25mm×0.5µm	03903-34003	WM-1MS 60m×0.32mm×1.0µm

WM-5, WM-54, WM-5MS

- 5% Diphenyl 95% dimethyl polysiloxane stationary liquid
 - General low-polarity stationary phase
 - Thermal stability is up to 350 °C
 - Chemically bonded crosslinked columns can be flushed with solvent
- Polarity is similar to stationary phases of DB-5, SPB-5, HP-5, Rtx-5
 - Comply with USP G27 specific stationary liquid
 - With low-loss, excellent inertness and high column efficiency,
 - WM-5MS can be used with MS detector

Due to the addition of 5% diphenyl in polydimethylsiloxane, WM-5 column has higher polarity than WM-1 capillary column and has better selectivity to aromatic compounds. In most cases, it will be the type of column you first consider. Beside, WM-5 capillary column also has excellent reproducibility and high column efficiency.

Through a more rigorous manufacturing technique, WM-5MS capillary column has low loss rate. Before being a qualified product, each column needs to be strictly tested, which is assuring. With good inertness to active compounds, ultra-low loss WM-5MS column can effectively improve the detection performance of MS, ECD and NPD.

WM-5, WM-54 Ordering Information:

P/N	Specification	P/N	Specification
05902-22001	WM-5 30m×0.25mm×0.25µm	05902-33002	WM-5 50m×0.32m×0.5µm
05902-23001	WM-5 50m×0.25mm×0.25µm	05915-11001	WM-54 15m×0.2mm×0.25µm
05902-24002	WM-5 60m×0.25mm×0.5µm	05915-21001	WM-54 15m×0.25mm×0.25µm
05902-32001	WM-5 30m×0.32mm×0.25µm	05915-22001	WM-54 30m×0.25mm×0.25µm
05902-32002	WM-5 30m×0.32m×0.5µm	05915-22002	WM-54 30m×0.25mm×0.5µm
05915-23002	WM-54 50m×0.25mm×0.5µm	03902-80028	WM-5 10m×0.18mm×0.36µm
05915-32001	WM-54 30m×0.32mm×0.25µm	03902-80022	WM-5 10m×0.18mm×0.4µm
05915-32002	WM-54 30m×0.32mm×0.5µm	03902-89018	WM-5 20m×0.18mm×0.18µm
05915-32003	WM-54 30m×0.32mm×1.0µm	03902-89022	WM-5 20m×0.18mm×0.4µm
05915-52002	WM-54 30m×0.53mm×0.5µm	03902-18029	WM-5 25m×0.20mm×0.11µm
05915-52006	WM-54 30m×0.53mm×3.0µm	03902-18021	WM-5 25m×0.20mm×0.33µm
03902-80018	WM-5 10m×0.18mm×0.18µm		

WM-5MS Ordering Infomation:

P/N	Specification	P/N	Specification
03904-00007	WM-5MS 10m×0.1mm×0.1µm	03904-24002	WM-5MS 60m×0.25mm×0.5µm
03904-80018	WM-5MS 10m×0.18mm×0.18µm	03904-24003	WM-5MS 60m×0.25mm×1.0µm
03904-89018	WM-5MS 20m×0.18mm×0.18µm	03904-31007	WM-5MS 15m×0.32mm×0.1µm
03904-89028	WM-5MS 20m×0.18mm×0.36µm	03904-31001	WM-5MS 15m×0.32mm×0.25µm
03904-18021	WM-5MS 25m×0.20mm×0.33µm	03904-31002	WM-5MS 15m×0.32mm×0.5µm
03904-21007	WM-5MS 15m×0.25mm×0.1µm	03904-31003	WM-5MS 15m×0.32mm×1.0µm
03904-21001	WM-5MS 15m×0.25mm×0.25µm	03904-38024	WM-5MS 25m×0.32mm×0.52µm
03904-21002	WM-5MS 15m×0.25mm×0.5µm	03904-32007	WM-5MS 30m×0.32mm×0.1µm
03904-21003	WM-5MS 15m×0.25mm×1.0µm	03904-32001	WM-5MS,30m×0.32mm×0.25µm
03904-22007	WM-5MS 30m×0.25mm×0.1µm	03904-32002	WM-5MS 30m×0.32mm×0.5µm
03904-22001	WM-5MS 30m×0.25mm×0.25µm	03904-32003	WM-5MS 30m×0.32mm×1.0µm
03904-22002	WM-5MS 30m×0.25mm×0.5µm	03904-34007	WM-5MS 60m×0.32mm×0.1µm
03904-22003	WM-5MS 30m×0.25mm×1.0µm	03904-34001	WM-5MS 60m×0.32mm×0.25µm
03904-24007	WM-5MS 60m×0.25mm×0.1µm	03904-34002	WM-5MS 60m×0.32mm×0.5µm
03904-24001	WM-5MS 60m×0.25mm×0.25µm	03904-34003	WM-5MS 60m×0.32mm×1.0µm

WM-1301, WM-624

➤ 6% Cyanopropyl phenyl, 94% dimethyl polysiloxane ➤ Comply with USP G43 specific stationary liquid ➤ Bond and crosslink with medium polarity ➤ It is specially used for the analysis of volatile organic compounds and residual solvents in drugs	➤ Has excellent inertness for most compounds ➤ Temperature range: -20 to 260 °C ➤ WM-624 is specially designed for EPA method ➤ Polarity is similar to stationary phases of DB-624, SPB-1301, HP-624, Elite-1301, Rtx-624.
--	--

WM-1301 Ordering Infomation:

P/N	Specification	P/N	Specification
03905-21001	WM-1301 15m×0.25mm×0.25µm	03905-22003	WM-1301 30m×0.25mm×1.0µm
03905-22001	WM-1301 30m×0.25mm×0.25µm	03905-24001	WM-1301 60m×0.25mm×0.25µm
03905-22002	WM-1301 30m×0.25mm×0.5µm	03905-24003	WM-1301 60m×0.25mm×1.0µm
03905-24009	WM-1301 60m×0.25mm×1.4µm	05905-31002	WM-1301 15m×0.32mm×0.5µm
03905-31001	WM-1301 15m×0.32mm×0.25µm	05905-51002	WM-1301 15m×0.53mm×0.5µm
03905-31002	WM-1301 15m×0.32mm×0.5µm	05905-12001	WM-1301 30m×0.2mm×0.25µm
03905-32001	WM-1301 30m×0.32mm×0.25µm	05905-12002	WM-1301 30m×0.2mm×0.5µm
03905-32002	WM-1301 30m×0.32mm×0.5µm	05905-22001	WM-1301 30m×0.25mm×0.25µm
03905-32003	WM-1301 30m×0.32mm×1.0µm	05905-22002	WM-1301 30m×0.25mm×0.5µm
05905-11001	WM-1301 15m×0.2mm×0.25µm	05905-22009	WM-1301 30m×0.25mm×1.4µm
05905-11002	WM-1301 15m×0.2mm×0.5µm	05905-32001	WM-1301 30m×0.32mm×0.25µm
05905-21001	WM-1301 15m×0.25mm×0.25µm	05905-32002	WM-1301 30m×0.32mm×0.5µm
05905-21002	WM-1301 15m×0.25mm×0.5µm	05905-13002	WM-1301 50m×0.2mm×0.5µm
05905-22003	WM-1301 30m×0.25mm×1µm	05905-23001	WM-1301 50m×0.25mm×0.25µm
05905-31001	WM-1301 15m×0.32mm×0.25µm		

WM-624 Ordering Infomation:

P/N	Specification	Product
03908-22009	WM-624 30m×0.25mm×1.4μm	GC capillary column
03908-24009	WM-624 60m×0.25mm×1.4μm	GC capillary column
03908-32001	WM-624 30m×0.32mm×0.25μm	GC capillary column
03908-32004	WM-624 30m×0.32mm×1.8μm	GC capillary column
03908-34004	WM-624 60m×0.32mm×1.8μm	GC capillary column
03908-52006	WM-624 30m×0.53mm×3.0μm	GC capillary column
03908-54006	WM-624 60m×0.53mm×3.0μm	GC capillary column
05908-54006	WM-624 60m×0.53mm×3.0μm	GC capillary column
03908-89003	WM-624 20m×0.18mm×1.0μm	GC capillary column
03908-512006	WM-624 75m×0.53mm×3.0μm	GC capillary column



WM-35, WM-35MS

- 35% Diphenyl 65% dimethyl polysiloxane stationary liquid
- General low-polarity stationary phase
- Thermal stability is up to 320 °C
- Chemically bonded crosslinked columns can be flushed with solvent
- Comply with USP G42 specific stationary liquid
- As a kind of low-loss column, WM-35MS can be used with MS detector
- Polarity is similar to stationary phases of DB-35, SPB-35, HP-35, Rtx-35, PE-35

Due to the addition of 35% diphenyl in polydimethylsiloxane, WM-35 column is suitable for the analysis of compounds with medium polarity. Besides, WM-35 capillary column has excellent reproducibility and high column efficiency. Through a more rigorous manufacturing technique, WM-35MS capillary has low loss rate. Before being a qualified product, each column needs to be strictly tested, which is assuring. With good inertness to active compounds, Ultra-low loss WM-35MS column can effectively improve the detection performance of MS, ECD and NPD.

WM-35 Ordering Infomation:

P/N	Specification	P/N	Specification
03921-89018	WM-35 20m×0.18mm×0.18μm	03921-32001	WM-35 30m×0.32mm×0.25μm
03921-11021	WM-35 15m×0.20mm×0.33μm	03921-32003	WM-35 30m×0.32mm×1.0μm
03921-18021	WM-35 25m×0.20mm×0.33μm	03921-34001	WM-35 60m×0.32mm×0.25μm
03921-22008	WM-35 30m×0.25mm×0.15μm	03921-34002	WM-35 60m×0.32mm×0.5μm
03921-22002	WM-35 30m×0.25mm×0.5μm	03921-52002	WM-35 30m×0.53mm×0.5μm
03921-24001	WM-35 60m×0.25mm×0.25μm	03921-52025	WM-35 30m×0.53mm×1.5μm
03921-24002	WM-35 60m×0.32mm×0.25μm	03921-54002	WM-35 60m×0.53mm×0.5μm
03921-31001	WM-35 15m×0.32mm×0.25μm		

WM-35MS Ordering Infomation:

P/N	Specification	P/N	Specification
03906-89018	WM-35MS 20m×0.18mm×0.18μm	03906-24001	WM-35MS 60m×0.25mm×0.25μm
03906-11021	WM-35MS 15m×0.20mm×0.33μm	03906-31001	WM-35MS 15m×0.32mm×0.25μm
03906-18021	WM-35MS 25m×0.20mm×0.33μm	03906-32001	WM-35MS 30m×0.32mm×0.25μm
03906-21001	WM-35MS 15m×0.25mm×0.25μm	03906-52002	WM-35MS 30m×0.53mm×0.5μm
03906-22008	WM-35MS 30m×0.25mm×0.15μm	03906-52003	WM-35MS 30m×0.53mm×1.0μm
03906-22001	WM-35MS 30m×0.25mm×0.25μm		

WM-17, WM-17MS

- 50% Phenyl 50% dimethyl polysiloxane
 - General low-polarity stationary phase
 - Thermal stability is up to 320 °C
 - Chemically bonded crosslinked columns can be flushed with solvent
- Polarity is similar to stationary phases of DB-17, HP-17, SPB-50
 - Comply with USP G3 specific stationary liquid
 - Low-loss WM-17MS can be used with MS detector

Due to the addition of 50% diphenyl in polydimethylsiloxane, WM-17 column is suitable for the analysis of compounds with medium polarity. Besides, WM-17 capillary column has excellent reproducibility and high column efficiency. Through a more rigorous manufacturing technique, WM-17MS capillary column has low loss rate. Before being a qualified product, each column needs to be strictly tested, which is assuring. With good inertness to active compounds, ultra-low loss WM-17MS column can effectively improve the detection performance of MS, ECD and NPD.

WM-17 Ordering Infomation:

P/N	Specification	P/N	Specification
03916-89018	WM-17 20m×0.18mm×0.18µm	03916-31008	WM-17 15m×0.32mm×0.15µm
03916-89013	WM-17 20m×0.18mm×0.3µm	03916-31001	WM-17 15m×0.32mm×0.25µm
03916-21008	WM-17 15m×0.25mm×0.15µm	03916-31002	WM-17 15m×0.32mm×0.5µm
03916-21001	WM-17 15m×0.25mm×0.25µm	03916-32008	WM-17 30m×0.32mm×0.15µm
03916-21002	WM-17 15m×0.25mm×0.5µm	03916-32001	WM-17 30m×0.32mm×0.25µm
03916-22008	WM-17 30m×0.25mm×0.15µm	05916-34002	WM-17 60m×0.32mm×0.5µm
03916-22001	WM-17 30m×0.25mm×0.25µm	05916-52003	WM-17 30m×0.53mm×1.0µm
03916-22002	WM-17 30m×0.25mm×0.5µm	05916-22001	WM-17 30m×0.25mm×0.25µm
03916-24001	WM-17 60m×0.25mm×0.25µm	05916-32001	WM-17 30m×0.32mm×0.25µm

WM-17MS Ordering Information:

P/N	Specification	P/N	Specification
03947-89018	WM-17MS 20m×0.18mm×0.18µm	03947-31001	WM-17MS 15m×0.32mm×0.25µm
03947-21008	WM-17MS 15m×0.25mm×0.15µm	03947-32001	WM-17MS 30m×0.32mm×0.25µm
03947-21001	WM-17MS 15m×0.25mm×0.25µm	03947-34001	WM-17MS 60m×0.32mm×0.25µm
03947-22008	WM-17MS 30m×0.25mm×0.15µm	03947-52002	WM-17MS 30m×0.53mm×0.5µm
03947-22001	WM-17MS 30m×0.25mm×0.25µm	03947-51003	WM-17MS 15m×0.53mm×1.0µm
03947-24001	WM-17MS 60m×0.25mm×0.25µm		

WM-1701

- 14% Cyanopropyl-phenyl 86% dimethyl polysiloxane
 - General medium-polarity stationary phase
 - Thermal stability is up to 300 °C
- Chemically bonded crosslinked columns can be flushed with solvent
 - Polarity is similar to stationary phases of DB-1701, SPB-1701, HP-1701
 - Comply with USP G46 specific stationary liquid

WM-1701 Ordering Information:

P/N	Specification	P/N	Specification
05907-22001	WM-1701 30m×0.25mm×0.25µm	03907-22002	WM-1701 30m×0.25mm×0.5µm
05907-22002	WM-1701 30m×0.25mm×0.5µm	03907-22003	WM-1701 30m×0.25mm×1.0µm
05907-31001	WM-1701 15m×0.32mm×0.25µm	03907-24001	WM-1701 60m×0.25mm×0.25µm
05907-32001	WM-1701 30m×0.32mm×0.25µm	03907-24002	WM-1701 60m×0.25mm×0.5µm
05907-32002	WM-1701 30m×0.32mm×0.5µm	03907-31001	WM-1701 15m×0.32mm×0.25µm
05907-32034	WM-1701 30m×0.32mm×2.65µm	03907-31002	WM-1701 15m×0.32mm×0.5µm
05907-33002	WM-1701 50m×0.32mm×0.5µm	03907-32001	WM-1701 30m×0.32mm×0.25µm
05907-51002	WM-1701 15m×0.53mm×0.5µm	03907-32002	WM-1701 30m×0.32mm×0.5µm
03907-89018	WM-1701 20m×0.18mm×0.18µm	03907-32003	WM-1701 30m×0.32mm×1.0µm
03907-18011	WM-1701 25m×0.20mm×0.2µm	03907-34001	WM-1701 60m×0.32mm×0.25µm
03907-21001	WM-1701 15m×0.25mm×0.25µm	03907-34002	WM-1701 60m×0.32mm×0.5µm
03907-22001	WM-1701 30m×0.25mm×0.25µm	03907-34003	WM-1701 60m×0.32mm×1.0µm

WM-225

- 50% Cyanopropyl-phenyl, 50% Dimethyl Polysiloxane
 - Stationary phase complies with the requirements of USP G7 and USP G19
 - Ideal for separating medium to high-polarity stereoisomers of FAMES and sugar derivatives
- Chemically bonded crosslinked column
 - Similar stationary phases: HP-225, DB-225, Rtx-225, etc.

P/N	Specification
07919-22001	WM-225 30m×0.25mm×0.25µm

WM-INOWAX

- Bonded crosslinked polyethylene glycol (PEG)
- General stationary phase with polarity
- Thermal stability is up to 280 °C
- Chemically bonded crosslinked columns can be flushed with solvent
- Polarity is similar to stationary phases of HP-INNOWax, CP-WAX 52CB
- Comply with USP G16 specific stationary liquid

WM-INOWAX Ordering Information:

P/N	Specification	P/N	Specification
03909-80018	WM-INOWAX 10m×0.18mm×0.18µm	03909-24002	WM-INOWAX 60m×0.25mm×0.5µm
03909-89018	WM-INOWAX 20m×0.18mm×0.18µm	03909-31001	WM-INOWAX 15m×0.32mm×0.25µm
03909-18011	WM-INOWAX 25m×0.20mm×0.2µm	03909-31002	WM-INOWAX 15m×0.32mm×0.5µm
03909-18022	WM-INOWAX 25m×0.20mm×0.4µm	03909-32008	WM-INOWAX 30m×0.32mm×0.15µm
03909-13011	WM-INOWAX 50m×0.20mm×0.2µm	03909-32001	WM-INOWAX 30m×0.32mm×0.25µm
03909-13022	WM-INOWAX 50m×0.20mm×0.4µm	03909-32002	WM-INOWAX 30m×0.32mm×0.5µm
03909-21001	WM-INOWAX 15m×0.25mm×0.25µm	03909-32003	WM-INOWAX 30m×0.32mm×1.0µm
03909-21002	WM-INOWAX 15m×0.25mm×0.5µm	03909-34008	WM-INOWAX 60m×0.32mm×0.15µm
03909-22008	WM-INOWAX 30m×0.25mm×0.15µm	03909-52003	WM-INOWAX 30m×0.53mm×1.0µm
03909-22001	WM-INOWAX 30m×0.25mm×0.25µm	03909-54002	WM-INOWAX 60m×0.53mm×0.5µm
03909-22002	WM-INOWAX 30m×0.25mm×0.5µm	05909-53005	WM-INOWAX 50m×0.53mm×2.0µm
03909-24008	WM-INOWAX 60m×0.25mm×0.15µm	05909-22001	WM-INOWAX 30m×0.25mm×0.25µm
03909-24001	WM-INOWAX 60m×0.25mm×0.25µm		

WM-FFAP

- Nitroterephthalic acid modified polyethylene glycol
- Stationary phase has strong polarity
- Has special advantages in the analysis of volatile fatty acids and phenol and other substances
- Thermal stability is up to 260 °C
- Comply with USP G35 specific stationary liquid
- Polarity is similar to stationary phases of DB-FFAP, HP-FFAP, Stabilwax-DA

WM-FFAP Ordering Information:

P/N	Specification	P/N	Specification
05911-12001	WM-FFAP 30m×0.20mm×0.25µm	03911-13013	WM-FFAP 50m×0.20mm×0.3µm
05911-22001	WM-FFAP 30m×0.25mm×0.25µm	03911-21001	WM-FFAP 15m×0.25mm×0.25µm
05911-24001	WM-FFAP 60m×0.25mm×0.25µm	03911-22001	WM-FFAP 30m×0.25mm×0.25µm
05911-32001	WM-FFAP 30m×0.32mm×0.25µm	03911-12001	WM-FFAP 30m×0.20mm×0.25µm
05911-32002	WM-FFAP 30m×0.32mm×0.5µm	03911-23001	WM-FFAP 50m×0.25mm×0.25µm
05911-32003	WM-FFAP 30m×0.32mm×1.0µm	03911-31001	WM-FFAP 15m×0.32mm×0.25µm
05911-52002	WM-FFAP 30m×0.53mm×0.5µm	03911-38002	WM-FFAP 25m×0.32mm×0.5µm
05911-52003	WM-FFAP 30m×0.53mm×1.0µm	03911-32001	WM-FFAP 30m×0.32mm×0.25µm
03911-89018	WM-FFAP 20m×0.18mm×0.18µm	03911-32002	WM-FFAP 30m×0.32mm×0.5µm
03911-18013	WM-FFAP 25m×0.20mm×0.3µm	03911-32003	WM-FFAP 30m×0.32mm×1.0µm
03911-33002	WM-FFAP 50m×0.32mm×0.5µm	03911-50003	WM-FFAP 10m×0.53mm×1.0µm
03911-34001	WM-FFAP 60m×0.32mm×0.25µm		

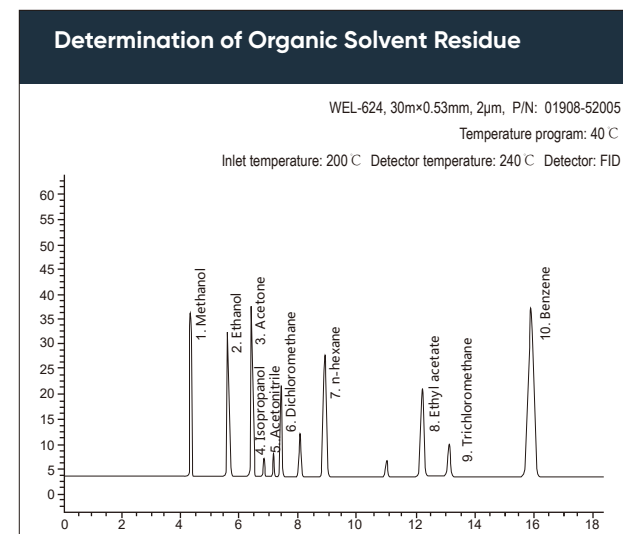
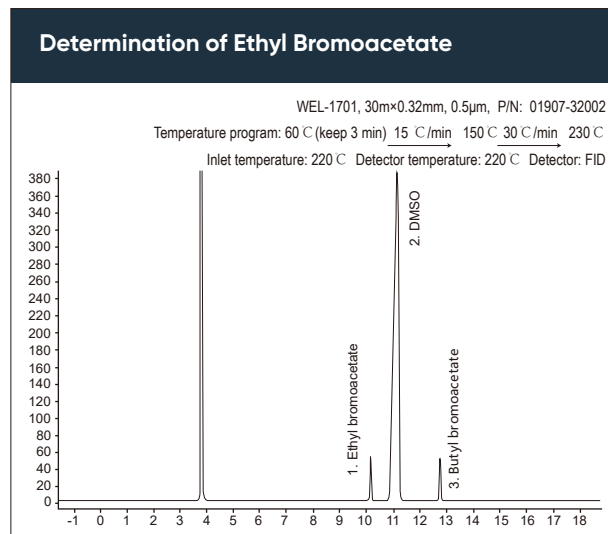
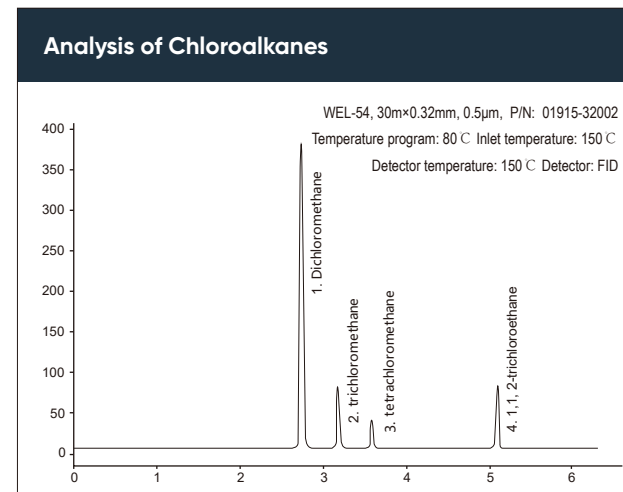
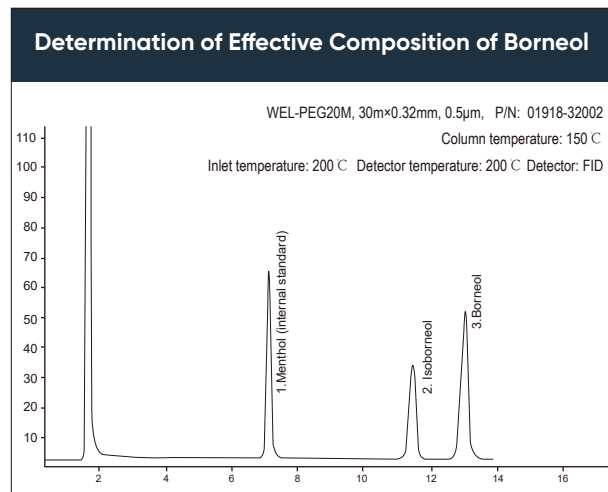
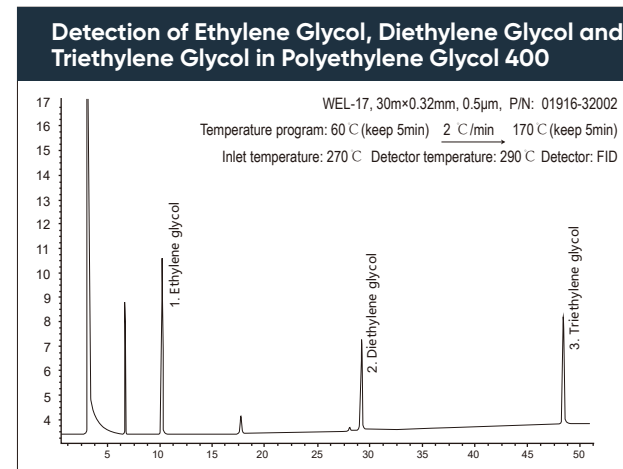
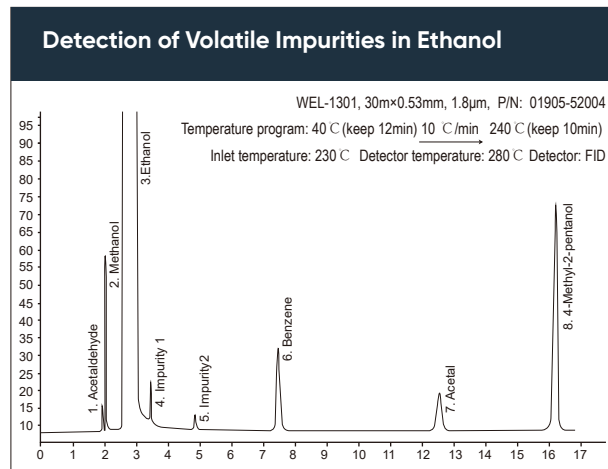
1.2 WEL SERIES ECONOMICAL GC COLUMN

Each of the WEL series capillary columns has been strictly tested with attached evaluation chromatogram. For high column efficiency and sensitivity, our products are popular among new and regular customers. We can provide sample analysis for customers to ensure the superior performance of columns and various dedicated columns for some test items with higher column efficiency and separation effect, which can help in the qualitative and quantitative analysis.

Sample Analysis Flow



Chromatogram of Typical Applications



Ordering Information:

P/N	Specification	P/N	Specification
01901-22001	WEL-1 30m×0.25mm×0.25μm	01907-24001	WEL-1701 60m×0.25mm×0.25μm
01901-22002	WEL-1 30m×0.25mm×0.5μm	01907-24002	WEL-1701 60m×0.25mm×0.5μm
01901-22003	WEL-1 30m×0.25mm×1.0μm	01908-22001	WEL-624 30m×0.25mm×0.25μm
01901-23001	WEL-1 50m×0.25mm×0.25μm	01908-22002	WEL-624 30m×0.25mm×0.5μm
01901-23002	WEL-1 50m×0.25mm×0.5μm	01908-22003	WEL-624 30m×0.25mm×1.0μm
01901-23003	WEL-1 50m×0.25mm×1.0μm	01908-22004	WEL-624 30m×0.25mm×1.4μm
01901-24001	WEL-1 60m×0.25mm×0.25μm	01908-23001	WEL-624 50m×0.25mm×0.25μm
01901-24002	WEL-1 60m×0.25mm×0.5μm	01908-23002	WEL-624 50m×0.25mm×0.5μm
01901-24003	WEL-1 60m×0.25mm×1.0μm	01908-23003	WEL-624 50m×0.25mm×1.0μm
01902-32001	WEL-5 30m×0.32mm×0.25μm	01908-24001	WEL-624 60m×0.25mm×0.25μm
01902-32002	WEL-5 30m×0.32mm×0.5μm	01908-24002	WEL-624 60m×0.25mm×0.5μm
01902-32003	WEL-5 30m×0.32mm×1.0μm	01908-24003	WEL-624 60m×0.25mm×1.0μm
01902-32006	WEL-5 30m×0.32mm×3.0μm	01908-28011	WEL-624 25m×0.25mm×0.2μm
01902-51003	WEL-5 15m×0.53mm×1.0μm	01908-32001	WEL-624 30m×0.32mm×0.25μm
01902-52003	WEL-5 30m×0.53mm×1.0μm	01908-32002	WEL-624 30m×0.32mm×0.5μm
01902-53003	WEL-5 50m×0.53mm×1.0μm	01911-22001	WEL-FFAP 30m×0.25mm×0.25μm
01905-24004	WEL-1301 60m×0.25mm×1.8μm	01911-22002	WEL-FFAP 30m×0.25mm×0.5μm
01905-32004	WEL-1301 30m×0.32mm×1.8μm	01911-22003	WEL-FFAP 30m×0.25mm×1.0μm
01905-52004	WEL-1301 30m×0.53mm×1.8μm	01911-23002	WEL-FFAP 50m×0.25mm×0.5μm
01905-53005	WEL-1301 50m×0.53mm×2.0μm	01911-23003	WEL-FFAP 50mm×0.25mm×1.0μm
01905-52005	WEL-1301 30m×0.53mm×2.0μm	01911-24001	WEL-FFAP 60m×0.25mm×0.25μm
01907-22001	WEL-1701 30m×0.25mm×0.25μm	01911-24002	WEL-FFAP 60m×0.25mm×0.5μm
01907-22002	WEL-1701 30m×0.25mm×0.5μm	01911-24003	WEL-FFAP 60m×0.25mm×1.0μm
01907-22003	WEL-1701 30m×0.25mm×1.0μm	01911-32001	WEL-FFAP 30m×0.32mm×0.25μm
01907-23001	WEL-1701 50m×0.25mm×0.25μm	01911-32002	WEL-FFAP 30m×0.32mm×0.5μm
01907-23002	WEL-1701 50m×0.25mm×0.5μm	01911-32003	WEL-FFAP 30m×0.32mm×1.0μm
01907-23003	WEL-1701 50m×0.25mm×1.0μm	01911-33001	WEL-FFAP 50m×0.32mm×0.25μm

P/N	Specification	P/N	Specification
01911-33002	WEL-FFAP 50m×0.32mm×0.5μm	01915-24003	WEL-54 60m×0.25mm×1.0μm
01911-33003	WEL-FFAP 50m×0.32mm×1.0μm	01915-32001	WEL-54 30m×0.32mm×0.25μm
01912-22001	WEL-30 30m×0.25mm×0.25μm	01915-32002	WEL-54 30m×0.32mm×0.5μm
01912-22002	WEL-30 30m×0.25mm×0.5μm	01915-32003	WEL-54 30m×0.32mm×1.0μm
01912-22003	WEL-30 30m×0.25mm×1.0μm	01915-33001	WEL-54 50m×0.32mm×0.25μm
01912-23001	WEL-30 50m×0.25mm×0.25μm	01915-33002	WEL-54 50m×0.32mm×0.5μm
01912-23002	WEL-30 50m×0.25mm×0.5μm	01915-33003	WEL-54 50m×0.32mm×1.0μm
01912-23003	WEL-30 50m×0.25mm×1.0μm	01916-22001	WEL-17 30m×0.25mm×0.25μm
01912-24001	WEL-30 60m×0.25mm×0.25μm	01916-22002	WEL-17 30m×0.25mm×0.5μm
01912-24002	WEL-30 60m×0.25mm×0.5μm	01916-22003	WEL-17 30m×0.25mm×1.0μm
01912-24003	WEL-30 60m×0.25mm×1.0μm	01916-23001	WEL-17 50m×0.25mm×0.25μm
01912-32001	WEL-30 30m×0.32mm×0.25μm	01916-23002	WEL-17 50m×0.25mm×0.5μm
01912-32002	WEL-30 30m×0.32mm×0.5μm	01916-23003	WEL-17 50m×0.25mm×1.0μm
01913-24001	WEL-101 60m×0.25mm×0.25μm	01916-24001	WEL-17 60m×0.25mm×0.25μm
01913-24002	WEL-101 60m×0.25mm×0.5μm	01916-24002	WEL-17 60m×0.25mm×0.5μm
01913-24003	WEL-101 60m×0.25mm×1.0μm	01916-24003	WEL-17 60m×0.25mm×1.0μm
01913-32001	WEL-101 30m×0.32mm×0.25μm	01916-32001	WEL-17 30m×0.32mm×0.25μm
01913-32002	WEL-101 30m×0.32mm×0.5μm	01916-32002	WEL-17 30m×0.32mm×0.5μm
01913-32003	WEL-101 30m×0.32mm×1.0μm	01916-32003	WEL-17 30m×0.32mm×1.0μm
01913-33001	WEL-101 50m×0.32mm×0.25μm	01917-22001	WEL-XE60 30m×0.25mm×0.25μm
01913-33002	WEL-101 50m×0.32mm×0.5μm	01917-22002	WEL-XE60 30m×0.25mm×0.5μm
01914-32001	WEL-52 30m×0.32mm×0.25μm	01917-22003	WEL-XE60 30m×0.25mm×1.0μm
01915-23001	WEL-54 50m×0.25mm×0.25μm	01917-23001	WEL-XE60 50m×0.25mm×0.25μm
01915-23002	WEL-54 50m×0.25mm×0.5μm	01917-23002	WEL-XE60 50m×0.25mm×0.5μm
01915-23003	WEL-54 50m×0.25mm×1.0μm	01917-24001	WEL-XE60 60m×0.25mm×0.25μm
01915-24001	WEL-54 60m×0.25mm×0.25μm	01917-24002	WEL-XE60 60m×0.25mm×0.5μm
01915-24002	WEL-54 60m×0.25mm×0.5μm	01917-24003	WEL-XE60 60m×0.25mm×1.0μm

P/N	Specification	P/N	Specification
01917-32002	WEL-XE60 30m×0.32mm×0.5μm	01919-23003	WEL-225 50m×0.25mm×1.0μm
01917-32003	WEL-XE60 30m×0.32mm×1.0μm	01919-24001	WEL-225 60m×0.25mm×0.25μm
01917-33001	WEL-XE60 50m×0.32mm×0.25μm	01919-24002	WEL-225 60m×0.25mm×0.5μm
01917-33002	WEL-XE60 50m×0.32mm×0.5μm	01919-24003	WEL-225 60m×0.25mm×1.0μm
01917-33003	WEL-XE60 50m×0.32mm×1.0μm	01919-32001	WEL-225 30m×0.32mm×0.25μm
01919-22001	WEL-225 30m×0.25mm×0.25μm	01919-32002	WEL-225 30m×0.32mm×0.5μm
01919-22002	WEL-225 30m×0.25mm×0.5μm	01919-32003	WEL-225 30m×0.32mm×1.0μm
01919-22003	WEL-225 30m×0.25mm×1.0μm	01921-22001	WEL-35 30m×0.25mm×0.25mm
01919-23001	WEL-225 50m×0.25mm×0.25μm	01921-32001	WEL-35 30m×0.32mm×0.25μm
01919-23002	WEL-225 50m×0.25mm×0.5μm	01921-12001	WEL-35 30m×0.20mm×0.25mm

PLOT Column

Welch provides high quality PLOT columns which applied the unique integrated synthesis technology. Commonly used PLOT column stationary phases include styrene and its derivatives, molecular sieves and alumina, which are suitable for the separation and analysis of permanent gas and low molecular weight hydrocarbon isomers.

1. Use Alumina as the stationary phase

Alumina columns can be divided into the following three kinds according to the surface treatment of alumina.

- WEL-PLOT AL₂O₃/KCl (Modified by KCl)
- WEL-AL₂O₃/M (Modified by Na₂MoO₄)
- WEL-AL₂O₃/S (Na₂SO₄)

*Polarity is similar to GS-Alumina, HP PLOT S, HP PLOT M, Alumina-PLOT, AT-Alumina, CP-Al₂O₃/Na₂SO₄

2. Use divinylbenzene - polystyrene as the stationary phase

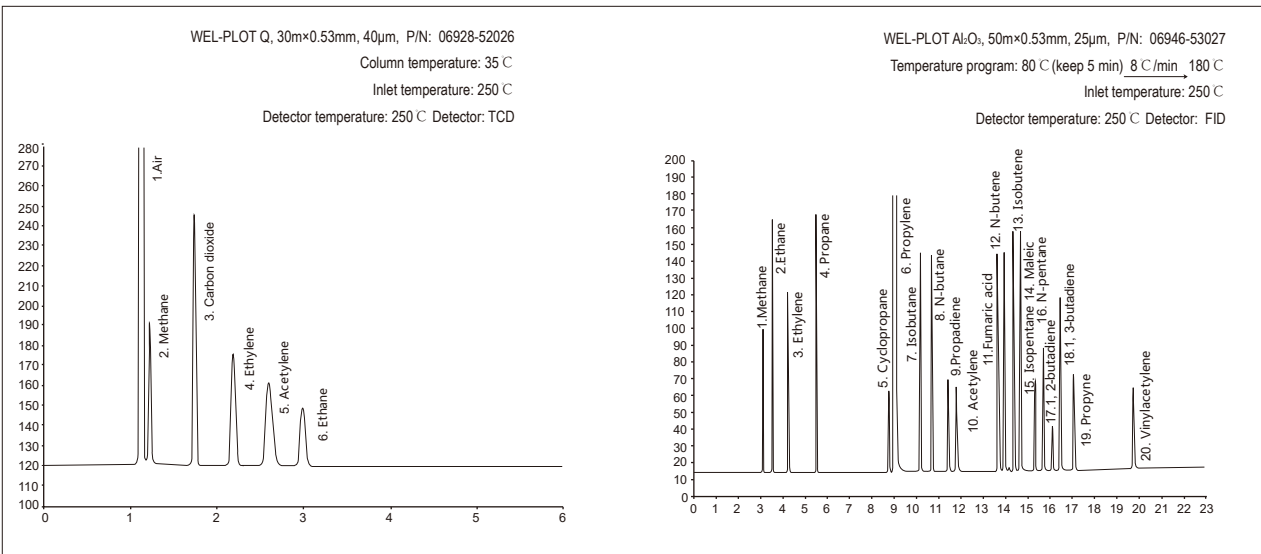
Used for analysis of alkanes, methane, air/carbon monoxide, oxides and sulfides of C1-C3 isomers, to C12.

► PLOT Q

3. Use molecular sieve as the stationary phase (Carbon molecular sieve, 5A molecular sieve)

Mainly used for the detection of permanent gases, such as nitrogen, oxygen, carbon monoxide, methane and other gases.

► WEL-PLOT Molesieve



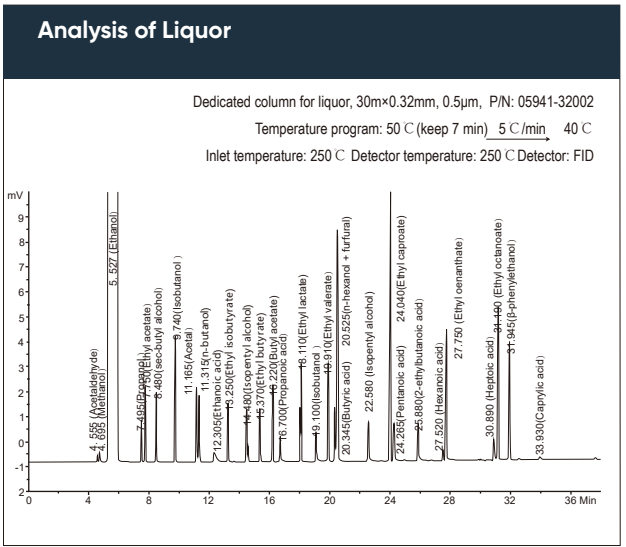
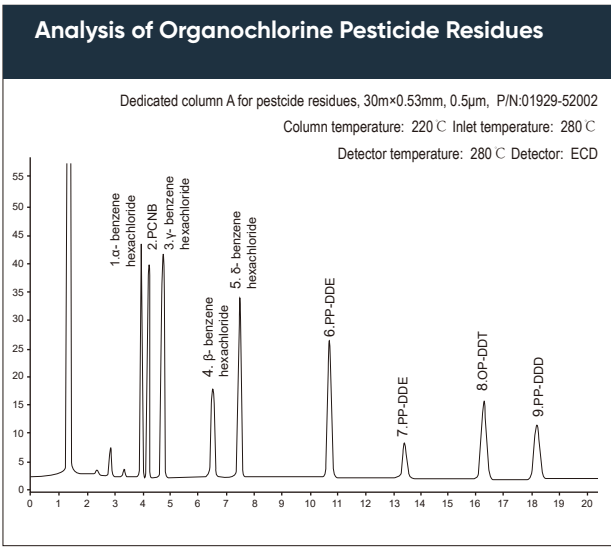
PLOT Column Ordering Information:

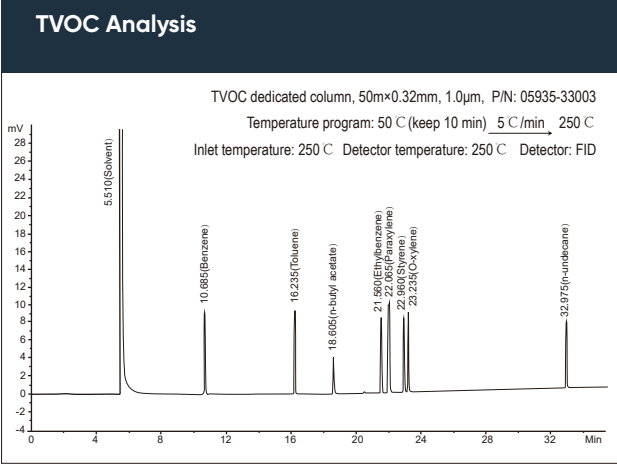
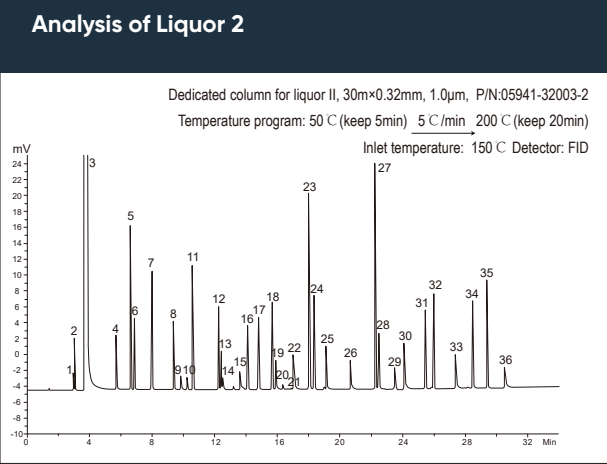
P/N	Specification	P/N	Specification
06928-32014	WEL-PLOT Q 30m×0.32mm×20µm	06928-52014	WEL-PLOT Q 30m×0.53mm×20µm
06928-32040	WEL-PLOT Q 30m×0.32mm×10µm	06928-52026	WEL-PLOT Q 30m×0.53mm×40µm
06951-53027	WEL-PLOT Al ₂ O ₃ /S 50m×0.53mm×25µm	05951-52020	WEL-PLOT Al ₂ O ₃ /S 30m×0.53mm×20µm
06952-53001	WEL-PLOT Al ₂ O ₃ /M 50m×0.53mm×0.25µm	05951-53020	WEL-PLOT Al ₂ O ₃ /S 50m×0.53mm×20µm
06928-52027	WEL-PLOT Q 30m×0.53mm×25µm	01951-33037	WEL-PLOT Al ₂ O ₃ /S 50m×0.32mm×8µm
01951-52020	WEL-PLOT Al ₂ O ₃ /S 30m×0.53mm×20µm		

1.3 DEDICATED GC COLUMN

For separation problem of some complex samples, Welch developed the dedicated column which can be applied to pesticide analysis, volatile organic compounds analysis, petrochemical analysis, liquor analysis and other aspects with unique performance. It requires short analysis time with good separation effect, and it is convenient for better qualitative and quantitative analysis.

P/N	Product	Specification	Application
01929-32002	Dedicated column A for pesticide residues	30m×0.32mm×0.5µm	Organochlorine pesticide
01929-52002		30m×0.32mm×0.5µm	
01937-32002	Dedicated column B for pesticide residues	30m×0.32mm×0.5µm	Organophosphorus pesticide
01937-52002		30m×0.53mm×0.5µm	
01932-22023	BPX-70	30m×0.25mm×0.22µm	Analysis of evening primrose oil
05935-33003	TVOC dedicated column	50m×0.32mm×1.0µm	Total volatile organic compounds (VOCs) in indoor air
01936-13002	PONA dedicated column	50m×0.20mm×0.5µm	Analysis of gasoline and diesel component
01936-23002		50m×0.25mm×0.5µm	
05941-32002	Dedicated column for liquor analysis	30m×0.32mm×0.5µm	Composition analysis of liquor and beer





WEL-PONA

- Dedicated column for analysis of complex hydrocarbon
- Polarity is similar to Petrocol DH, DB-Petro, HP-PONA column

Ordering Information:

P/N	Specification
01936-13002	WEL-PONA, 50m×0.2mm×0.5μm

WM-TVOC

- Dedicated column, used for determination of total volatile organic compounds (TVOC) in indoor air

Ordering Information:

P/N	Specification
05935-30021	WM-TVOC, 40m×0.32mm×0.33μm

WM-PEG20M, WEL-PEG20M

- Polyethylene glycol column
- Recommended for fatty acids
- Bond and crosslink with strong polarity

Ordering Information:

P/N	Specification	P/N	Specification
05918-11001	WM-PEG20M 15m×0.2mm×0.25μm	05918-53002	WM-PEG20M 50m×0.53mm×0.5μm
05918-11002	WM-PEG20M 15m×0.2mm×0.5μm	05918-14001	WM-PEG20M 60m×0.2mm×0.25μm
05918-21001	WM-PEG20M 15m×0.25mm×0.25μm	05918-14002	WM-PEG20M 60m×0.2mm×0.5μm
05918-21002	WM-PEG20M 15m×0.25mm×0.5μm	05918-24001	WM-PEG20M 60m×0.25mm×0.25mm
05918-31001	WM-PEG20M 15m×0.32mm×0.25μm	05918-34002	WM-PEG20M 60m×0.32mm×0.5μm
05918-12001	WM-PEG20M 30m×0.2mm×0.25μm	01918-22001	WEL-PEG20M 30m×0.25mm×0.25μm
05918-12002	WM-PEG20M 30m×0.2mm×0.5μm	01918-22002	WEL-PEG20M 30m×0.25mm×0.5μm
05918-22001	WM-PEG20M 30m×0.25mm×0.25μm	01918-22003	WEL-PEG20M 30m×0.25mm×1.0μm
05918-22002	WM-PEG20M 30m×0.25mm×0.5μm	01918-23001	WEL-PEG20M 50m×0.25mm×0.25μm
05918-32001	WM-PEG20M 30m×0.32mm×0.25μm	01918-23002	WEL-PEG20M 50m×0.25mm×0.5μm
05918-32002	WM-PEG20M 30m×0.32mm×0.5μm	01918-23003	WEL-PEG20M 50m×0.25mm×1.0μm
05918-13001	WM-PEG20M 50m×0.2mm×0.25μm	01918-23022	WEL-PEG20M 50m×0.25mm×0.4μm
05918-13002	WM-PEG20M 50m×0.2mm×0.5μm	01918-24001	WEL-PEG20M 60m×0.25mm×0.25μm
05918-23001	WM-PEG20M 50m×0.25mm×0.25μm	01918-24002	WEL-PEG20M 60m×0.25mm×0.5μm
05918-23002	WM-PEG20M 50m×0.25mm×0.5μm	01918-32001	WEL-PEG20M 30m×0.32mm×0.25μm
05918-33001	WM-PEG20M 50m×0.32mm×0.25μm	01918-32002	WEL-PEG20M 30m×0.32mm×0.5μm
05918-33002	WM-PEG20M 50m×0.32mm×0.5μm	01918-32003	WEL-PEG20M 30m×0.32mm×1.0μm

Dedicated Column for 37 Kinds of Fatty Acids

P/N	Specification
07965-25011	WM-CN100 100m×0.25mm×0.2μm

Dedicated Column for Liquor

P/N	Specification
05941-32002	30m×0.32mm×0.5μm

Dedicated Column for Liquor II

P/N	Specification
05941-32003-2	30m×0.32mm×1.0μm

Dedicated Column for Medicinal Ethanol

P/N	Specification
05941-32003-1	15m×0.32mm×1.0μm

Dedicated Column for Organophosphorus Residue

P/N	Specification
05939-32002	30m×0.32mm×0.5μm

Dedicated Column for Alkyl Mercury

P/N	Specification
05971-51002	15m×0.53mm×0.5μm

High Temperature Column

P/N	Specification
07977-22007	WM-5HT 30m×0.25mm×0.1μm

1.4 GC PACKED COLUMN

► **STATIONARY LIQUID:** OV-1, OV-17, OV-101, OV-225, SE-30, SE-52, SE-54, PRG-400, PEG-600, PEG-1500, PEG-4000, PEG-6000, PEG-20M, DEGS,EGA, EGS, QF-1, FFAP, DNP, β, β- Diethoxyacetonitrile, silicone oil, apiezon, squalane, DC series and etc.

► **SUPPORT:** Aiatomite (Chrosorb series and others), organic support

► **ADSORBENT AND POLYMER MICROSPHERES:** Porapak series, Proasil series, GDX series, HDG series, SD series, molecular sieve, carbon molecular sieve, graphitized carbon black, silica gel, aluminium oxide, etc.

► **SPECIFICATION:** Inner diameter 2-4 mm, length: 0.5-9 m.

◆ Welch also offers custom-made GC packed columns. Please provide GC model number, column tube type, stationary phase composition, type and particle size of the solid support, inner diameter and length, and the targeted samples.

Ordering Information:

PACKING MATERIALS

Support: Mesh Number: Stationary Phase A: Stationary Phase A Coated Amount/%:

Stationary Phase B: Stationary Phase B Coated Amount/%:

TUBE MATERIALS

☐ Stainless Steel ☐ Passivated stainless steel ☐ Glass ☐ PP

INSTRUMENT MODEL

DIMENSION

Length/m: OD/mm: ID/mm: Center Distance/mm:

◆ Note: Before ordering a packed column, first verify that the GAS chromatograph instrument has a GC Packed Column inlet for injecting. When ordering stainless steel packed column, please provide the instrument type and the outer diameter of the packed column. When ordering glass packed column, please provide the instrument type and the center distance between the injector and the detector.

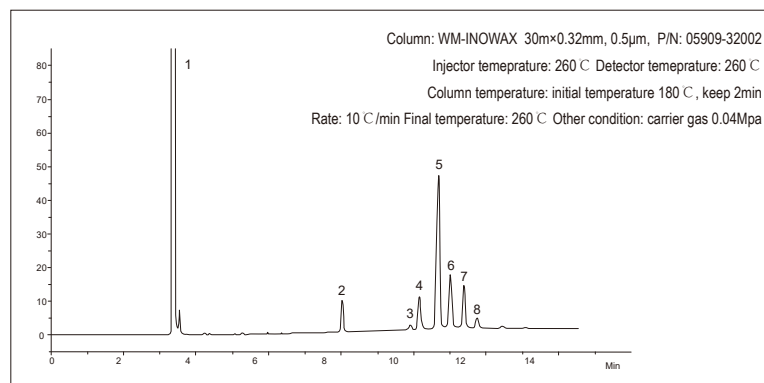
02 APPLICATION OF GC COLUMN

APPLICATION OF GC COLUMN

2.1 APPLICATION IN CHEMICAL ENERGY

Analysis of High Carbon Fatty Acid Methyl Ester by High Temperature Resistant Crosslinked Polar Column

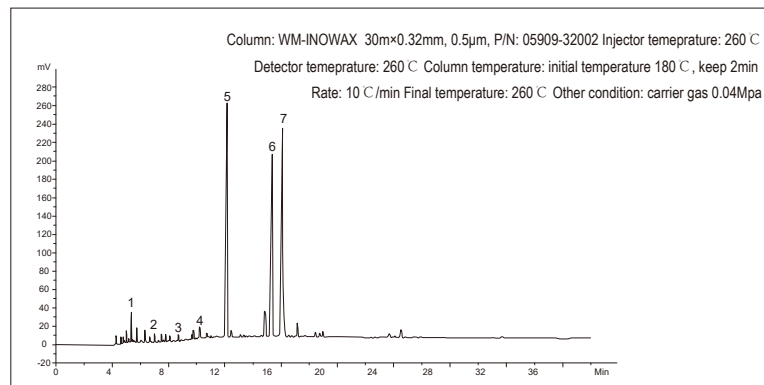
- **Characteritics:** The high carbon fatty acid methyl ester can be analyzed to solve the difficulty of high temperature resistance of polar column. The maximum temperature of modified column can reach 320 °C.



No.	Component
1	Solvent
2	Methyl palmitate
3	Methyl stearate
4	Methyl oleate
5	Linolenic acid methyl ester
6	γ-linolenic acid methyl ester
7	α-linolenic acid methyl ester
8	Linolenic acid methyl ester

Analysis of Biodiesel on High-carbon Fatty Acid Methyl Ester Column

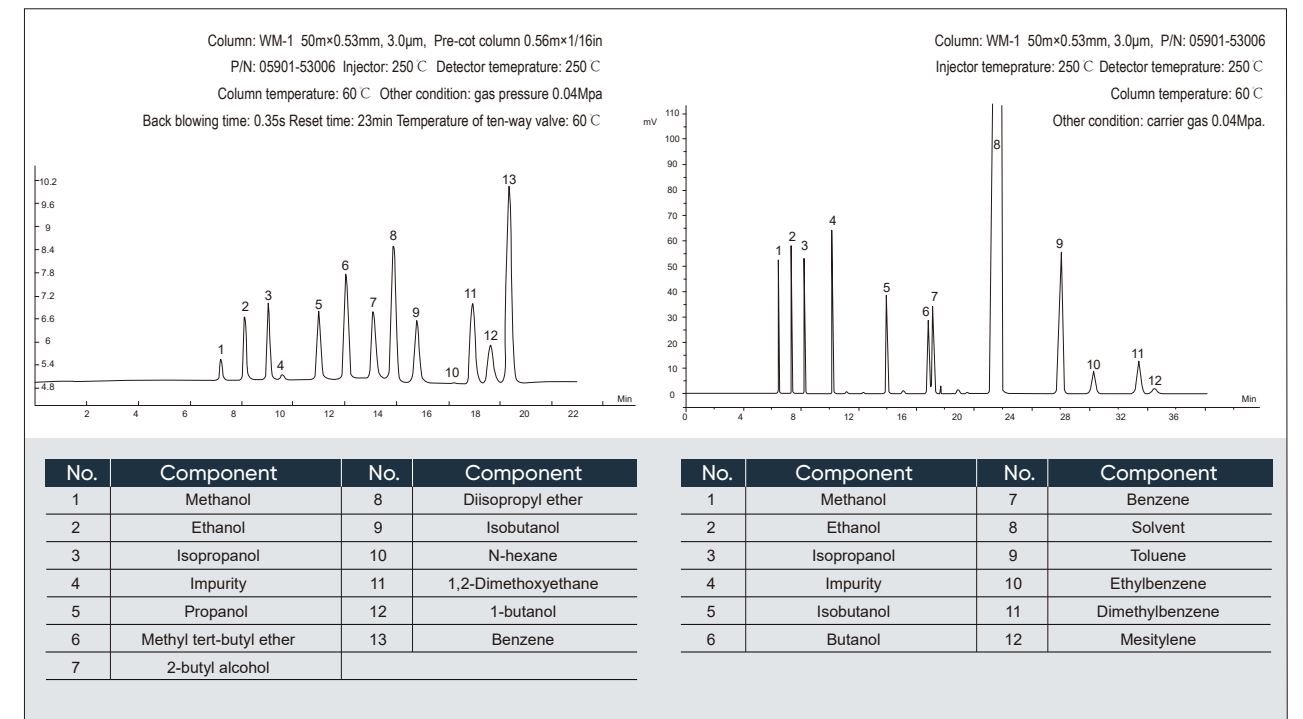
- **Characteritics:** The high carbon fatty acid methyl ester in biodiesel was analyzed to solve the difficulty of high temperature resistance of polar column. The maximum temperature of modified column could reach 320 °C.



No.	Component
1	N-dodecane
2	N-tridecane
3	N-heptadecane
4	N-nonadecane
5	Methyl hexadecanoate
6	Methyl stearate
7	Methyl linoleate

Analysis of Oxidation and Aromatics in Gasoline

- **Characteritics:** comply with SH/T 0663 analysis requirements for alcohols and ethers in gasoline
- **Characteritics:** comply with SH/T 0693 aromatics analysis requirements in gasoline

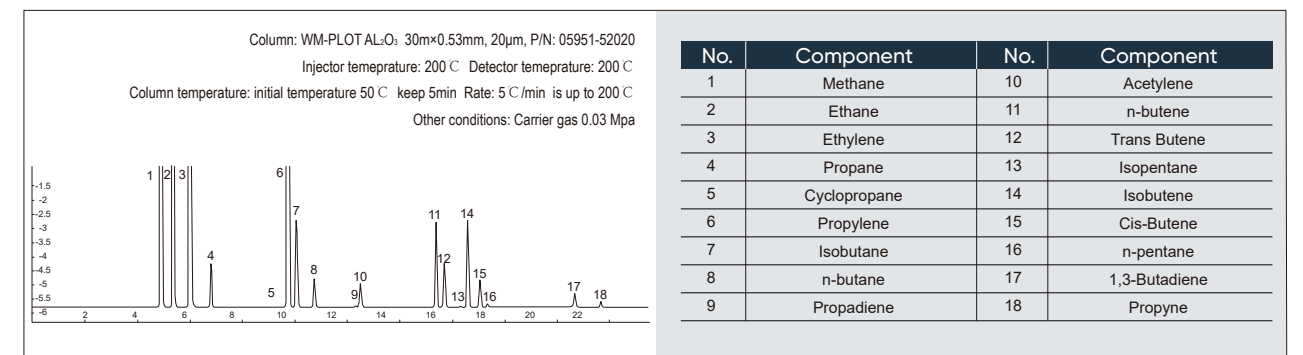


No.	Component	No.	Component
1	Methanol	8	Diisopropyl ether
2	Ethanol	9	Isobutanol
3	Isopropanol	10	N-hexane
4	Impurity	11	1,2-Dimethoxyethane
5	Propanol	12	1-butanol
6	Methyl tert-butyl ether	13	Benzene
7	2-butyl alcohol		

No.	Component	No.	Component
1	Methanol	7	Benzene
2	Ethanol	8	Solvent
3	Isopropanol	9	Toluene
4	Impurity	10	Ethylbenzene
5	Isobutanol	11	Dimethylbenzene
6	Butanol	12	Mesitylene

Chromatogram of Pyrolysis Gas Group Analyzed by Capillary Column

- **Characteritics:** analyze C1-C7, the olefins are effectively separated from the olefins

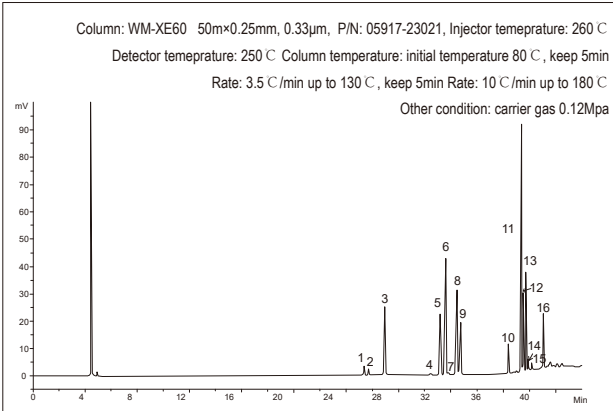


No.	Component	No.	Component
1	Methane	10	Acetylene
2	Ethane	11	n-butene
3	Ethylene	12	Trans Butene
4	Propane	13	Isopentane
5	Cyclopropane	14	Isobutene
6	Propylene	15	Cis-Butene
7	Isobutane	16	n-pentane
8	n-butane	17	1,3-Butadiene
9	Propadiene	18	Propyne

Analyze Industrial Phenols by Phenolic Dedicated Column

► **Characteritics:** analyze the components of phenolic products

Column: WM-XE60 50m×0.25mm, 0.33μm, P/N: 05917-23021, Injector temeprature: 260 C
 Detector temeprature: 250 C Column temperature: initial temperature 80 C, keep 5min
 Rate: 3.5 C/min up to 130 C, keep 5min Rate: 10 C/min up to 180 C
 Other condition: carrier gas 0.12Mpa

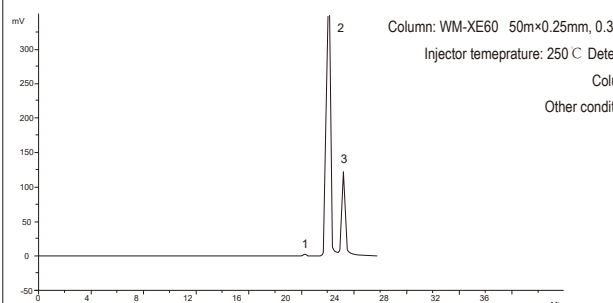


No.	Component	No.	Component
1	2,6-Dimethylphenol	9	2,5-dimethyl phenol
2	Phenol	10	2, 3 dimethyl phenol
3	O-cresol	11	3, 5 dimethyl phenol
4	2,4,6-Trimethylphenol	12	4-Ethylphenol
5	p-Cresol	13	Ethyl between phenol
6	m-Cresol	14	Unknown components
7	2-Ethylphenol	15	Unknown components
8	2,4-Dimethylphenol	16	3,4 dicresol

Analyze Purity of P-Methoxyphenol by Phenolic Dedicated Column

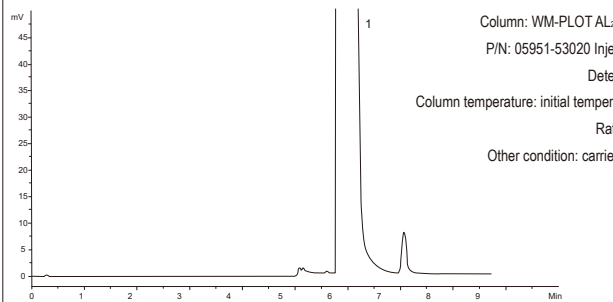
► **Characteritics:** analyze purity of p-methyl phenol, and achieve baseline separation of o-methyl phenol, p-methyl phenol and m-methyl phenol.

Column: WM-XE60 50m×0.25mm, 0.33μm, P/N: 05917-23021
 Injector temeprature: 250 C Detector temeprature: 250 C
 Column temperature: 160 C
 Other condition: carrier gas 0.08Mpa



No.	Component
1	O-cresol
2	P-cresol
3	M-cresol

Analyze Refrigerant R22 by Dedicated column

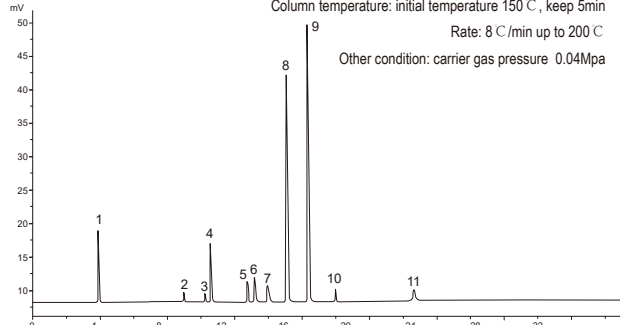


Column: WM-PLOT AL₂O₃ 50m×0.53mm, 20μm
 P/N: 05951-53020 Injector temeprature: 250 C
 Detector temeprature: 250 C
 Column temperature: initial temperature 150 C, keep 2 min
 Rate: 5 C/min up to 200 C
 Other condition: carrier gas pressure 0.04Mpa

No.	Component
1	R22

Analyze Mixed Gas Refrigerant by Dedicated Column

Column: WM-PLOT AL₂O₃ 50m×0.53mm, 20μm
 P/N: 05951-53020 Injector temeprature: 250 C Detector temeprature: 250 C
 Column temperature: initial temperature 150 C, keep 5min
 Rate: 8 C/min up to 200 C
 Other condition: carrier gas pressure 0.04Mpa

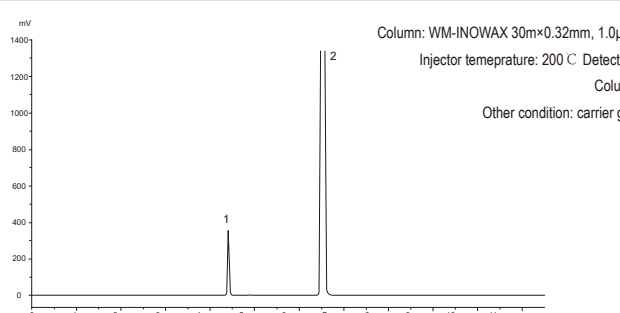


No.	Component	No.	Component
1	Methane	7	R41
2	R142b	8	Trans-butene
3	R12	9	Cis-2-butene
4	R32	10	R1141
5	Acetylene	11	R23
6	R152a		

Analyze Cyclohexane and Benzene

► **Characteritics:** effectively analyze of cyclohexane and benzene. It can be used to detect benzene or benzene in cyclohexane cyclohexane

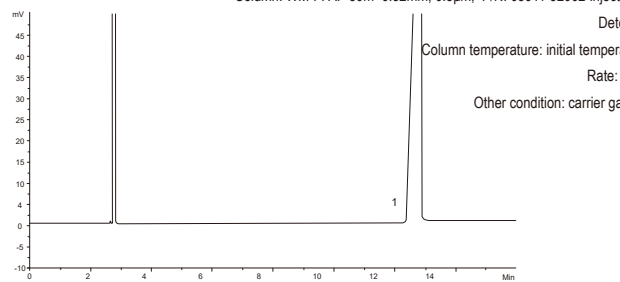
Column: WM-INOWAX 30m×0.32mm, 1.0μm, P/N: 05909-32003
 Injector temeprature: 200 C Detector temeprature: 200 C
 Column temperature: 70 C
 Other condition: carrier gas pressure 0.04Mpa



No.	Component
1	Cyclohexane
2	benzene

Analyze Purity of P-Phthalic Anhydride by Dedicated Column

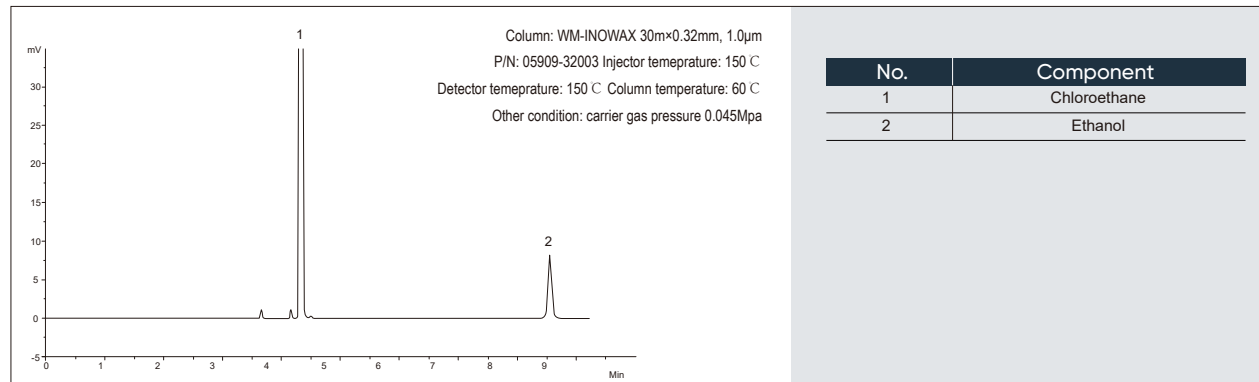
Column: WM-FFAP 30m×0.32mm, 0.5μm, P/N: 05911-32002 Injector temeprature: 300 C
 Detector temeprature: 300 C
 Column temperature: initial temperature 90 C, keep 2min
 Rate: 10 C/min up to 250 C
 Other condition: carrier gas pressure 0.065MPa



No.	Component
1	Phthalic anhydride

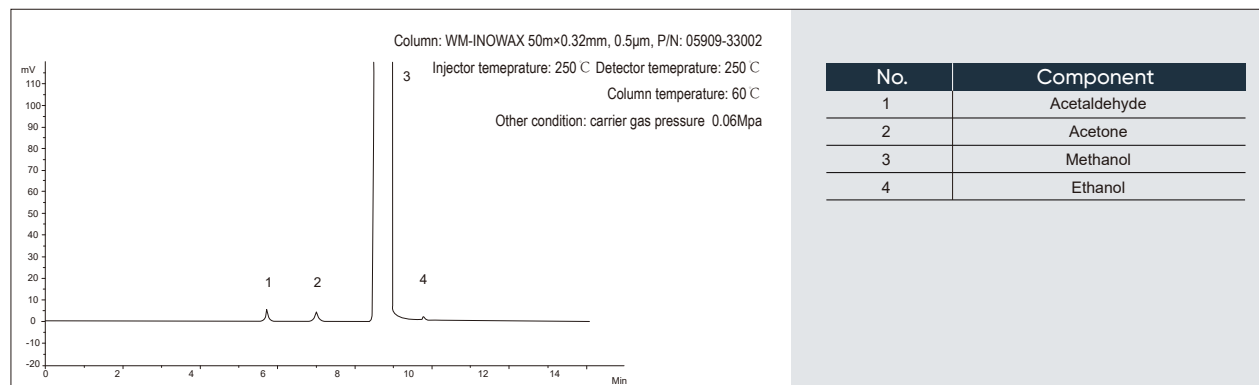
Analyze Chloroethane Purity by Capillary Column

► **Characteritics:** analyze purity of chloroethane and the content of ethanol in chloroethane by capillary column



Analyze Methanol Purity by Capillary Column

► **Characteritics:** if use capillary column to analyze the trace alcohol and related impurities in methanol, the methanol tailing would improve with good separation effect.

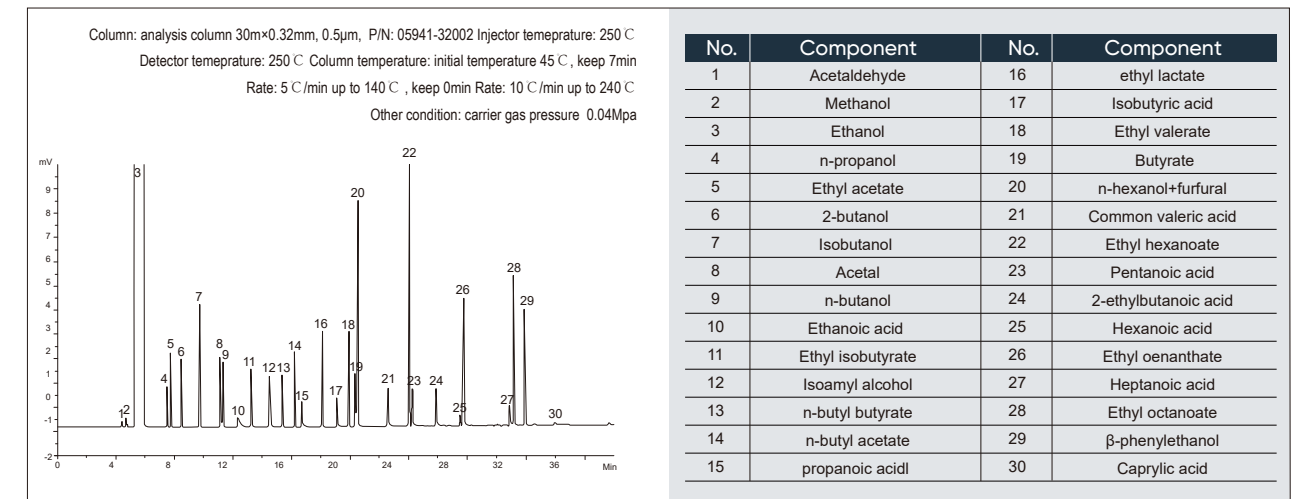


2.2 APPLICATION IN BREWING

► **Characteritics:** in addition to alcohols and esters, organic acids, such as acetic acid, butyric acid and pentanoic acid can be well analyzed according to temperature programming. Baseline separation of methanol, acetaldehyde, ethanol and ethyl acetate can be achieved for temperature-programmed analysis of more components. More components also can be analyzed by temperature programming.

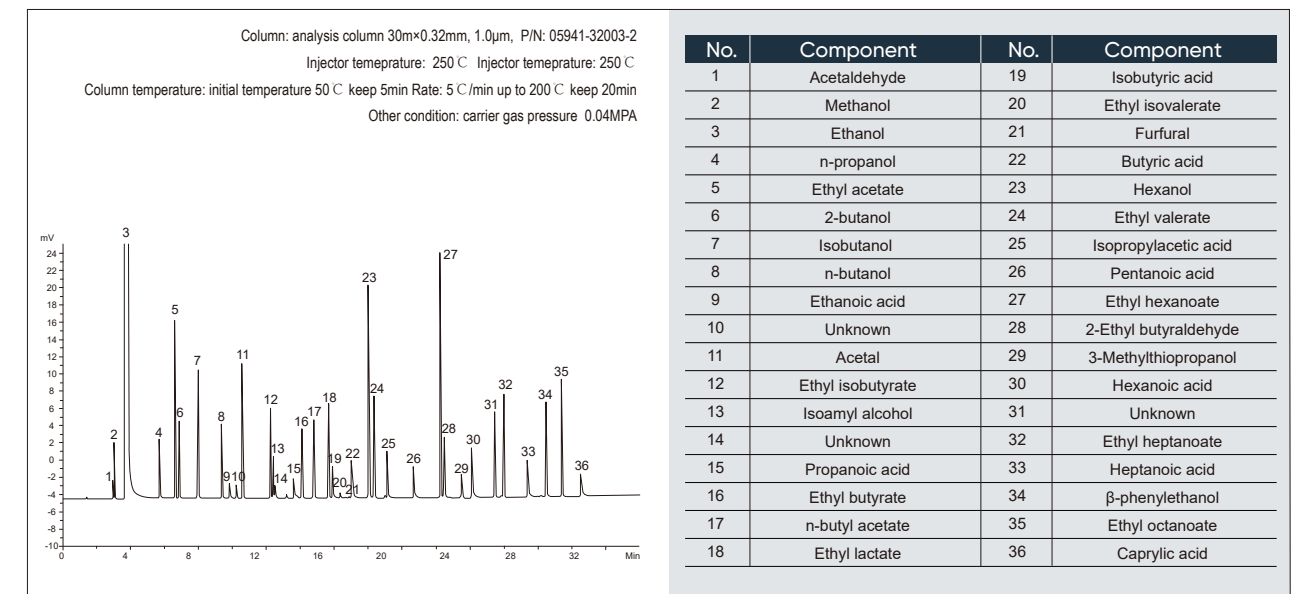
Liquor Capillary Column C1

C1 column can be used to analyze various mixed components of liquor, and there are up to 30 qualitative components at present.



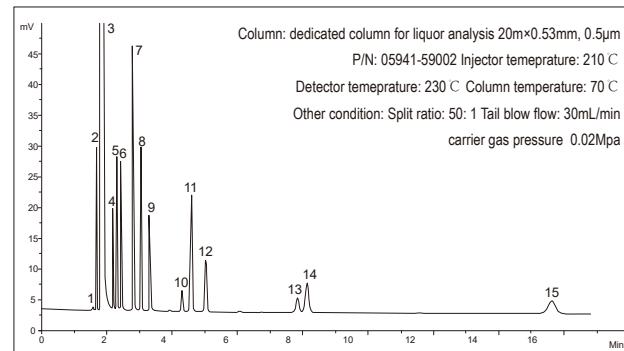
Liquor Capillary Column C2

C2 column has been upgraded on the basis of Liquor analysis C1 column, which can analyze more components such as 3-methiopropyl alcohol, n-hexanol, etc. Suitable for separation of acids. At present, there are 36 qualitative components



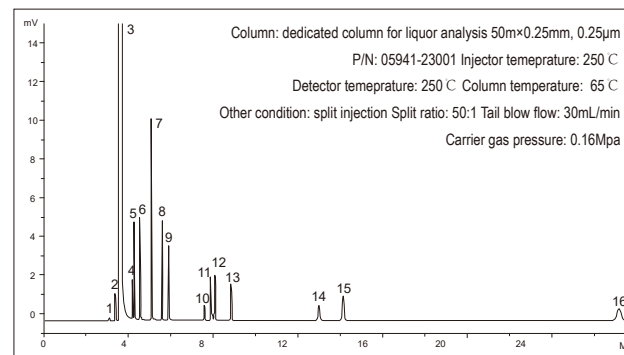
Analyze with Large Diameter Dedicated Column for Liquor

► **Characteristics:** can be used for thermostatic analysis and completely separate methanol, acetaldehyde, ethyl acetate.



No.	Component	No.	Component
1	Acetaldehyde	9	n-butanol
2	Methanol	10	Isopentanol
3	Ethanol	11	Ethyl butyrate
4	n-propanol	12	Butyl acetate
5	Ethyl acetate	13	Ethyl lactate
6	2-butanol	14	Ethyl pentanoate
7	Isobutanol	15	Ethyl caproate
8	Acetal		

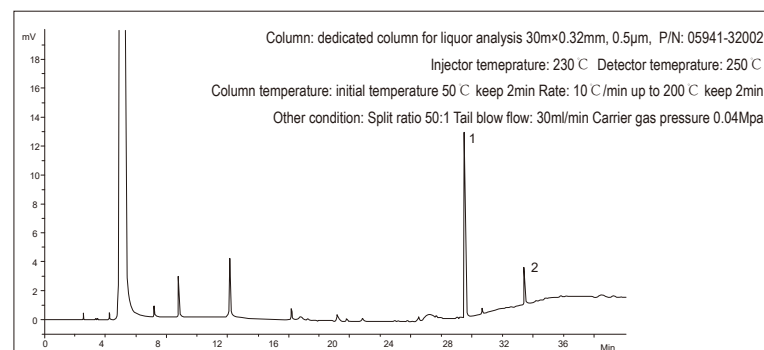
Constant Temperature Analysis of by Small Diameter Dedicated Column for Liquor



No.	Component	No.	Component
1	Acetaldehyde	9	n-butanol
2	Methanol	10	2-methyl-1-butanol
3	Ethanol	11	Isoamyl alcohol
4	n-propanol	12	Ethyl butyrate
5	Ethyl acetate	13	Butyl acetate
6	2-butanol	14	Ethyl lactate
7	Isobutanol	15	Ethyl valerate
8	Acetal	16	Ethyl caproate

Analyze the Content of β-phenylethanol in Black Rice Wine

► **Characteristics:** determine β-phenylethanol in black rice wine with 2-ethyln-butyric acid as internal standard. This method can also be used for the analysis of other similar yellow rice wine products

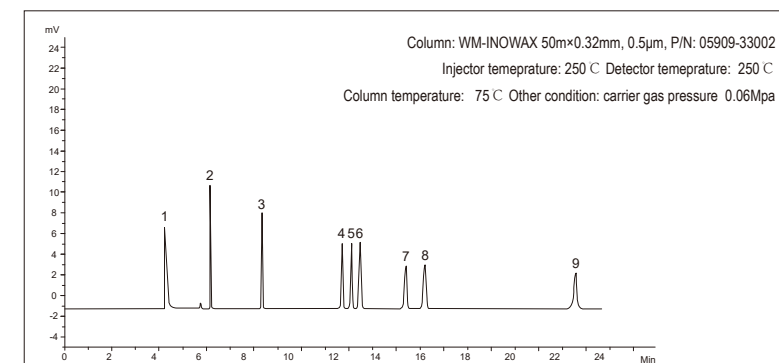


No.	Component
1	2-ethyln-butyric acid
2	β-benzyl ethanol

2.3 APPLICATION IN ENVIRONMENTAL ANALYSIS

Separation of Benzene Series Samples by Capillary Column

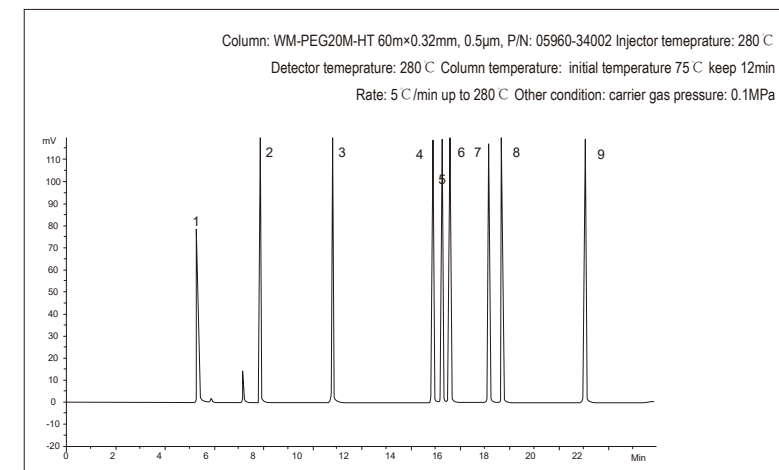
► **Characteristics:** analyze eight kinds of benzene series samples



No.	Component
1	Carbon disulfide
2	Benzene
3	Methylbenzene
4	Ethylbenzene
5	P-xylene
6	M-xylene
7	Isopropyl benzene
8	O-xylene
9	Styrene

Analyze the Benzene Series Samples by High Temperature Resistant Capillary Column

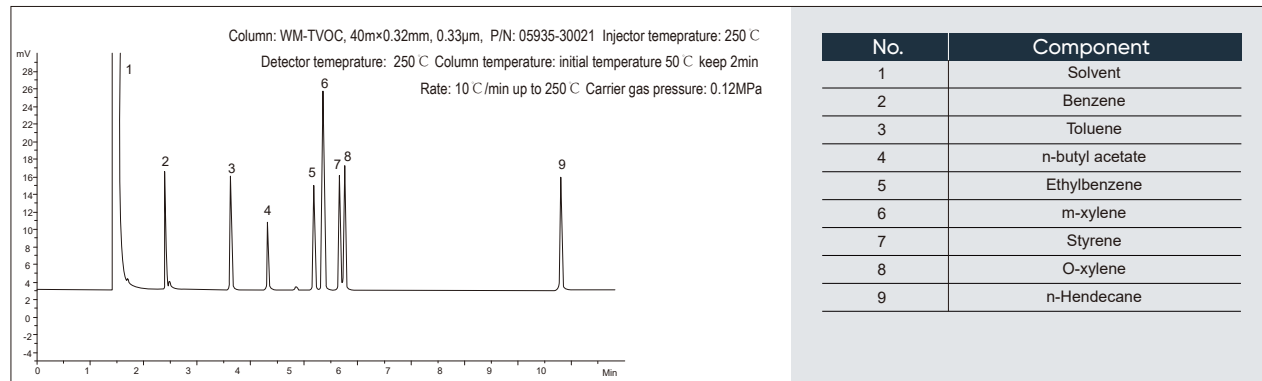
► **Characteristics:** comply with HJ 583/584 standards, analyze the maximum temperature of 8 benzene series samples up to 320 °C, more durable than normal benzene column.



No.	Component
1	Carbon disulfide
2	Benzene
3	Toluene
4	Ethylbenzene
5	P-xylene
6	M-xylene
7	Isopropyl benzene
8	O-xylene
9	Styrene

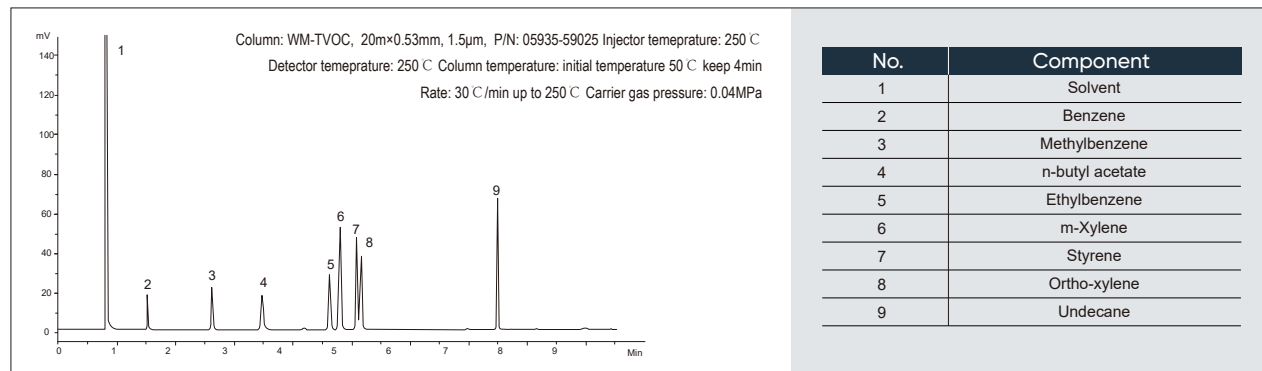
TVOC Column for Rapid Analysis

► **Characteristics:** 8 kinds of volatile toxic and harmful substances in the indoor environment can achieve baseline separation within 10 min.



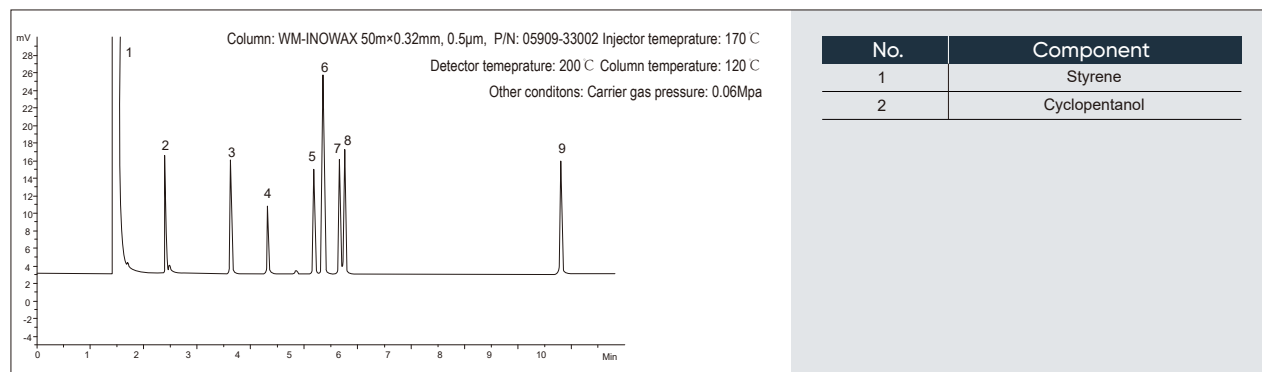
TVOC Special Capillary Column for Portable Micrometer

- **Characteritics:** it can be used for portable miniature TVOC detector, which has the advantages of fast speed, good efficiency and convenient analytical conditions, etc., and is specially customized for miniature chromatograph



Residue Analysis of Styrene

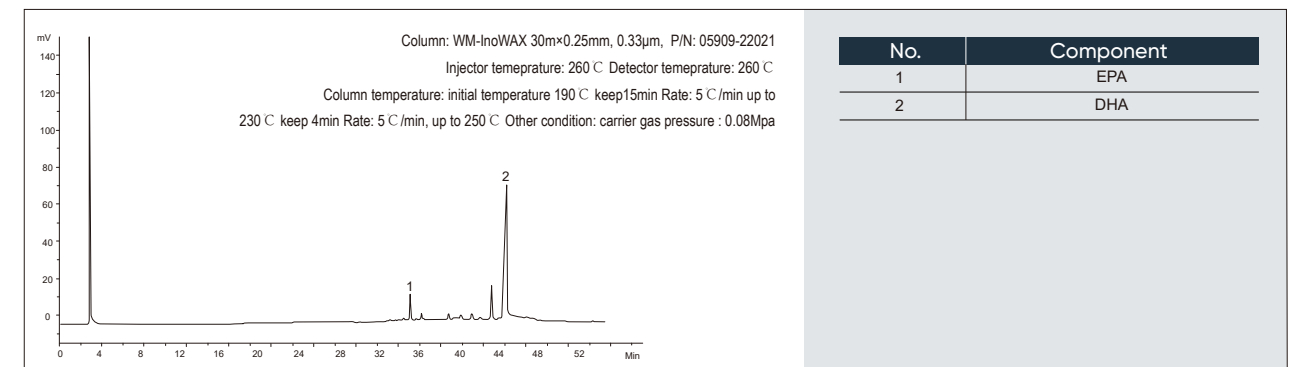
- **Characteritics:** analyze the residue of styrene in polystyrene



2.4 APPLICATION IN FOOD

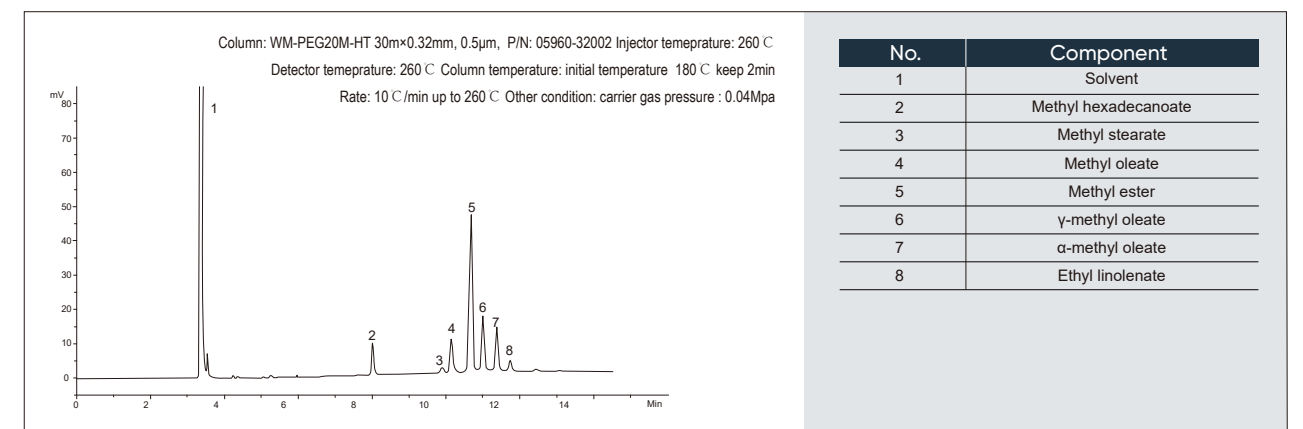
DHA, EPA Analysis

- **Characteritics:** determine the content of DHA and EPA in fish oil by GC capillary column

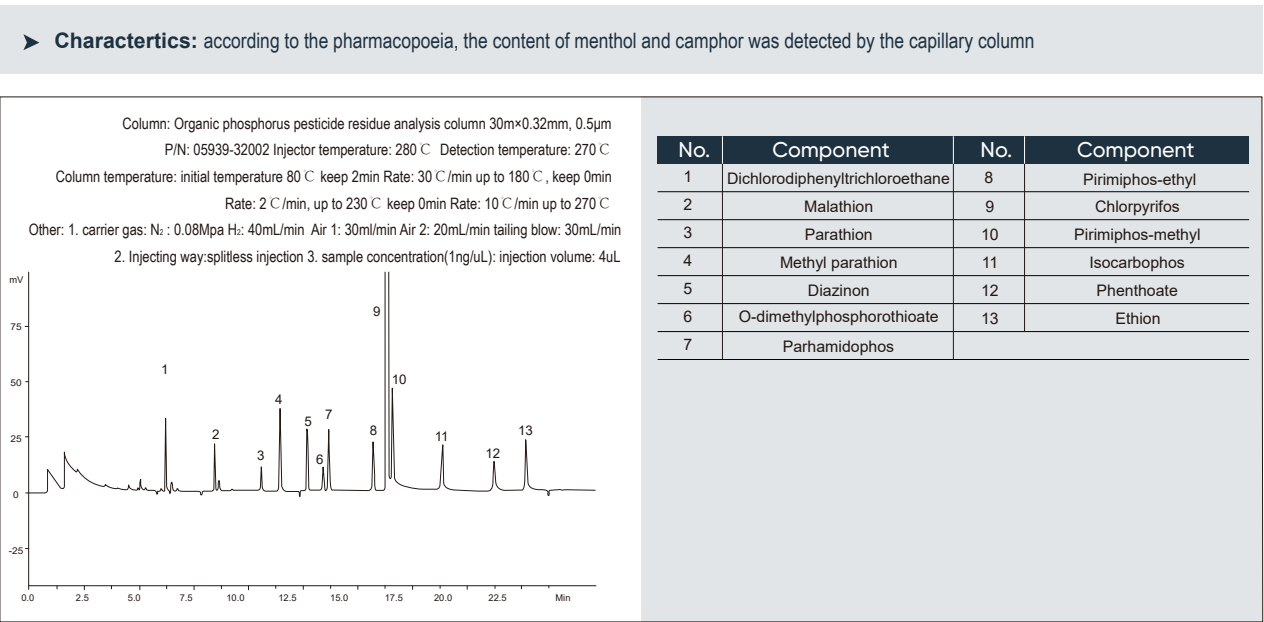


Analyze Fatty Acid Component

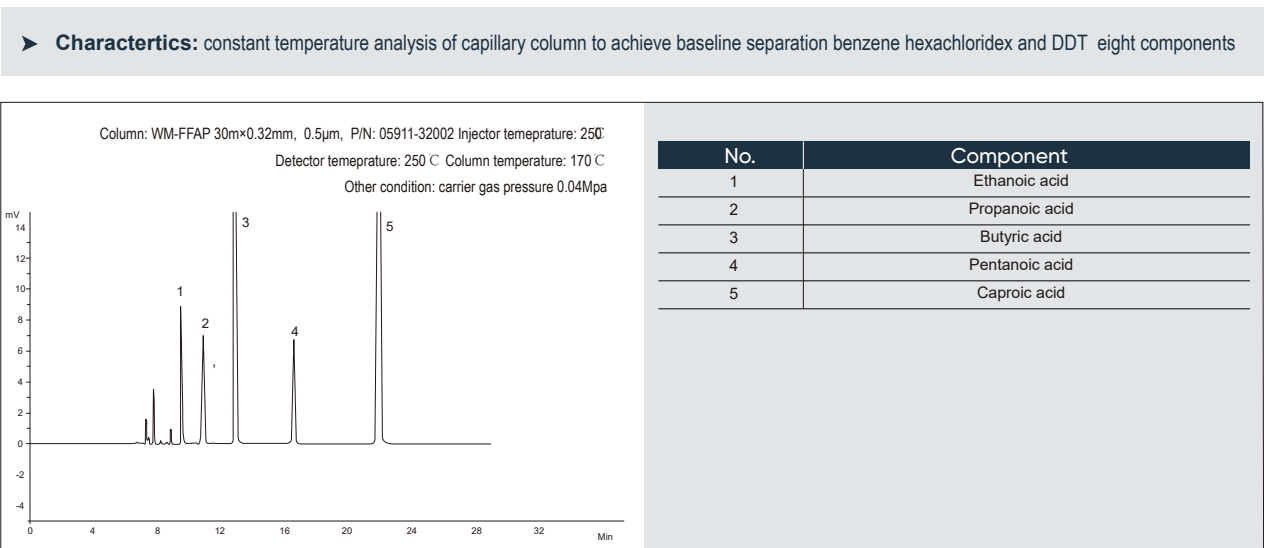
- **Characteritics:** select GC capillary column to detect fatty acid components with good separation effect. The maximum temperature of the column can be up to 320 °C



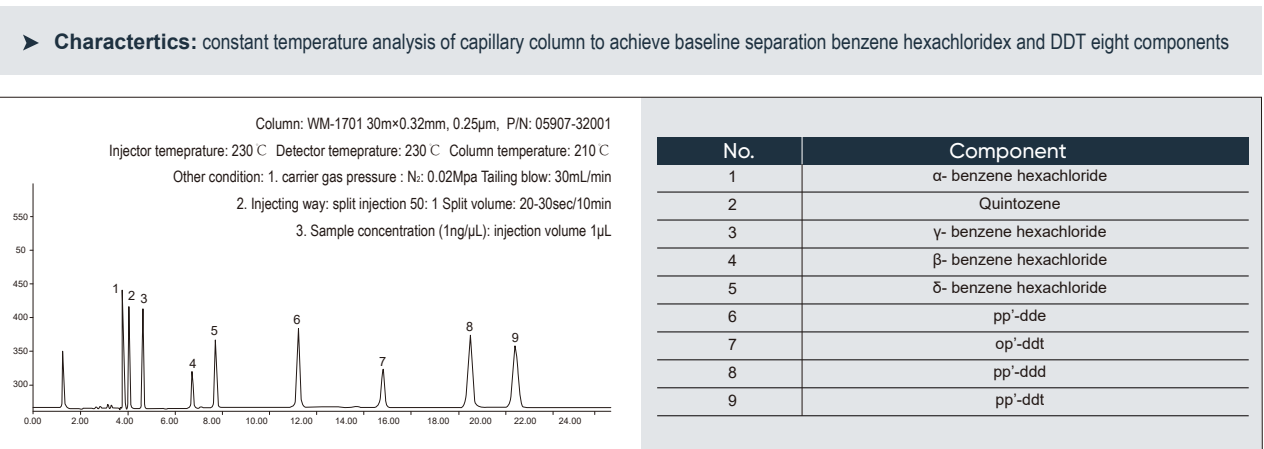
Analysis of Organophosphorus Pesticide Residues in Food



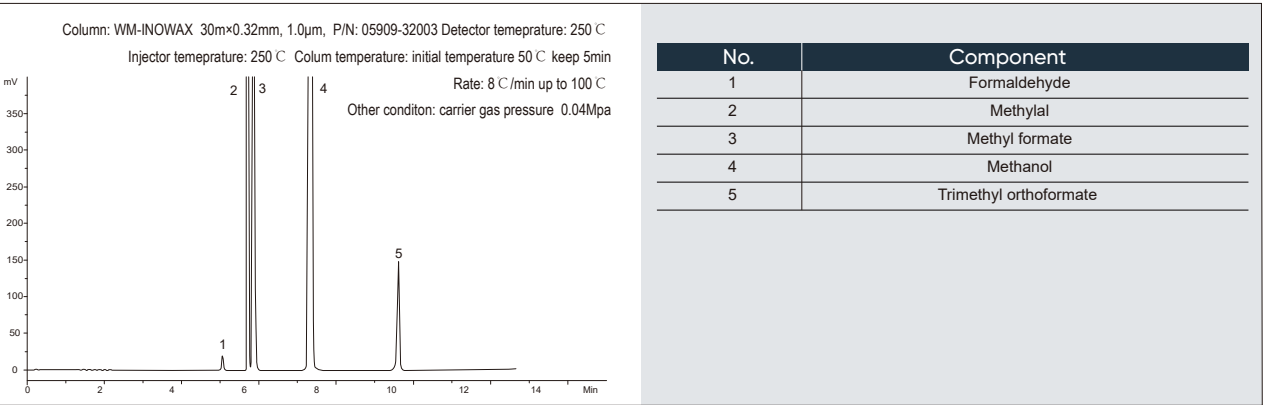
Chromatogram Analysis of C1-C6 Organic Acids



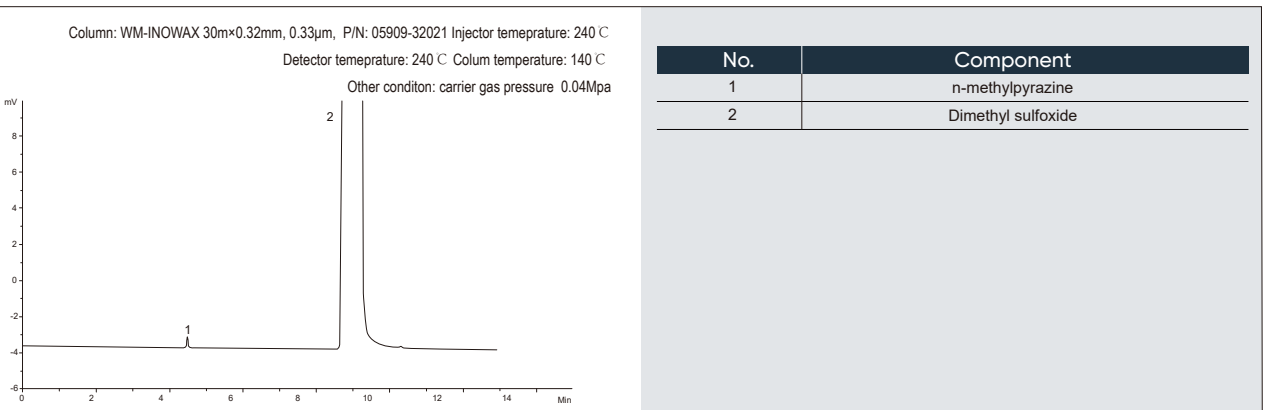
Analysis of Organochlorine Pesticide Residues in Food



Analysis of Formaldehyde, Methyl Acetal, Methyl formate, Methanol and Methyl Orthoformate



Analysis of N-Methylpyrazine Residue

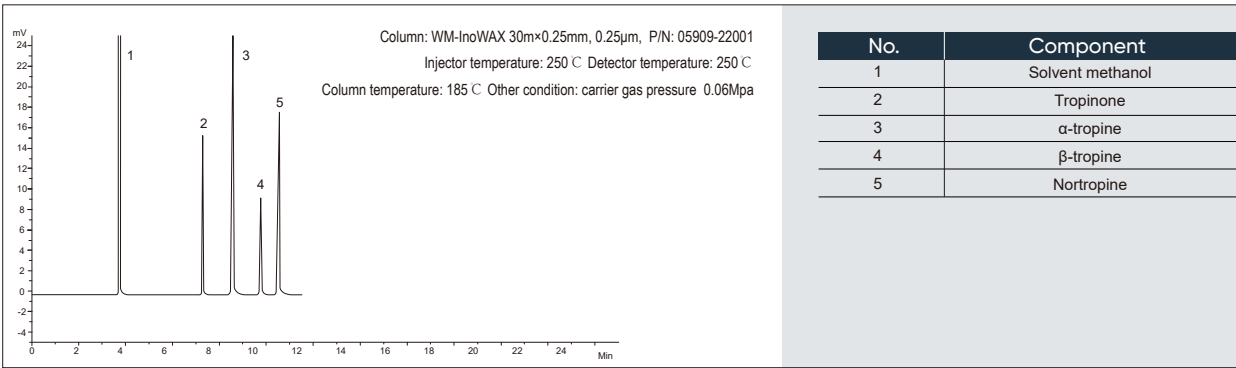


2.5 APPLICATION IN PHARMACOPOEIA

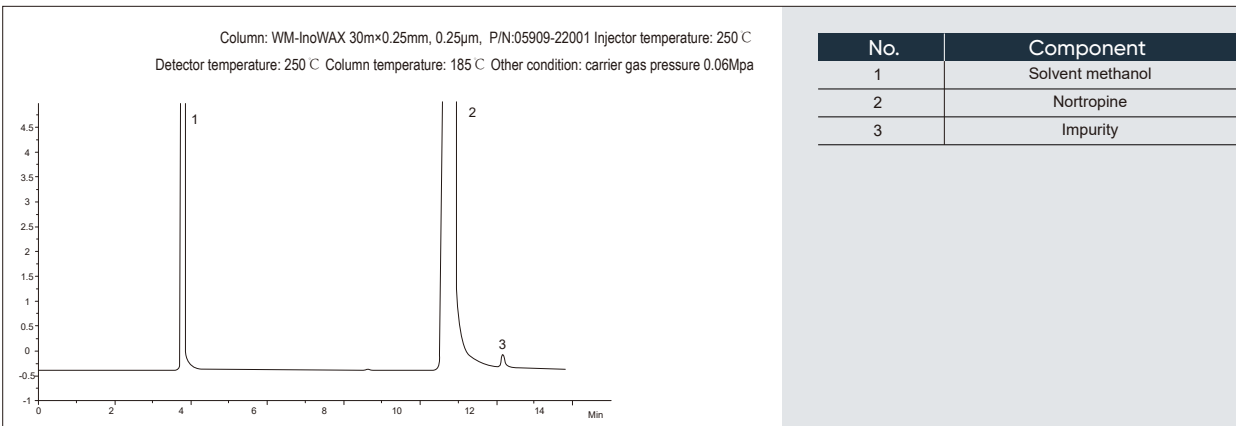
According to the provisions of the 2020 edition of Chinese Pharmacopoeia and the actual needs of customers, Welch specially launched the pharmacopoeia GC detection chromatogram atlas. Welch GC column perfectly conforms to the pharmacopoeia's requirements for column effect, resolution and tailing factor, etc., with good quality stability and excellent inter-batch reproducibility, which provides a strong guarantee for pharmaceutical enterprises to monitor drug quality.

Analysis of Tropine Mixed Samples

► **Characteritics:** analyze the reactants of tropine in medicine

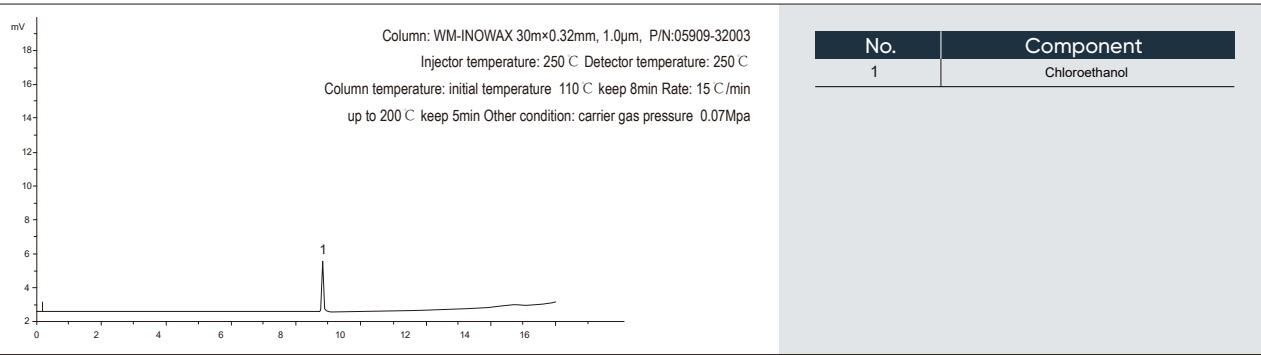


Analysis of the Purity of Noratropine



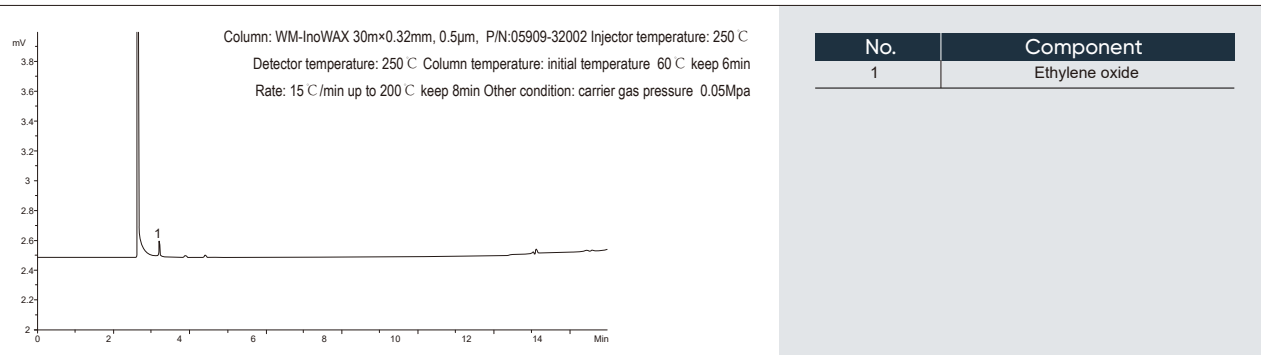
Analysis of Chloroethanol in Water

► **Characteritics:** analyze the 2-chlorine ethanol residue in medical devices or hollow capsules in accordance with the pharmacopoeia, use water as solvent for direct injection analysis



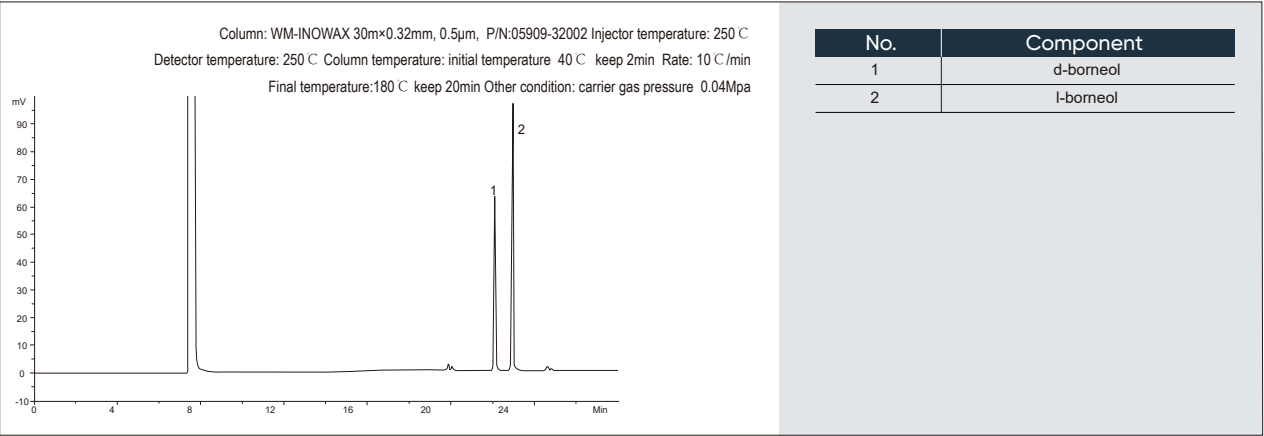
Analysis of Ethylene Oxide

► **Characteritics:** Use headspace injection to analyze ethylene oxide residue in medical devices or hollow capsules. The column can also be used for 2-chloroethanol analysis



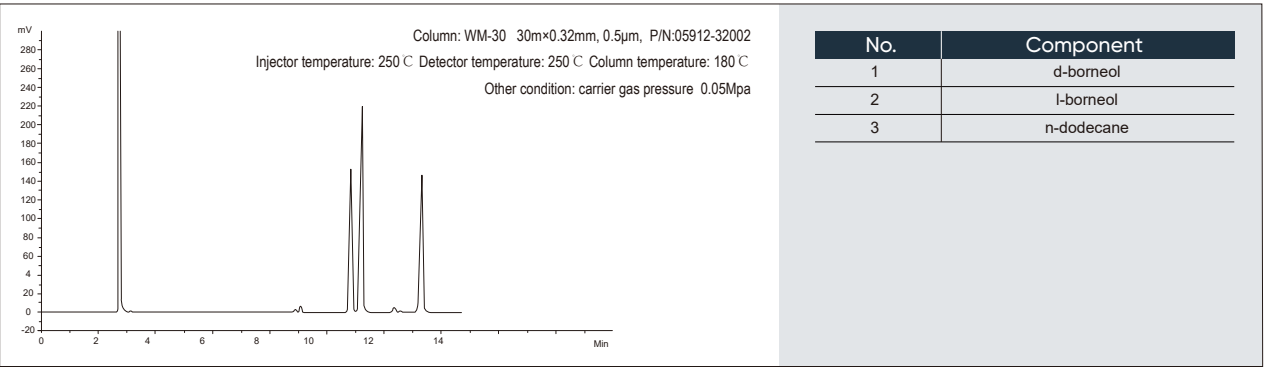
Analysis of Borneol Capillary Column 1

► **Characteritics:** referring to the analysis requirements of natural borneol and synthetic borneol in the pharmacopoeia, select the capillary column specified in the pharmacopoeia to detect the content of isobornol and borneol in borneol, and the analysis effect was better than that of packed column

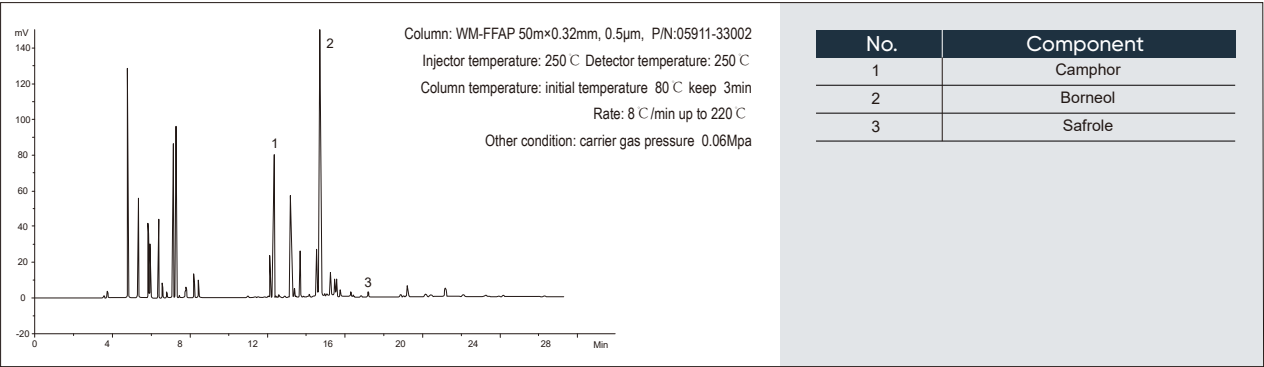


Analysis of Borneol by Capillary Column 2

► **Characteritics:** to determine the contents of isobornol and borneol in borneol by capillary column, because this column has better analysis effect of the than that of the packed column and faster analysis speed than that of borneol capillary column 1

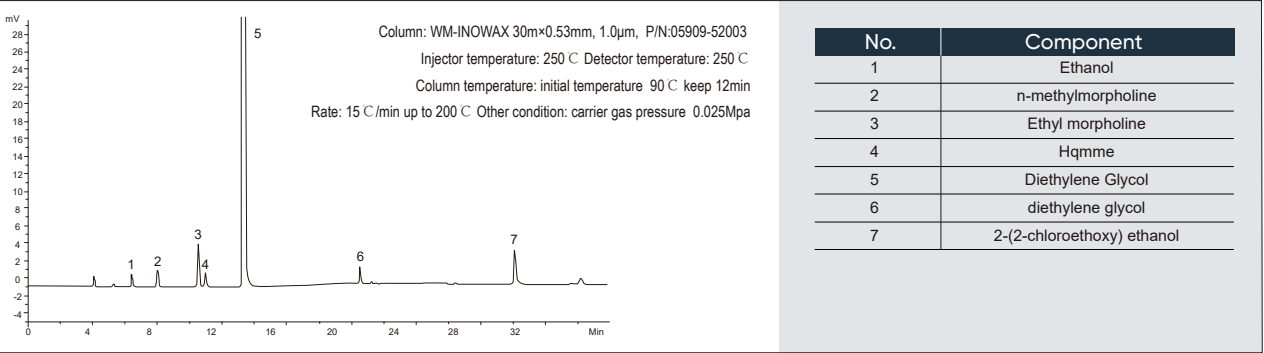


Analysis of Camphor, Camphor and Safrol in Essential Oil



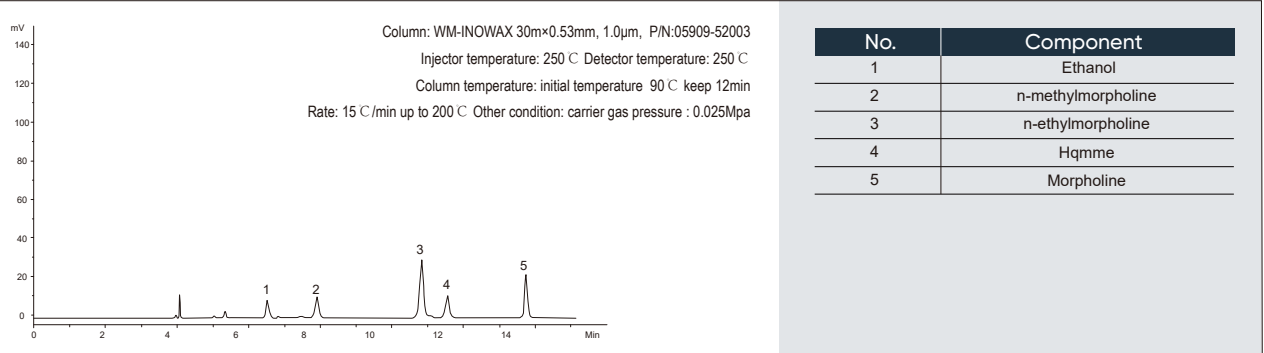
Analysis of Coarse Morpholine

► **Characteritics:** the capillary column is suitable for detecting the purity of morpholine raw material and the composition of morpholine treated with dehydrogenation



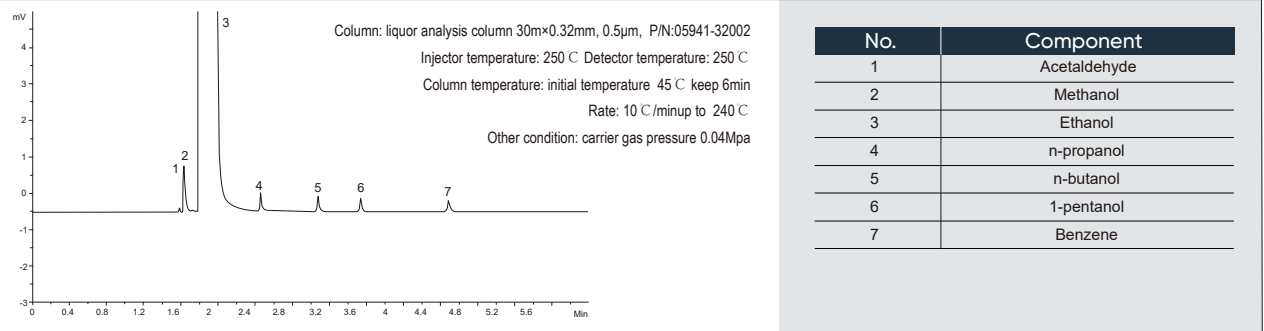
Analysis of Morpholine

► **Characteritics:** The column can be used for analysis of related components of morpholine with good reproducibility and high resolution



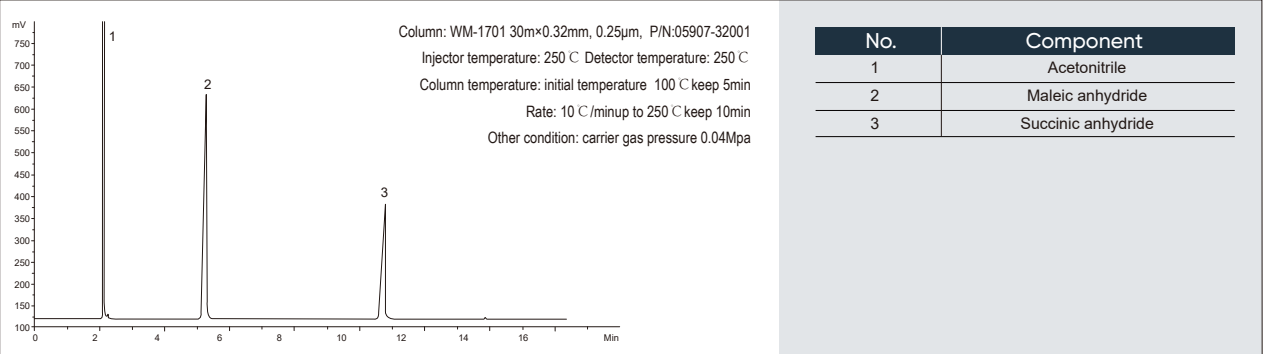
Determination of Ethanol Volatile Substance

► **Characteritics:** according to the determination method requirements of volatile substances in the pharmacopoeia, select capillary column to test the purity of ethanol



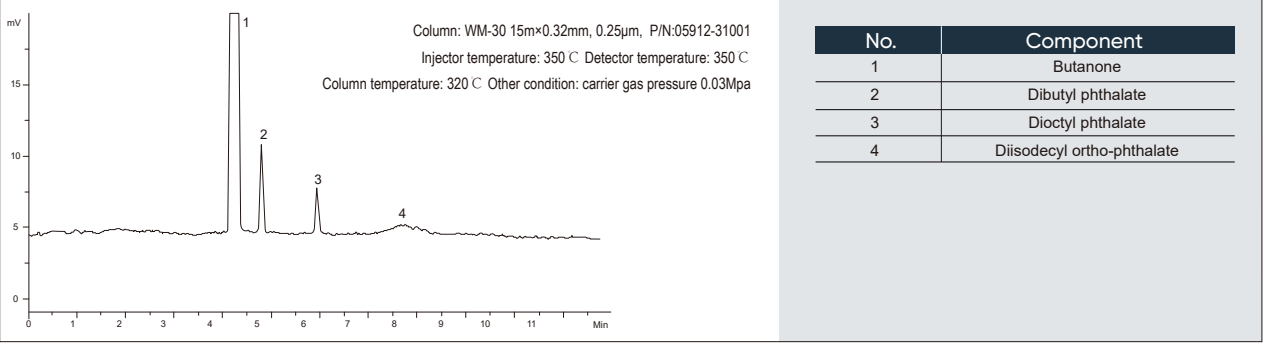
Analysis of Maleic Anhydride and Succinic Anhydride

► **Characteritics:** the capillary column is suitable for the detection of maleic anhydride and succinic anhydride with high analytical accuracy and symmetry peak

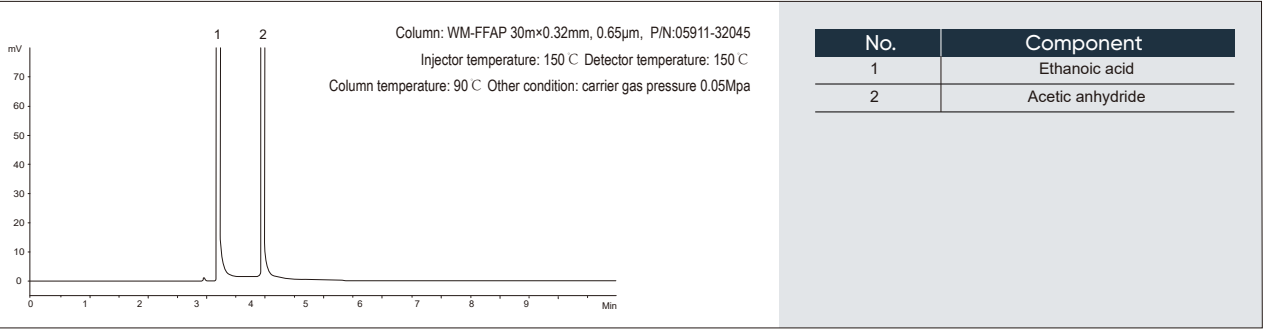


Analysis of Plasticizer

► **Characteritics:** this capillary column is suitable for detecting the components of phthalate plasticizer in medical packaging

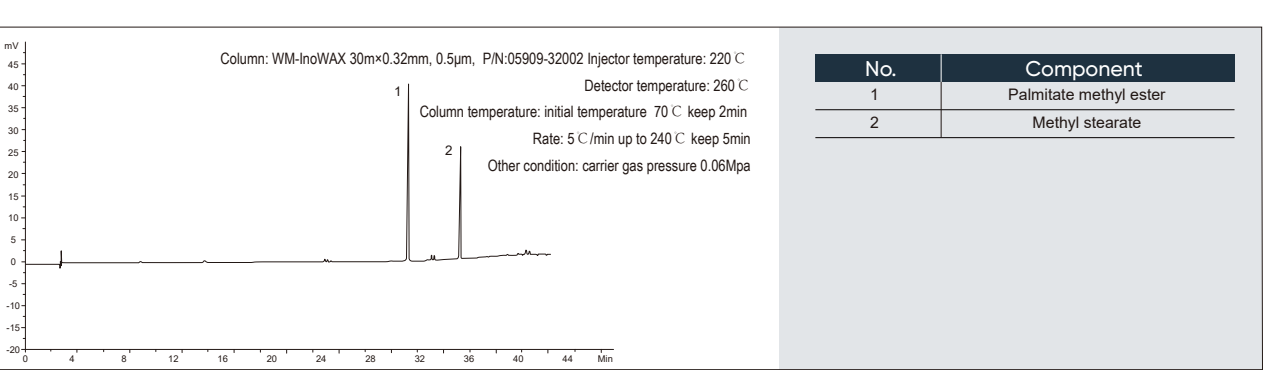


Separation of Acetic Acid and Acetic Anhydride by Capillary Column



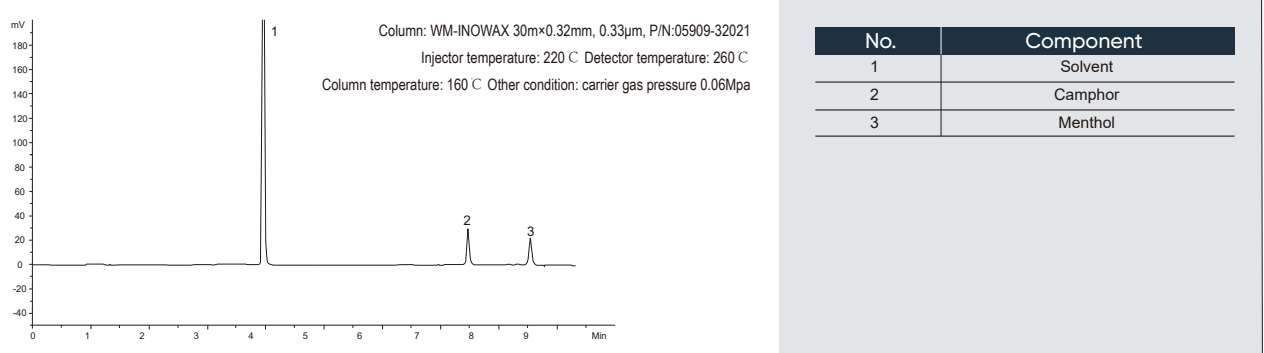
Analysis of Magnesium Stearate

► **Characteritics:** according to the requirement of magnesium stearate analysis in the pharmacopeia, convert the magnesium stearate into methyl stearate by capillary column

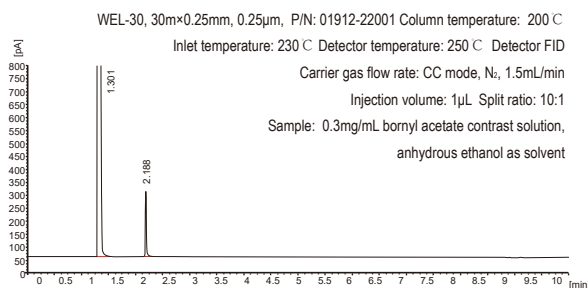


Analysis of Menthol Camphor

► **Characteritics:** according to the pharmacopeia, use the capillary column to detect menthol camphor content

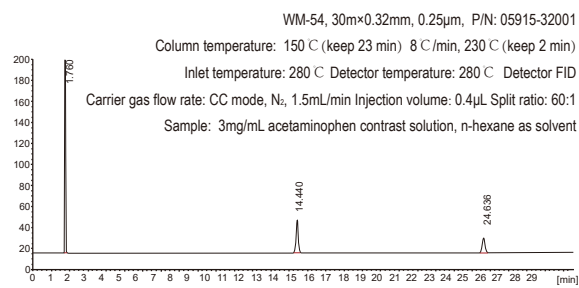


Amomum



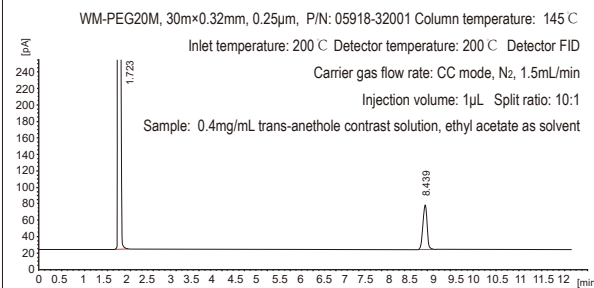
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.301	263183	3.269	21230	
2	Bornyl acetate	2.188	345	1.471	83463	26.94

Pogostemon Cablin



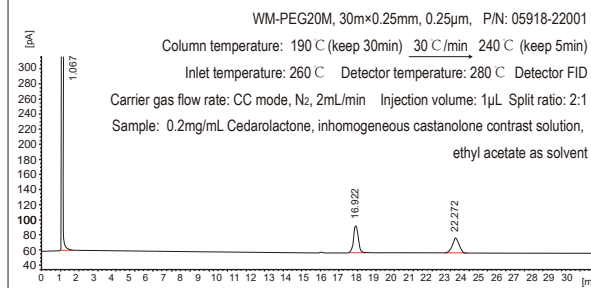
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	1.760	68279	1.110	98722	
2	Patchouli alcohol	14.440	283	0.996	58573	97.40
3	n-octadecane	24.636	149	0.948	130743	40.00

Fennel



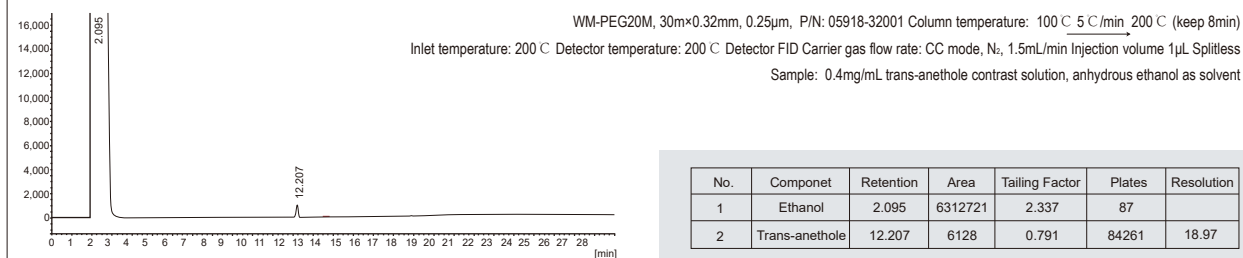
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethyl acetate	1.723	331796	3.206	9924	
2	Trans-anethole	8.439	343	0.996	40424	56.80

Elecampene



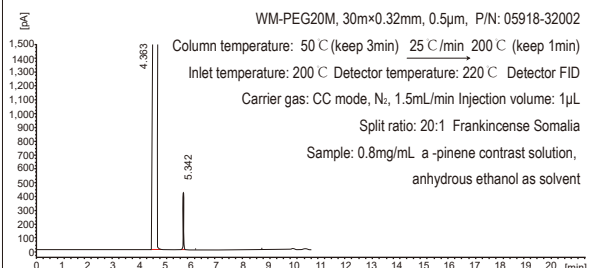
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethyl acetate	1.067	948452	4.228	1578	
2	Alantolactone	16.922	688	0.983	17421	51.25
3	Isoalantolactone	22.272	532	1.036	16650	8.92

Fructus Anisi Stellati



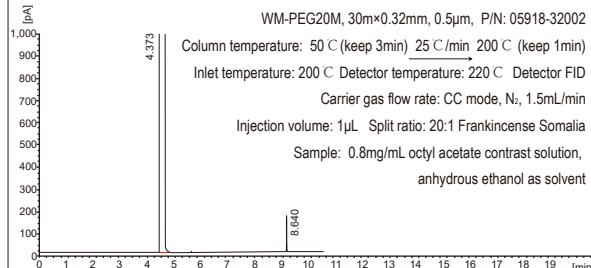
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	2.095	6312721	2.337	87	
2	Trans-anethole	12.207	6128	0.791	84261	18.97

Frankincense Somalia



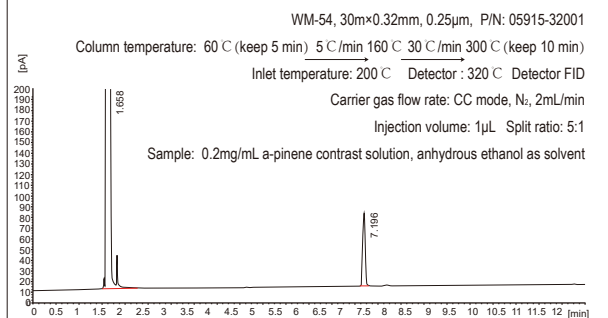
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	4.363	137074	0.598	12683	
2	a-pinene	5.342	821	0.969	172330	9.50

Ethiopian Frankincense



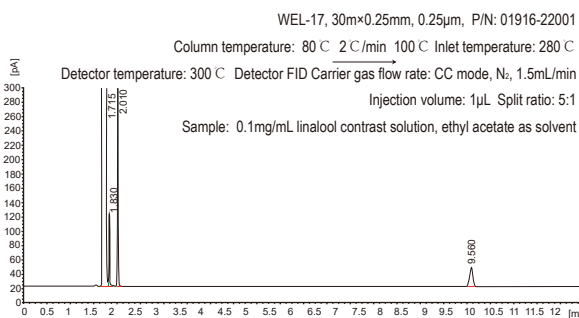
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	4.373	171514	0.591	10319	
2	Octyl acetate	8.640	228	1.032	927785	41.12

Pine Nodular Branch



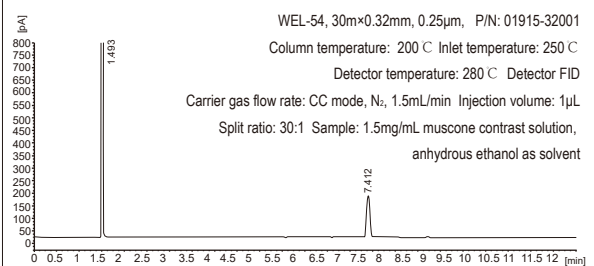
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.658	545052	0.579	2638	
2	a-pinene	7.196	250	0.985	88058	49.10

Homalomena Rhizoma

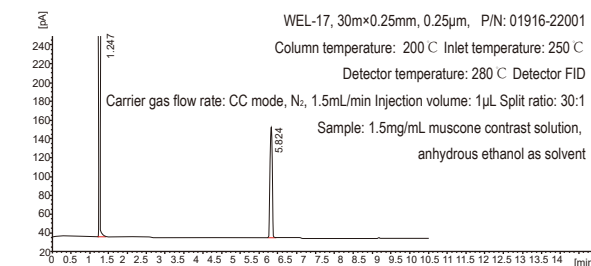


No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethyl acetate	1.715	511539	0.903	13244	
2		1.830	99	0.965	124104	
3		2.010	282	0.969	119893	
4	Linalool	9.560	112	1.009	117821	112.39

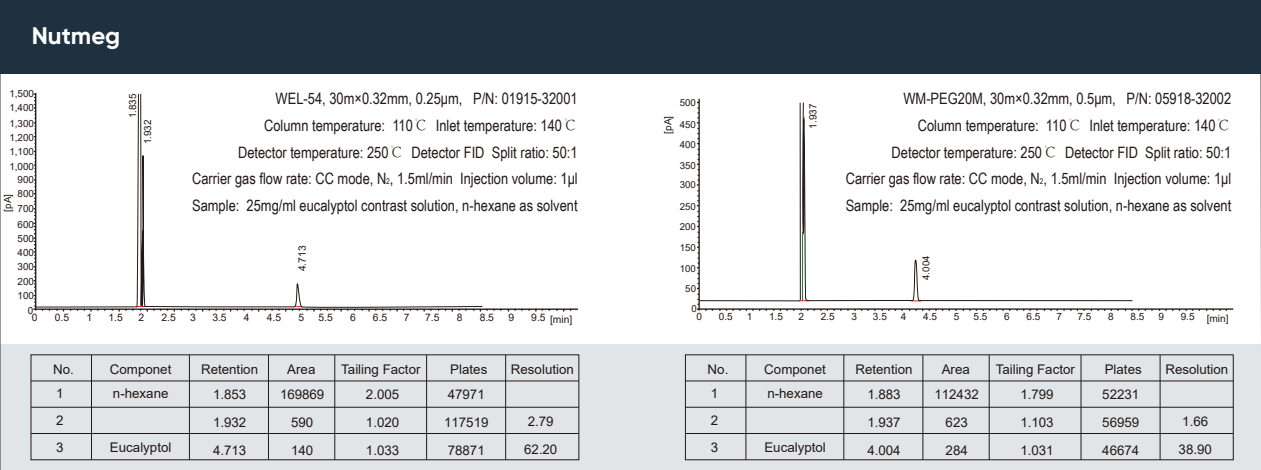
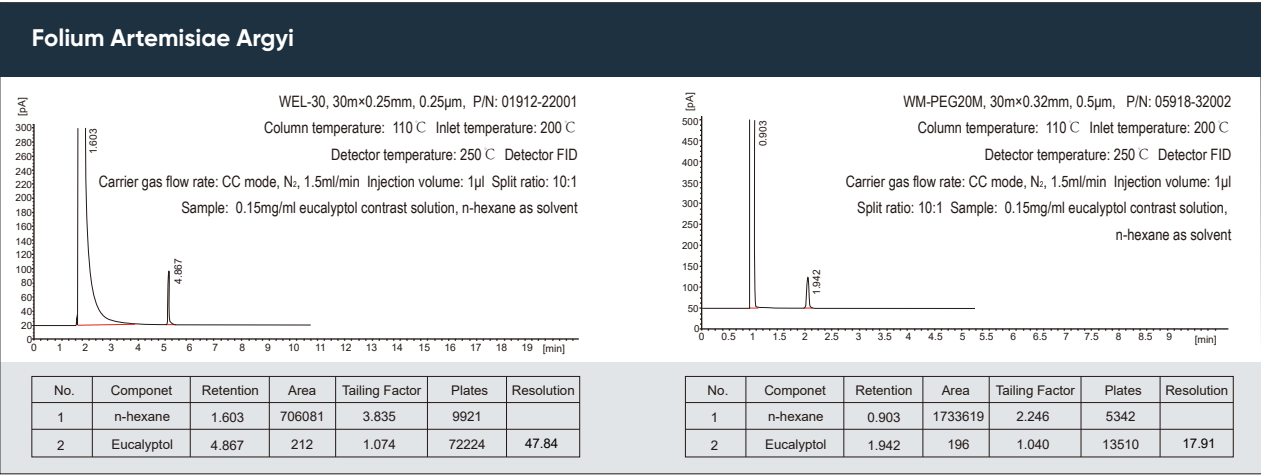
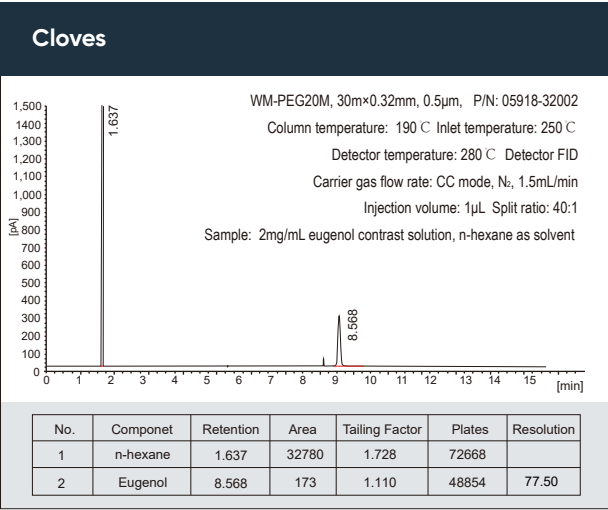
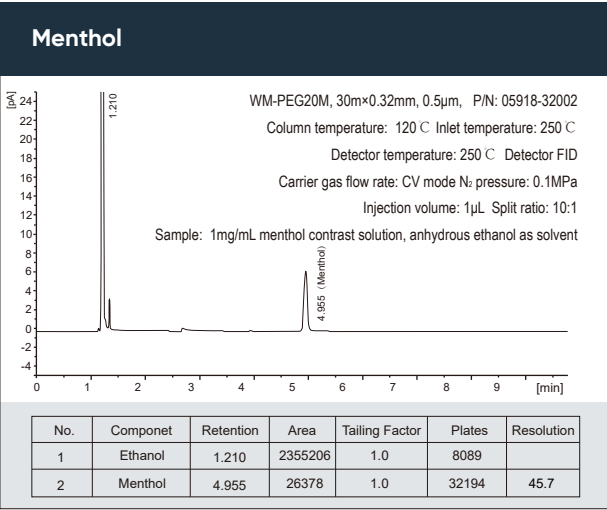
Moschus



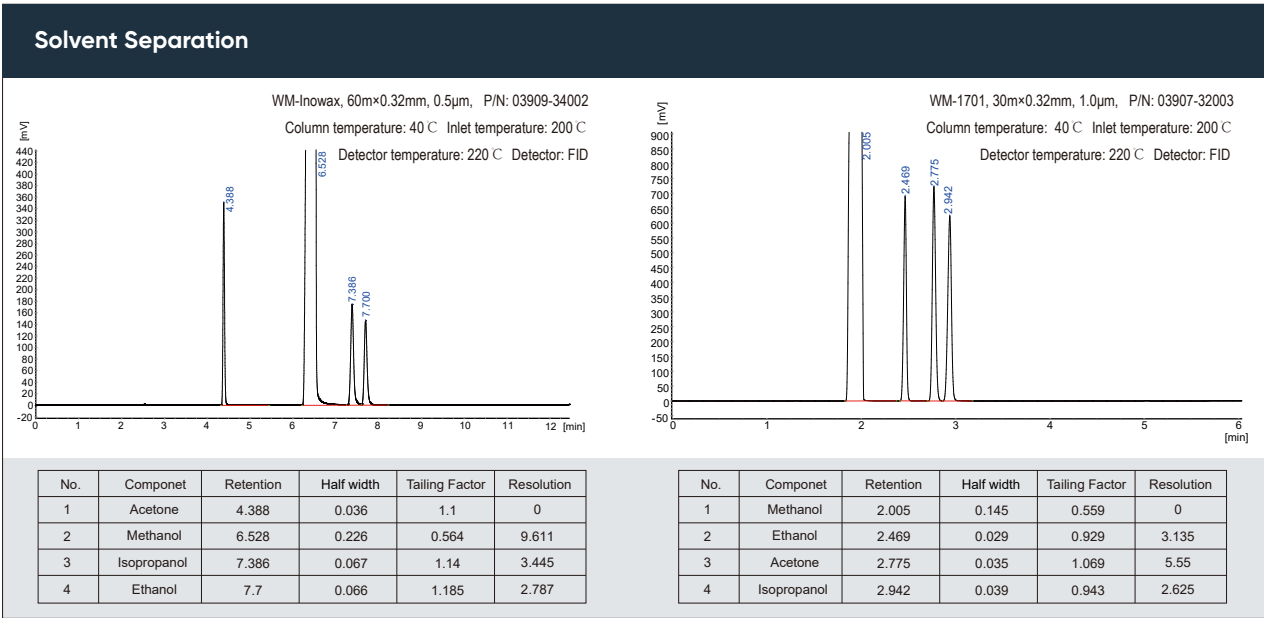
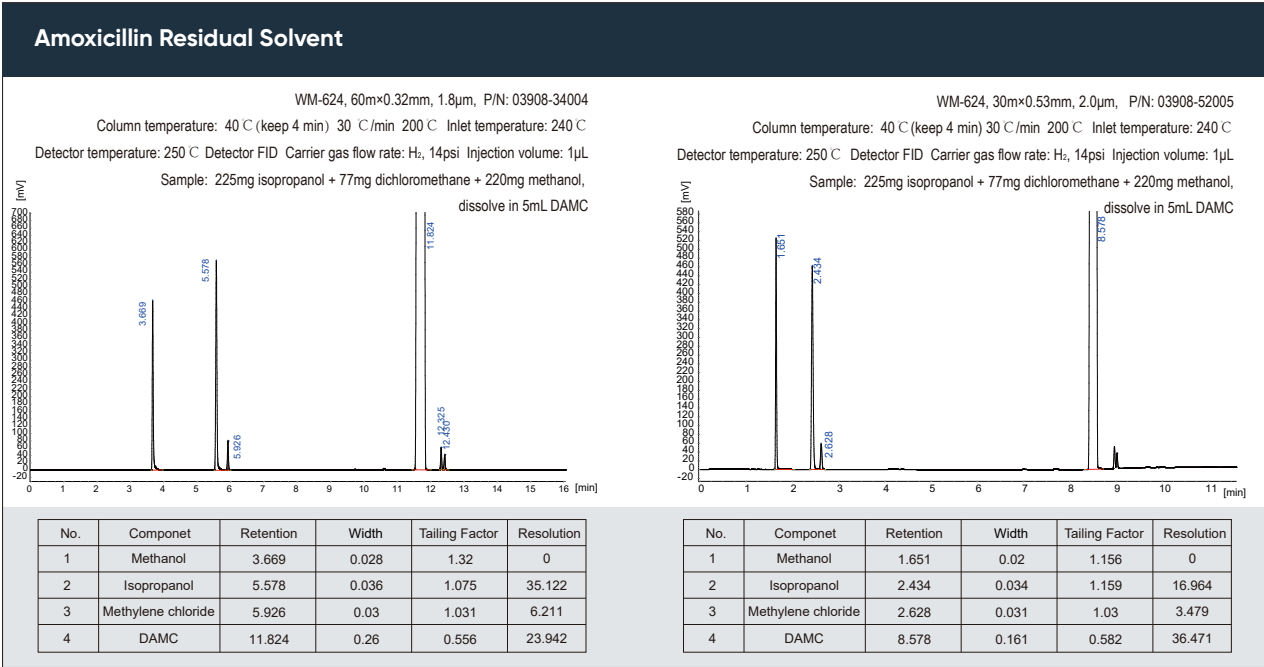
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.493	23616	2.403	27792	
2	Muscone	7.412	783	0.922	59574	75.45



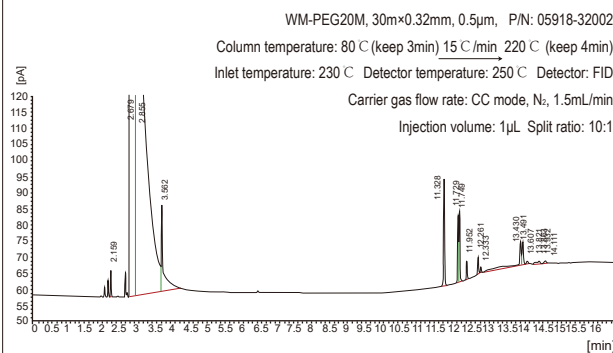
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.247	97561	1.696	45899	
2	Muscone	5.824	425	0.931	63850	79.49



2.6 APPLICATION IN OTHER FIELDS



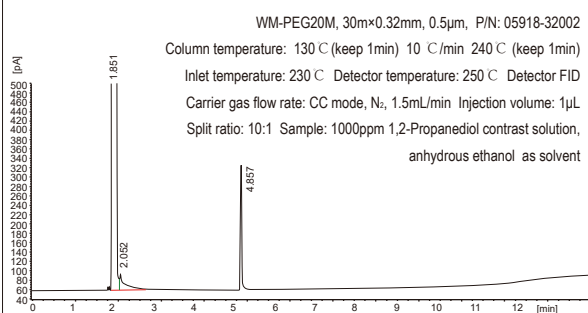
Related Substance of Propanediol



Sample: 12mg/ml Diethylene glycol+242.2mg/ml Dipropylene glycol +68.8mg/ml Tripropylene glycol+8.4mg/ml Epoxy propane contrast solution, anhydrous ethanol as solvent

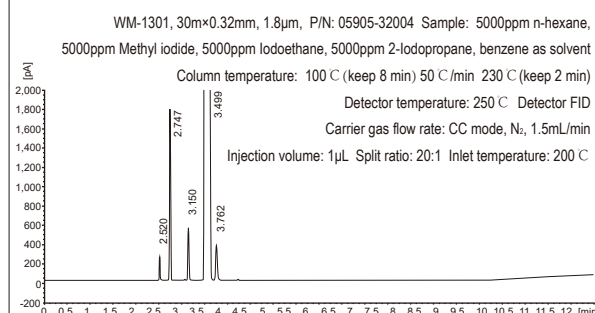
No.	Component	Retention	Area	Tailing Factor	Plates	Resolution
1	Propylene oxide	2.159	8.7	1.148	98077	2.63
2	Anhydrous ethanol	2.679	613153.3	4.373	11402	1.09
3	Anhydrous ethanol	2.855	2025.5	7.041	1086	0.79
4	Impurity	3.562	124.8	3.782	57734	3.49
5	Dipropylene glycol	11.328	62.5	1.016	833078	103.00
6	Dipropylene glycol	11.712	37.6	1.056	992838	7.97
7	Dipropylene glycol	11.749	40.9	0.999	891837	0.78
8	Dipropylene glycol	11.952	10.5	1.027	938722	4.10
9	Dipropylene glycol	12.261	9.9	1.065	1020006	6.33
10	Diethylene glycol	12.333	3.5	0.945	1045708	1.50
11	Tripropylene glycol	13.430	44.9	0.528	506934	17.78
12	Tripropylene glycol	13.491	19.8	1.052	512213	0.81
13	Tripropylene glycol	13.607	3.8	1.027	279177	1.30
14	Tripropylene glycol	13.821	1.2	0.941	651177	2.50
15	Tripropylene glycol	13.863	1.1	1.046	778881	0.64
16	Tripropylene glycol	13.932	2.6	0.832	402300	0.93
17	Tripropylene glycol	14.110	2.3	0.988	577699	2.20

Content of Propanediol



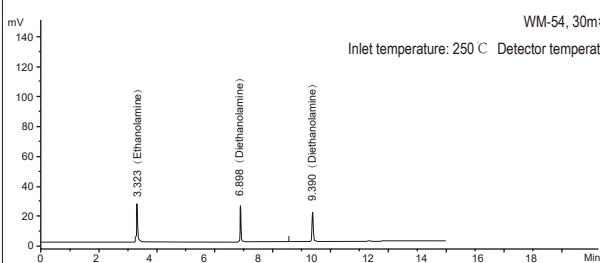
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.851	477568	4.413	5583	0
2	Impurity 1	2.052	302	6.579	4496	1.82
3	Propanediol	4.857	539	1.195	153604	32.71

Methoxy, Ethoxy



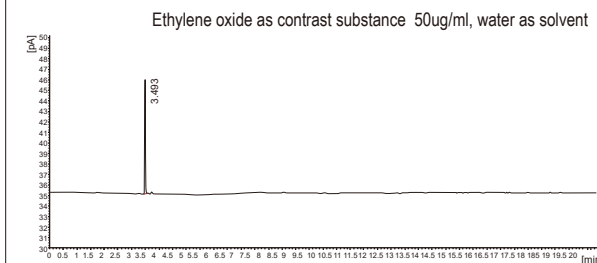
No.	Component	Retention	Area	Tailing Factor	Plates	Resolution
1	Methyl iodide	2.520	297	1.039	95973	0
2	n-hexane	2.747	2674	1.043	75243	6.28
3	iodoethene	3.150	911	1.039	80111	9.54
4	Benzene	3.499	582569	4.557	15313	4.44
5	2-Iodopropane	3.762	973	0.900	45821	2.84

Triethanolamine



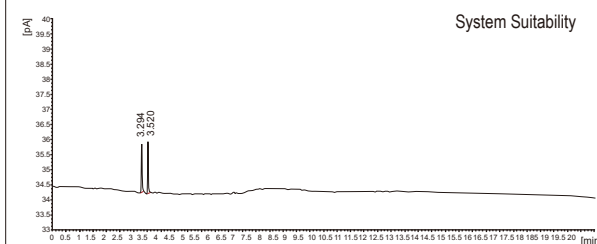
No.	Component	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanolamine	3.323	81480	1.2	38242	0
2	Diethanolamine	6.898	54495	1.2	237269	57.5
3	Triethanolamine	9.390	61107	1.1	209097	36.0

Epoxyethane and Dioxane in Polysorbate 80

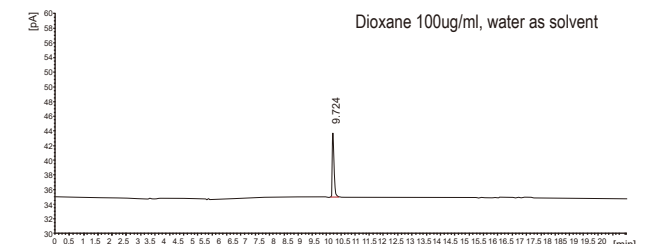


WM-1, 30m×0.53mm, 1.0μm, P/N: 05901-52003 Column temperature: 190 °C
Inlet temperature: 250 °C Detector temperature: 280 °C Detector FID
Carrier gas flow rate: CC mode, N₂, 1.5mL/min Injection volume: 1μL Split ratio: 40:1

No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethylene oxide	3.493	18.6	1.025	99784	0

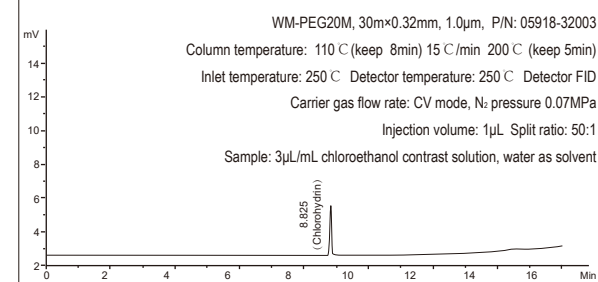


No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Acetaldehyde	3.294	2.8	1.395	97748	0
2	Ethylene oxide	3.520	3.2	1.297	97930	5.197



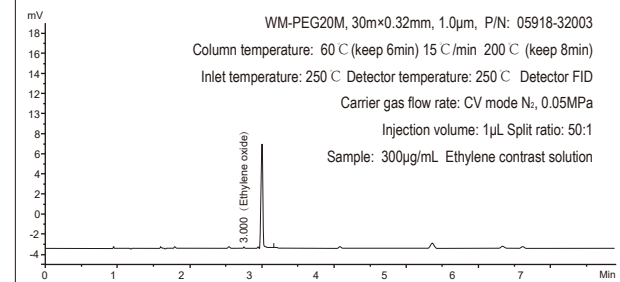
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Dioxane	9.724	38.4	1.400	121054	0

Gelatin Hollow Capsules Containing Chloroethanol



No.	Componet	Rt	Area	Tailing Factor	Plates	Resolution
1	Chlorohydrin	8.825	10674	1.0	134364	0

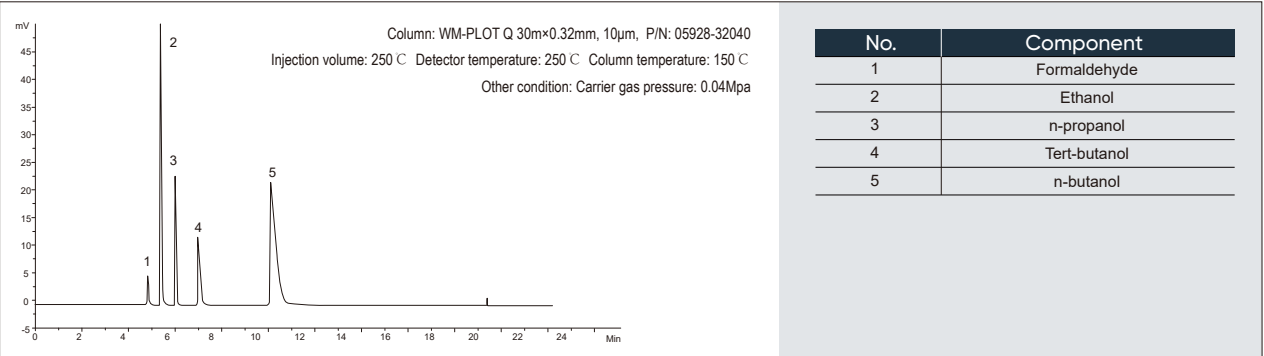
Gelatin Hollow Capsules Containing Ethylene Oxide



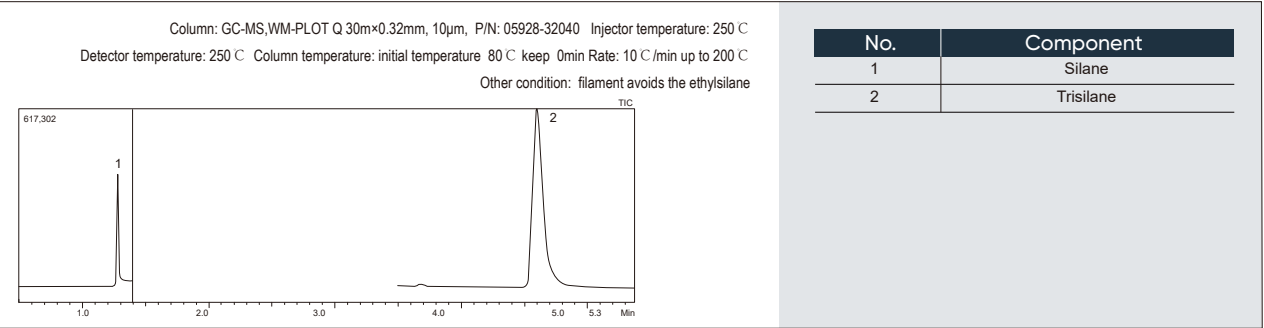
No.	Componet	Rt	Area	Tailing Factor	Plates	Resolution
1	Ethylene oxide	3.000	15185	1.0	91580	0

Analysis of Alcohol in Blood

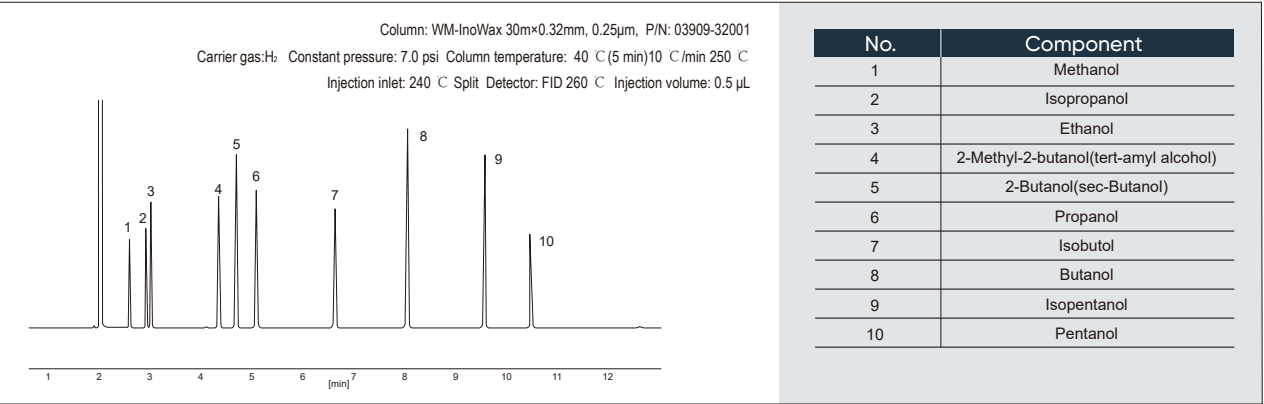
► **Characteritics:** according to the GA/T 842 blood alcohol test method, the capillary column detection of blood alcohol content can also be suitable for the analysis of large amounts of water trace alcohol components.



Analysis of Methylsilane and Propylsilane in Ethylsilane

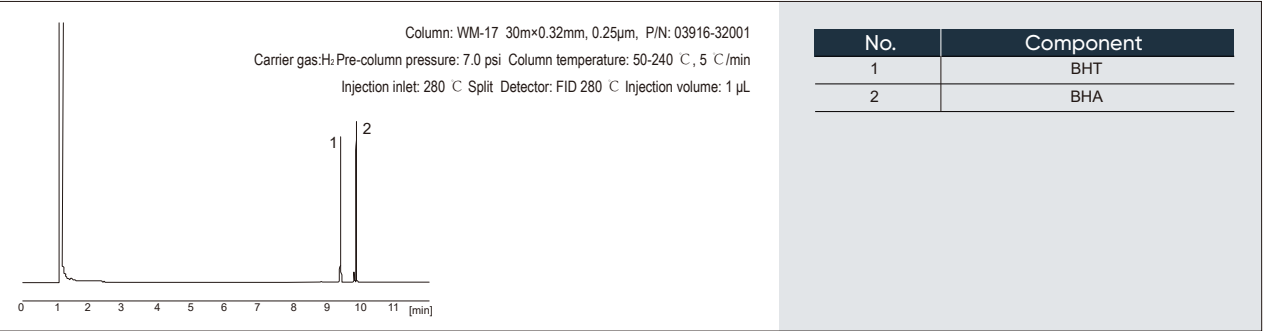


Analysis of Alcohol Compounds

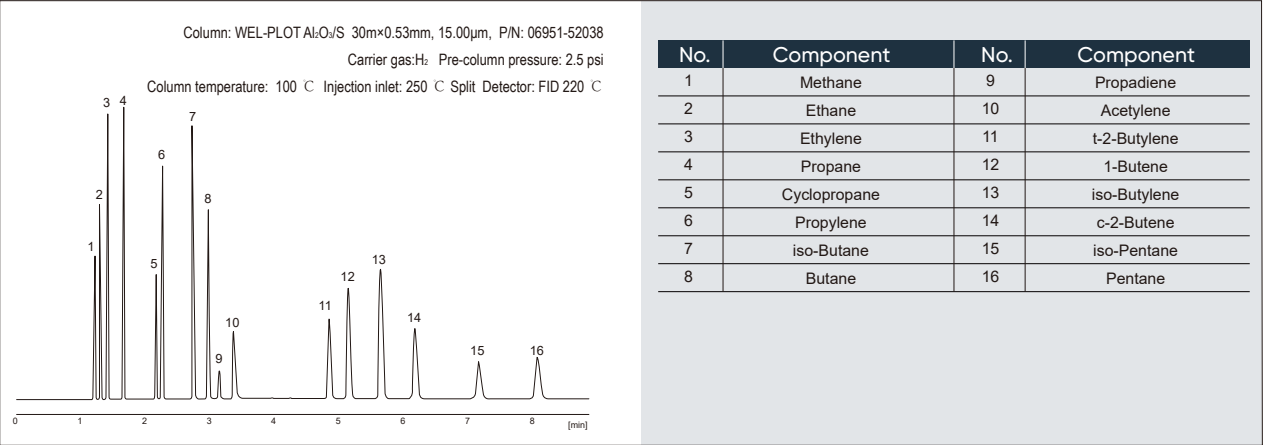


BHA (carcinogen, butylhydroxyanisole) and BHA Determination of BHT (dibutyl hydroxytoluene)

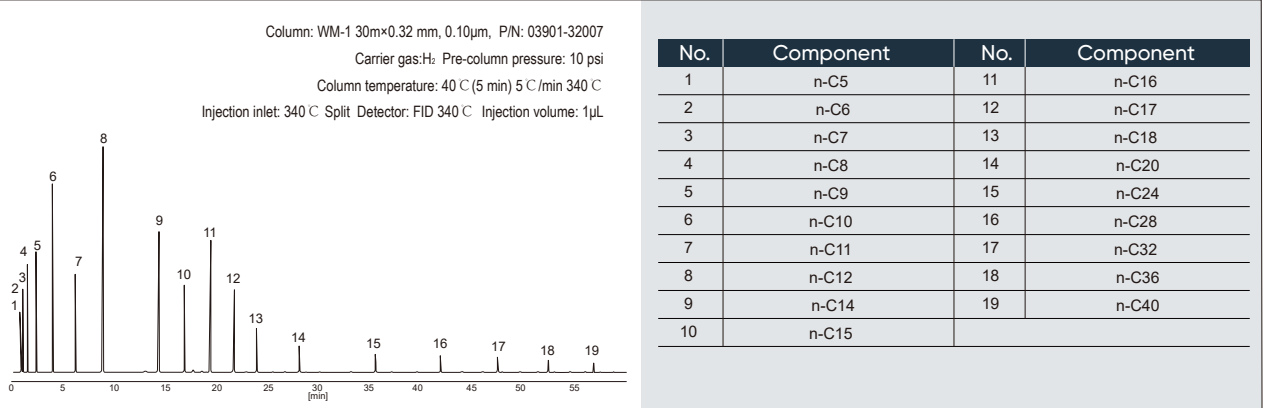
► **Characteritics:** these two compounds have strong antioxidant ability and are often used as preservatives in food



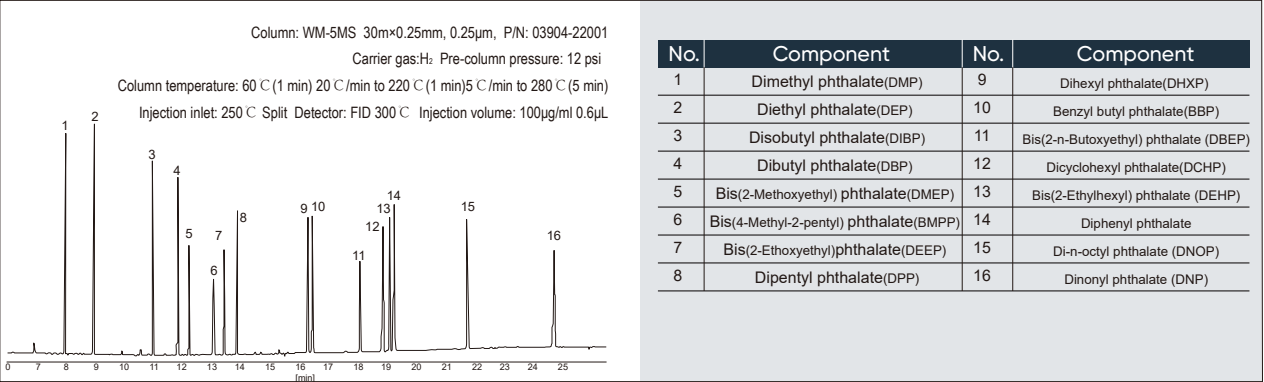
C1-C5 Hydrocarbons (analysis of hydrocarbons)



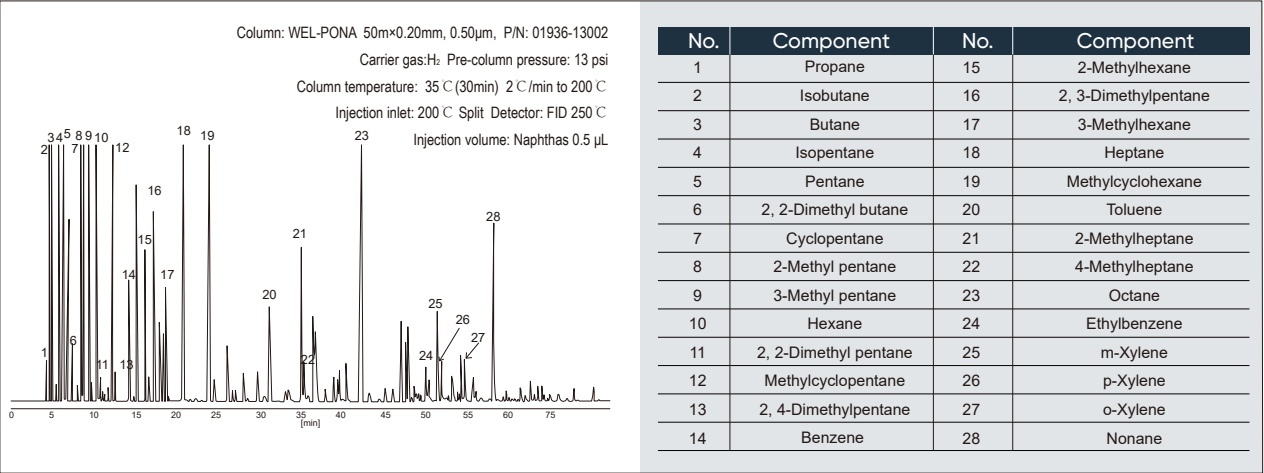
C5-C40 Hydrocarbons (Analysis of Hydrocarbons)



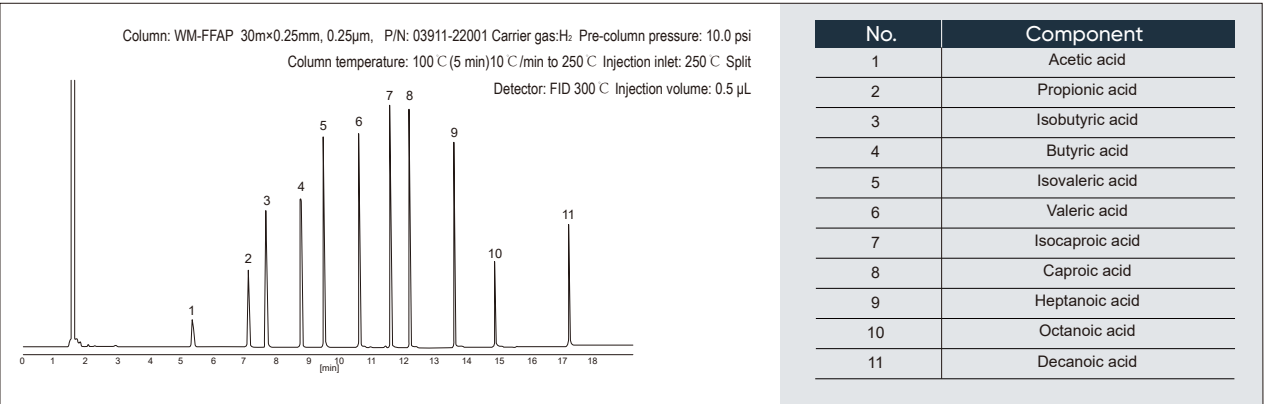
Analysis of Ester Compounds (Dimethyl phthalate, diethyl phthalate, phthalate esters)



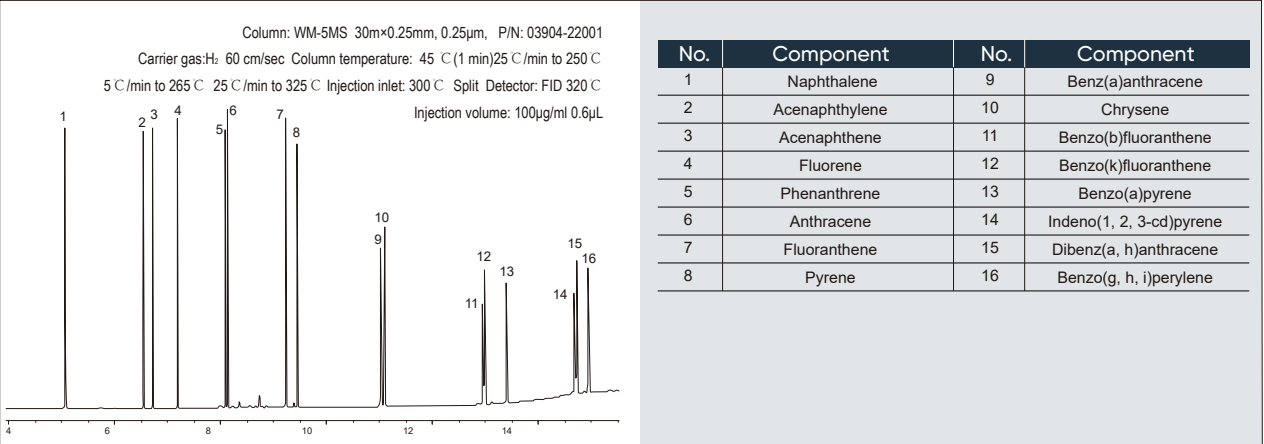
Naphthas Analysis(Petroleum products, chemical light oil hydrocarbon compounds)



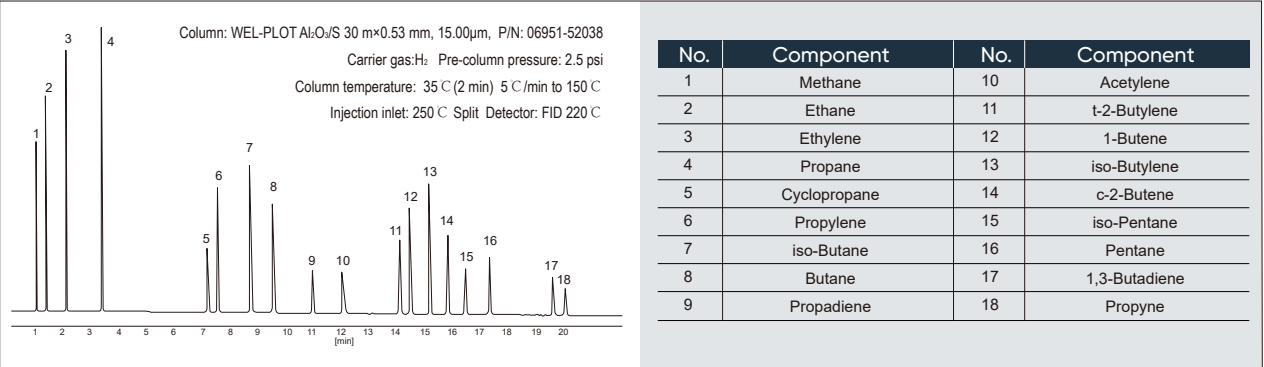
Small Molecular Organic Acids Determination



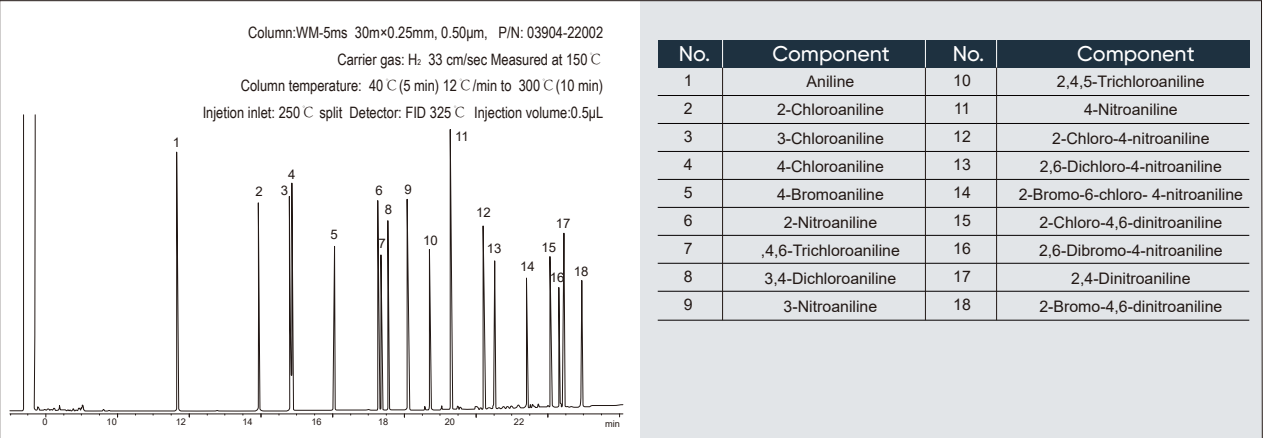
Determination of Polycyclic Aromatic Hydrocarbons (PAHS)



Determination of Refinery Gas



Determination of Substituted Aniline Compounds



03 GC ACCESSORIES

GC ACCESSORIES

3.1 GAS GENERATOR

► **Product description:** gas generator is safe, reliable and easy to operate, if turn on the power, it can produce high purity carrier gas with stable pressure, which is suitable for various GC manufacturers as an ideal substitute for gas cylinder.

P/N	Product	Figure	P/N	Product	Figure
GH-300	High-purity hydrogen generator		NA-300A	Nitrogen, air generator	
GH-500	High-purity hydrogen generator		NA-500A	Nitrogen, air generator	
GH-400	High-purity hydrogen generator		HA-300A	Hydrogen, air generator	
GH-600	High-purity hydrogen generator		HA-500A	Hydrogen, air generator	
GN-300	High-purity hydrogen generator		GX-300A	Nitrogen, hydrogen, air generator	
GN-500	High-purity hydrogen generator		GX-500A	Nitrogen, hydrogen, air generator	
GA-2000A	Low noise air pump				
GA-5000A	Low noise air pump				
GA-3000	Low noise air pump				

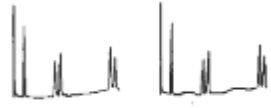
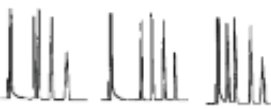
3.2 GC COLUMN ACCESSORIES

Product description: with reliable quality, can match all kinds of gas chromatographs (Agilent, Shimazu, Platinum Elmer, Syme Technology, Brook, etc.) perfectly.

3.2.1 Injection Septa

Septum pollution or loss under high temperature, will lead to ghost peaks; Septa leakage, will lead to increased retention time and detector signal noise, decreased head pressure. It is recommended that the injection septa need to be changed frequently during daily use of the gas chromatograph.

Tab 3.1 Common fault of injection septa and solutions

Phenomenon	Specification
	Extra peak/round peak Possible Reasons: Septa loss Solutions: If the extra peak disappears after closing the injector heater, it is suggested to change to high temperature septa or reduce the inlet temperature for analysis.
	Post-peak baseline variation Possible Reasons: Severe leakage at the septa during the short time after injection, which is usually caused by a larger diameter injection needle Solutions: Change septa and use a smaller diameter injection needle
	Post-peak baseline variation Possible Reasons: Carrier gas leakage occurs at the injector septa or column junction Solutions: Check for leaks, if any, replace the septa, or tighten the column junction
Suggestions for the Maintenance of Injection Septa: ➤ The use temperature of the septa shall not exceed the recommended temperature ➤ Use an autosampler and the septa sweeping function if possible ➤ Check and replace regularly	

3.2.2 Graphite Ferrule

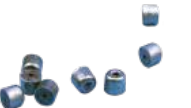
Improper use of sealing ferrule results in inconsistent chromatographic peaks and unreliable analytical results. Specifically, improper sealing ferrule can cause air and other contaminants and into the instrument system, seriously affecting column efficiency and detector performance. For optimal performance, replace the sealing ferrule every time the column is replaced or maintained.

To minimize problems, install the sealing ferrule with the following precautions:

- Don't twist too tight - tighten the column cap by hand, then use a wrench to tighten it further
- Before reusing, check the ferrule for cracks, debris, or other damage with a magnifying glass
- Replace the ferrule when installing a new column or injector/detector component
- Prevent pollution and keep clean

Type	Temperature limit	Usage	Advantage	Limitaion
 Graphite(100%)	450 ℃	• Universal type • Suitable for FID and NPD • Recommended for high temperature and cold columns	• Easy to use, stable seal • Higher temperature upper limit • Easy to remove	• It is not recommended for MS and oxygen sensitive detectors • Soft, easy to deformation or damage
 Vespel/Graphite	400 ℃	• Universal type • It is recommended for MS and oxygen sensitive detectors • The most reliable leak-free connection	• Stable mechanical properties • Long life	• Cannot be reused • It flows at high temperatures • It must be retightened frequently
 100% Vespel	350 ℃	• Constant temp operation • Reusable and easy to remove • It is an excellent sealing material for connecting metal or glass	• Stable mechanical properties • Long lifetime • Reusable and easy to remove	• The program may leak after heating up several times • It's going to run off at high temperatures • It must be retightened frequently

Ordering Information

P/N	Product	Specification	Pack	Picture
00832-00001	Silanized glass wool	Welchrom®, max temp. 400 ℃, 0.5g/pcs	1bag	
00832-00004	Two-way valve	Welchrom®, no variable diameter, 3mm outer diameter (Stainless steel): Suitable for 2mm inner diameter column tube	1pk	
00832-00005	Three-way valve	Welchrom®, no variable diameter, 3mm outer diameter(Stainless steel): Suitable for Suitable for 2mm inner diameter column tube	1pk	
00832-00006	Nut	Welchrom®, 3mm outer diameter (Stainless steel) suitable for 2mm inner diameter column tube	1pk	
00832-00007	Gas path on/off valve	Welchrom®, 3mm outer diameter (Stainless steel)	1pcs	
00832-00008	Graphite ferrule	Welchrom®, max temp: 400 ℃, suitable for column inner diameter: 3mm	1pcs	
00832-00013	Graphite ferrule	Welchrom®, max temp: 400 ℃, suitable for column inner diameter: 2mm	1pcs	
00832-00014	Graphite ferrule	Welchrom®, max temp: 400 ℃, suitable for column inner diameter: 0.53mm	1pcs	
00832-00015	Graphite ferrule	Welchrom®, max temp: 400 ℃, suitable for column inner diameter: 0.32mm	1pcs	
00832-00009	Soap bubble flowmeter	Welchrom®, contains a glass flowmeter, a 50cm hose, a rubber head, 100mL (glass)	1pcs	
00832-00010	Gas pipeline	Welchrom®, outer diameter 3mm, inner diameter 2mm, materials: teflon	1meter	
00832-00011	Deoxidation tube	Welchrom®, color changing type, organic glass material, visible deoxidizing tube, JY-1 model	1pcs	
00832-00012	Gas path purifier	Welchrom®, Packing Type: Color-changing silica gel, activated carbon, molecular sieve; Hydrogen, air, nitrogen three-way purification	1set	

2020 EDITION OF THE 'CHINESE PHARMACOPOEIA'

04 OVERALL SOLUTION FOR PESTICIDE RESIDUE DETECTION

OVERALL SOLUTION FOR PESTICIDE RESIDUE DETECTION

4.1 METHOD A: DETERMINATION OF ORGANOCHLORINE PESTICIDE RESIDUE -CHROMATOGRAPHY METHOD

Determination of 9 Organochlorine Pesticide Residues

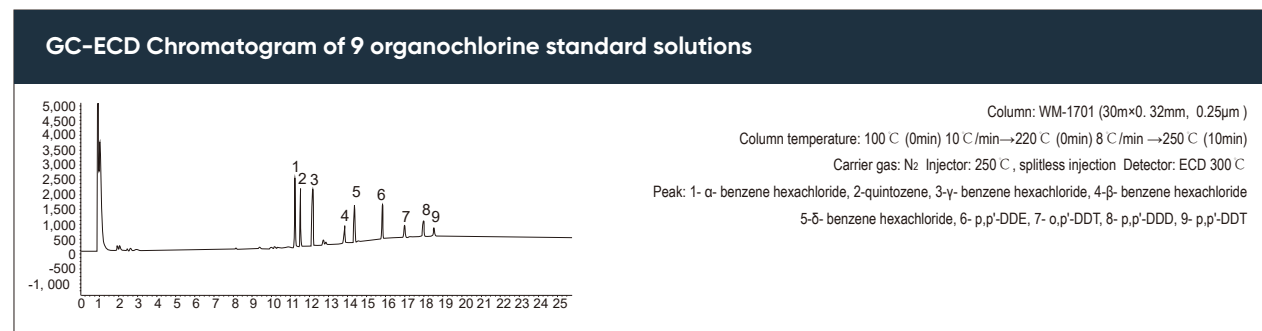
► Method Introduction:

After homogenization, the sample is subjected to extraction with water and acetone, followed by addition of sodium chloride and dichloromethane to achieve phase separation. The organic phase is then concentrated and redissolved in petroleum ether, treated with concentrated sulfuric acid for sulfonation, and then concentrated under reduced pressure. The resulting organic phase is redissolved in petroleum ether for GC-ECD analysis and determination.

► Sample Preparation:



► GC Chromatographic Condition:



► Related Products

P/N	Product	Specification
03907-32001	WM-1701 GC Column	WM-1701 30m×0.32mm×0.25μm
03902-32001	WM-5 GC Column	WM-5 30m×0.32mm×0.25μm

Determination of 22 Organochlorine Pesticide Residues

► Method Introduction:

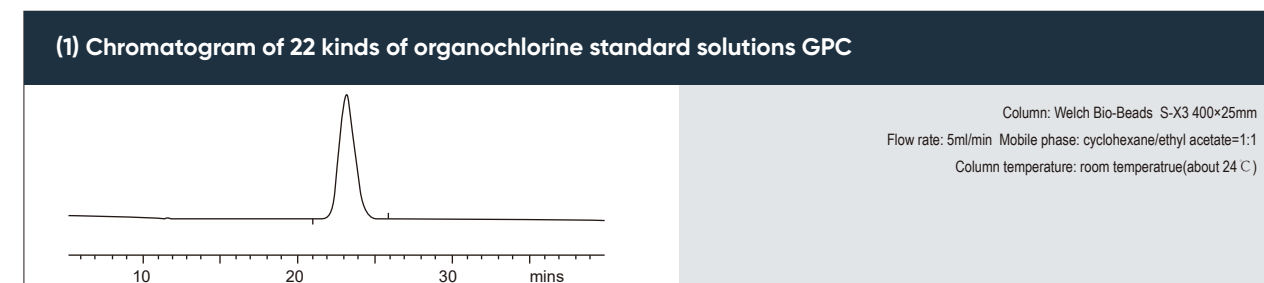
After homogenization, the sample is extracted with water and acetonitrile, followed by the addition of a QuEChERS extraction bag to induce phase separation. The acetonitrile phase is then concentrated and redissolved in a solution of cyclohexane and ethyl acetate (1:1). After purification by gel chromatography and further purification using Florisil SPE cartridge, the purified sample is concentrated under reduced pressure and redissolved in isooctane for GC-ECD analysis and determination.

► Sample Preparation:

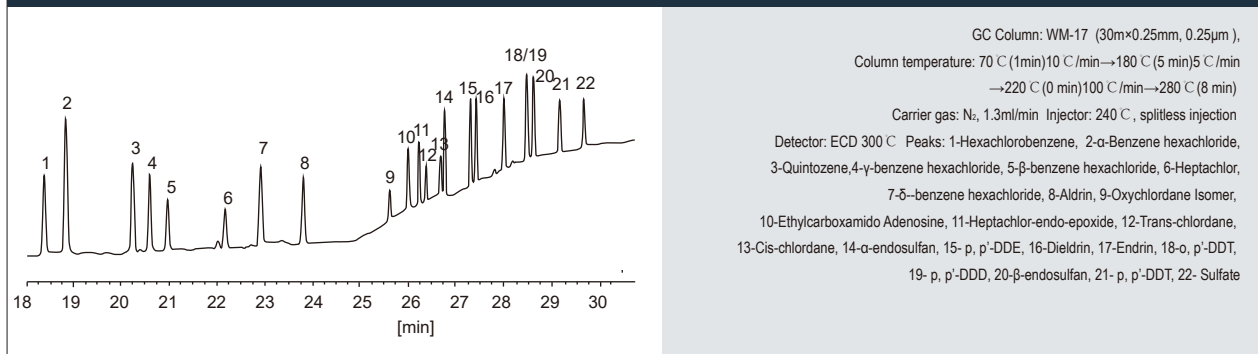


Note: The boiling range of petroleum ether used in this experiment is 60-90 °C

► Chromatographic Analysis:



(2) Chromatogram of 22 kinds of organochlorine standard solutions GC-ECD



► Related Products

P/N	Product	Specification
03916-32001	WM-17 GC Column(Analysis column)	WM-1701 30m×0.32mm×0.25μm
01901-22001	WEL-1 GC Column (Verification column)	WM-5 30m×0.32mm×0.25μm
00530-20000	QuEChERS Extraction Bag	QuEChERS extraction bag, original method (without buffer salt) 4g magnesium sulphate, 1g NaCl, 10g samples, 50pcs/box
00516-20007	Welchrom® SPE Column	Welchrom®, Florisil PR,1g/6mL, 30pk
00823-00002	GPC Column	Welch Bio-Beads S-X3, 200-400 mesh, 400mm×25mm

*Variety of specifications, welcome to consult

4.2 METHOD B: DETERMINATION OF ORGANOPHOSPHORUS PESTICIDE RESIDUES-CHROMATOGRAPHIC METHOD

► Method Introduction:

After homogenization, the sample is subjected to ultrasonic extraction in an ice bath using ethyl acetate. Following vacuum concentration, purification is conducted using a graphitized carbon SPE cartridge. The concentrated eluate is then redissolved and made up to volume using ethyl acetate for GC-NPD/FPD analysis.

► Sample Preparation:



► Related Products

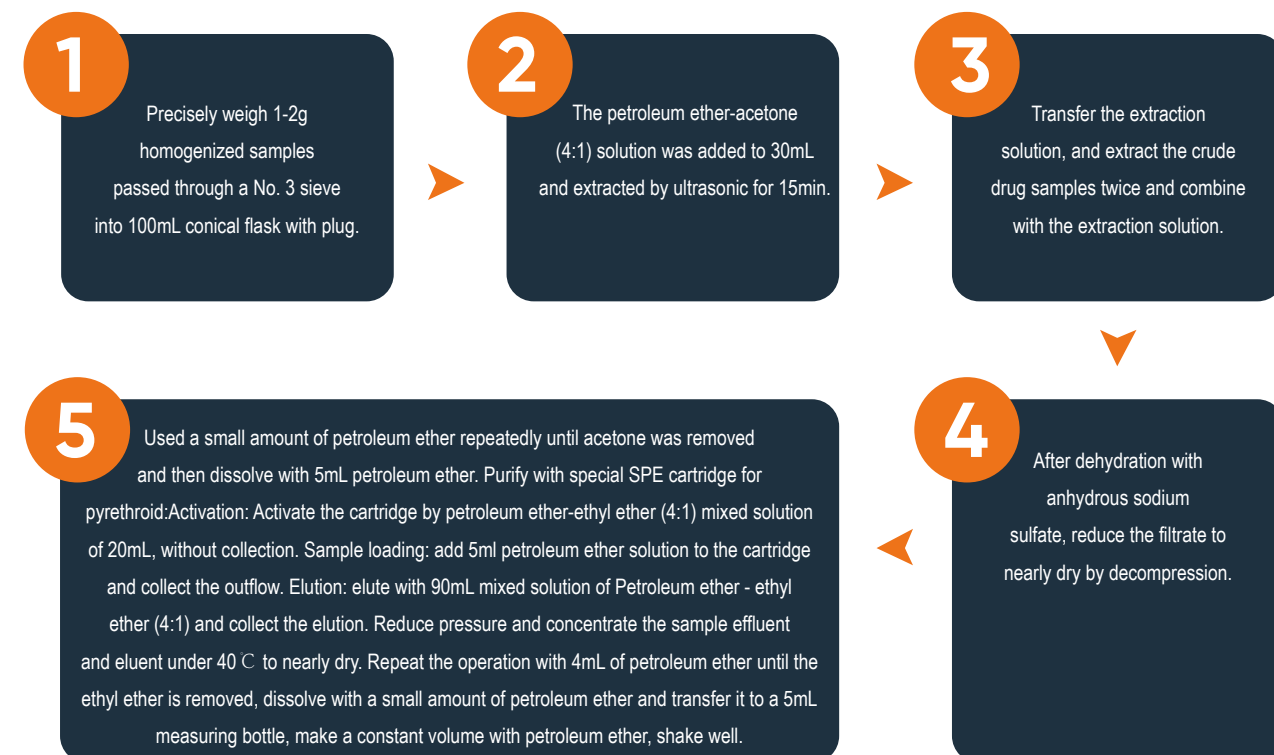
P/N	Product	Specification
03916-22001	WM-17 GC column	WM-17 30m×0.25mm×0.25μm
03902-22001	WM-5 GC column	WM-5 30m×0.25mm×0.25μm
00551-20000	QuEChERS Extraction Bag	QuEChERS extraction bag, 5.0g anhydrous sodium sulfate, 50 pcs/box
00517-20012	Welchrom® SPE Cartridge	Welchrom® Carb, 250mg/3mL, 50pk

4.3 METHOD C: DETERMINATION OF PYRETHROID PESTICIDE RESIDUES - CHROMATOGRAPHIC METHOD

► Method Introduction:

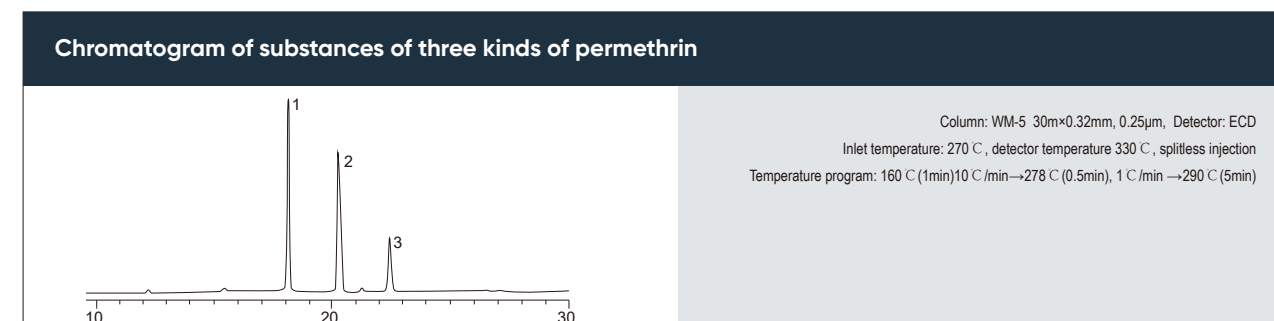
After homogenization, the sample is subjected to ultrasonic extraction using a mixture of petroleum ether and acetone. Following dehydration with anhydrous sodium sulfate, it is concentrated under reduced pressure. Subsequently, purification is carried out using a specialized SPE cartridge for pyrethroid pesticides, followed by concentration and redissolving in petroleum ether for GC-ECD analysis

► Sample Preparation:



Note: The boiling range of petroleum ether used in this experiment is 60-90 °C

► Chromatographic Analysis:



► Related Products

P/N	Product	Specification
03902-32001	WM-5 GC column	WM-5 30m×0.32mm×0.25μm

4.4 METHOD D: DETERMINATION OF MULTIPLE PESTICIDE RESIDUES -MS METHOD

► Method Introduction:

After homogenization, the sample is soaked in a 1% acetic acid aqueous solution and then extracted with acetonitrile. Addition of a QuEChERS extraction bag induces phase separation, followed by centrifugation to collect the supernatant. The supernatant is then purified using QuEChERS Clean-up tubes, concentrated, and made up to volume. Finally, it is supplied for analysis either by gas chromatography tandem mass spectrometry (GC-MS/MS) or liquid chromatography tandem mass spectrometry (LC-MS/MS).

► Sample Preparation:



► Related Products

P/N	Product	Specification
03904-22001	WM-5MS GC Column (1.GC-MS/MS)	WM-5MS 30m×0.25mm, 0.25µm
960-04023	Boltimate®, C18 Column (2.LC-MS/MS)	Boltimate®, C18, 2.7µm, 90Å, 3.0×150mm
00528-20000	QuEChERS Extraction Bag	QuEChERS extraction bag, AOAC method, 6g magnesium sulfate, 1.5g sodium acetate, 50 pcs/box
00581-20021	QuEChERS Clean-up Tube	QuEChERS Clean-up tube-15mL, 900mg MgSO ₄ , 300mg PSA, 300mg C18E, 300mg Silica, 90mg GCB, 50pcs/box

4.5 METHOD E: DETERMINATION OF PESTICIDE RESIDUE-MS METHOD

► Extration Steps

Weigh 5g of the sample and add 1g of sodium chloride, then immediately shake to disperse. Next, add 50mL of acetonitrile and homogenize the mixture. Centrifuge for 5minutes at 4000rpm and collect the supernatant. Repeat the process with an additional 50mL of acetonitrile on the precipitate, centrifuge again for 5 minutes at 4000rpm, and collect the supernatant. Combine the supernatants from both centrifugations. Concentrate the combined supernatants in a 40°C water bath to 3–5mL, then dilute with acetonitrile to 10mL. Shake well and set aside for further use.

► Celanup Steps

1

Method 1

Welchrom® QuEChERS: 1200mg of anhydrous magnesium sulfate, 300mg of primary secondary amine (PSA), and 100mg of C18E bonded silica gel. Take 3mL of the sample solution prepared by direct extraction method and place it in a centrifuge tube. Vortex thoroughly to mix well and then centrifuge for 5minutes at 4000rpm. Finally, collect the supernatant for further analysis.

2

Method 2

Welch Welchrom® BRP SPE, 200mg/6mL. Directly load 3mL of the sample solution prepared by the direct extraction method onto the SPE cartridge. Collect all eluates after purification through the column, mix well, and the sample is ready for further analysis.

3

Method 3

Welch Welchrom® Carb/NH₂, 250mg/250mg/6mL Activation: Pass 10mL of acetonitrile-toluene (3:1) through the cartridge and discard. Sample Loading: Directly load 2mL of the sample solution prepared by the direct extraction method onto the SPE cartridge. Collect the eluate in a vial. Washing: Wash the cartridge with 20mL of acetonitrile-toluene (3:1). Dry the cartridge and collect the eluate in a vial. Redissolution: Evaporate the collected eluat to dryness using a 40°C water bath. Transfer the dried residue with acetonitrile and dilute to 2mL. Your sample is now ready.

Accurately pipette 1 mL of the prepared matrix control solution and 1mL of the sample solution into separate containers. Add 0.3mL of internal standard to each container and mix thoroughly. Filter the mixture and collect the filtrate for further analysis. Analyze the filtrate using the chosen detection method. Calculate the concentration of the analyte in the sample using the internal standard calibration curve method.

► Related Products

P/N	Product	Specification
00522-20014	SPE Column	Welchrom®, BRP, 200mg/6mL, 30pk
00527-20010	SPE Column	Welchrom®, Carb/NH ₂ , 250mg/250mg/6mL, 30pk
005PM-077-50	QuEChERS	QuEChERS clean-up tubes-15ml, 1200mg MgSO ₄ , 300mg PSA, 100mg C18E, 50 pcs/box
00837-05006	Centrifuge Tube	Welchrom®, centrifuge tube, disposable centrifugal tube, flat cap, conial, RCF12000xg, bag packing, without sterilization, 50mL, 50/pcs
00837-05002	Centrifuge Tube	Welchrom®, centrifuge tube, centrifuge tube, flat cap, RCF12000xg, bag packing, without sterilization, 15mL, 50/pcs
00824-31001	SPE Manifold	Welch SPE Manifold, 12 port
00821-32291	Caps and Septa	Pre-slit white PTFE/white silicone septa, 9mm blue short screw-thread cap, 100/pk
00821-40927	Sample Vial	Welchrom®, 2mL wide opening short screw-thread vial, clear, 11.6×32mm, 100/pk
03916-22001	GC Column	WM-17, 30m×0.25mm×0.25µm



05 TECHNICAL REFERENCE

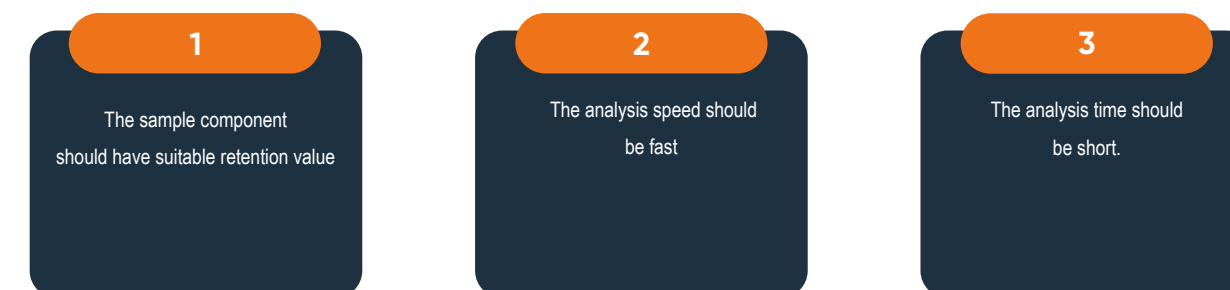
TECHNICAL REFERENCE

5.1 SELECTION OF GC COLUMN

- In actual work, if the separated component has enough thermal stability and volatility, GC separation mode should be considered first during analysis. Compared with LC, GC has advantages as follows: faster analysis speed, great repeatability, lower cost, and its column efficiency usually has a higher order of magnitude.

► How to Select Correct Capillary Column

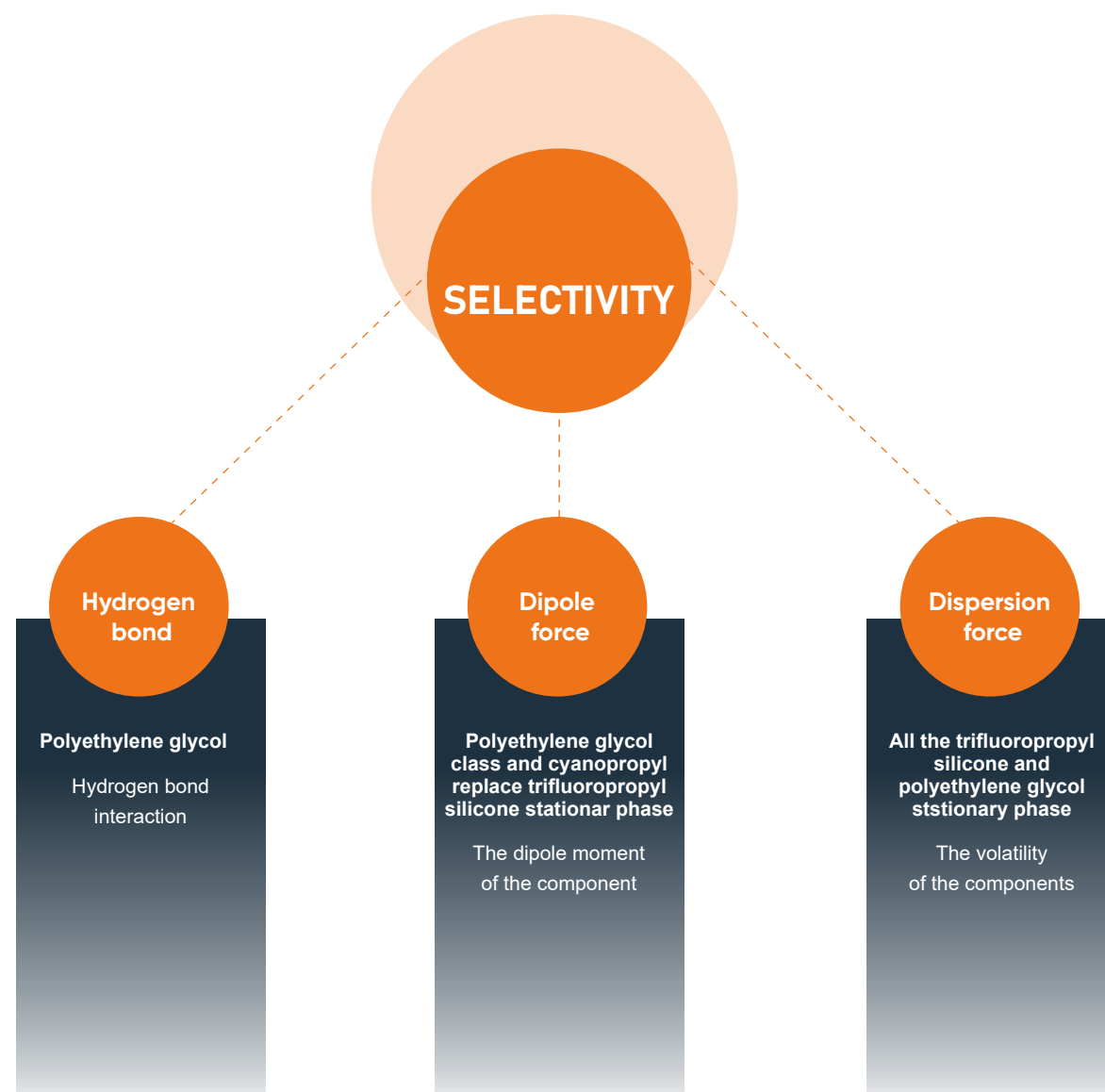
For separation problem of a kind of sample, selecting a suitable capillary column is a very important task, which concerns a series of principles. In general, this selection principles are around three requirements as follows:



*According to GC basic principles and actual requirements, we need to consider several main influencing factors, such as stationary phase, inner diameter of column, column length and film thickness.

5.1.1 Selection of Stationary Phase

- Stationary phase of polydimethylsiloxane has high thermal stability and it keeps liquid state from -60 °C to 350 °C, which has wide application range among GC. When other groups, such as -CN or phenyl, replace the alkyl of siloxane, the polarity of the stationary phase will change and columns with polarity and selectivity appear.
- Polyethylene glycol (PEG) is another widely used stationary phase with polarity, among which PEG 20M (WM is about 20,000) is the most popular one. The hydroxyl groups of polyethylene glycol chain react with various functional groups, which can change the selectivity and improve the thermal stability of stationary phase. FFAP, for example, is to connect O-nitroterephthalic acid at the end of the PEG. The stationary phase has weak acidity, suitable for separating neutral and acidic compounds, and the thermal stability of the stationary phase can be increased to 250 °C.



► The selectivity and polarity of stationary phase should be considered, because selectivity is the ability of a stationary phase to distinguish between two component properties (chemical or physical), while polarity depends on the structure of the stationary phase. The selectivity is shown in the following Figure and Table 5.1, and the polarity is shown in Table 5.2.

Tab 5.1 Selectivity of Stationary Phase

Fuctional group	Dispersion force	Dipole force	Hydrogen bond
Methyl group	Strong	No	No
Phenyl group	Strong	No or weak	Weak
Cyanopropyl	Strong	Very strong	Medium
Propyl three fluorine	Strong	Medium	Weak
Polyethylene glycol	Strong	Strong	Medium

Tab 5.2 Polarity of Stationary Phase

Fuctional group			Moderate polarity			Strong polarity
WEL-1	WEL-5	WEL-35	WEL-1301	WEL-1701	WEL-225	WEL-WAX
WEL-101	WEL-52	WM-35	WEL-624	WM-1701	WM-225	WEL-PEG 20M
WEL-30	WEL-54	WEL-17	WM-1301		WEL-930	WEL-INOWAX
WM-1	WM-5	WEL-XE60	WM-624			WEL-FFAP
WM-1MS	WM-5MS	WM-17				WM-INOWAX
WEL-PONA						WM-FFAP

Summary of Stationary Phase Selection:

Summary 1

Non-polar stationary phase has a longer lifetime than polar stationary phase. If the resolution and analysis time meet the requirements, choose the stationary phase with small polarity as far as possible.

Summary 2

The typically chosen stationary phase is one that matches the polarity of the components being separated, but polarity is just one of the factors influencing separation.

Summary 3

If you do not know which stationary phase to choose and have no information to refer to, you can start testing from WEL-1 or WEL-5.

► 5.1.2 GC Column Inner Diameter

The inner diameter of a GC column is an important factor affecting column efficiency, retention, column pressure, and column capacity.

- Column efficiency (N/m) is inversely proportional to the inner diameter of the GC column. Separation factor is a square root function of column efficiency. In theory, doubling the column efficiency increases the separation factor by 1.41 times. Therefore, to achieve high column efficiency and separation factor, it is advisable to use chromatography columns with smaller diameters.
- Keeping the temperature constant, smaller inner diameters of GC columns result in less retention of components.
- The column head pressure of a GC column is highly sensitive to changes in the column's inner diameter, approximately following a negative quadratic function. As the inner diameter of the GC column decreases, the column head pressure sharply increases.

Tab 5.3 Column Capacity (ng)

In general, as the diameter of column increases, the capacity of column will increase. The typical column capacity of various columns is shown in Table 5.3.

Column inner diameter (mm)	Film thickness (μm)					
	0.10	0.25	0.50	1.00	3.00	5.00
0.18-0.20	20-35	35-75	75-150	150-250		
0.25	25-50	50-100	100-200	200-300	400-600	1000-1500
0.32	35-75	75-125	125-250	250-500	500-800	1200-2000
0.53	50-100	100-250	250-500	500-1000	1000-2000	2000-3000

Summary of Column Inner Diameter Selection:

- Column with inner diameter of 0.18-0.25mm has high column efficiency. The column with smaller inner diameter has smaller column capacity and larger column head pressure.
- Column with inner diameter of 0.32mm has large sample capacity. For large volume injection or earlier outflow of components of splitless injection, it has better degree of separation.
- A column of 0.45mm inner diameter is especially suitable for high carrier gas flow rate, such as sweep traps, headspace injectors and valve injection applications.
- A column of 0.53mm inner diameter, which is suitable for the situation where equipped with a large-caliber direct sampler. It integrates advantages of sample capacity, column efficiency and injection on the needle, and is increasingly replacing the GC packed column.

5.1.3 Selection of Column Length:

Column efficiency (N/m) is proportional to column length. The resolution is the square root function of the column efficiency. Theoretically, if the column length is doubled, the resolution will increase to 1.41 times. However, with the increase of column length and the extension of analysis time, the loss of column will also increase. The cost of column is doubled with the doubling of column length, so increasing column length is the last consideration when increasing column efficiency.

Summary 1

25-30m columns are more commonly used and generally available.

Summary 2

10-15m column, especially suitable for the separation of samples containing fewer or easily separated components.

Summary 3

50-60m column, suitable for the separation of complex samples containing multiple components.

5.1.4 Selection of Column Thickness

Summary 1

For columns with inner diameter of 0.18-0.32mm and film thickness of 0.18-0.25μm, suitable for most analyses.

Summary 2

For columns with inner diameter of 0.45-0.53mm and film thickness of 0.8-1.5μm, suitable for most analyses.

Summary 3

Thick film column is suitable for separation of volatile components. Thin film column is suitable for the analysis of components with high molecular weight and high boiling point.

5.2 INSTALLATION OF GC COLUMN

The installation of column directly affects the analysis effect and the lifetime of column, so it is crucial to connect column with injection inlet and detector accurately. Installation steps of capillary column are as follows:

1 Preparations before installing

Check the carrier gas and gas filter to ensure the use of auxiliary gas and detector gas; check whether the column is damaged or broken; check the inlet, clean or replace the injection pad and the injection port liner.

2 Cutting columns

Secure the nut and ferrule onto one end of the capillary column, then cut the capillary column end flat. **Cutting the capillary column:** First, use your fingers to hold the part of the capillary column that needs to be cut, and mark the outer wall of the capillary column with the appropriate cutting tool. Then, hold the column about 1-2 cm away from the mark with both hands, pull and bend the column outward. Finally, use a magnifying glass to inspect and ensure that the cut end of the column is perpendicular to the tube wall, without burrs or residual debris.

3 Connecting the GC column to the injection port

Typically, the top of the GC column should be positioned in the middle or lower part of the injection port liner. Ideally, when the injection needle is inserted into the injection port after passing through the septum, the distance between the needle tip and the top of the GC column should be 1-2 cm. Installation of the connecting nut: After inserting the GC column into the injection port, tighten the connecting nut by hand. If it cannot be tightened by hand, use a wrench to tighten it for 1/4 to 1/2 turn to ensure a tight seal.

4 Connecting the carrier gas

After connecting the GC column to the injection port, it is necessary to connect the carrier gas and then adjust the front pressure of the column to obtain the appropriate carrier gas flow rate. The relationship between front pressure and column length and inner diameter is shown in Table 5.4.

Insert the other end of the GC column into a sample bottle containing hexane. When the carrier gas is connected, stable and continuous bubbles appear in the bottle, indicating normal connection. Otherwise, the carrier gas device, flow control device, and gas path tightness need to be checked again. After the problem is solved, remove the GC column from the sample bottle, wipe it until there is no solvent residue at the GC column outlet, and prepare for the next installation.

Note: When hydrogen is used as the carrier gas, safety must be ensured. When the content of hydrogen in the air reaches 4%-10%, there is a risk of explosion, so the diffusion of gas should be accelerated.

5 Connecting the GC column to the detector

The connection between the GC column and the detector is similar to step (3).

Note: When the detector is ECD or NPD, in order to allow the detector to stabilize in a shorter time, do not connect it to the detector when aging the GC column.

6 Gas leak detection

Before heating the GC column, the gas phase system must be checked for leaks. An electronic leak detector is one of the most convenient and efficient methods for checking carrier gas leaks at the injection port and detector. Note: It is better not to use soap bubbles such as Snoop for carrier gas leak detection at the injection port and detector to avoid contamination or damage to the system.

7 Determine the carrier gas flow rate and check the installation of the GC column

After installing the GC column, adjust the carrier gas flow rate or verify whether the installation of the injection port and detector is correct by analyzing the chromatogram of non-retained compounds. Common non-retained compounds are listed in Table 5.5.

8 Aging and testing of GC column

Set the temperature of the column oven to the highest operating temperature or 20°C higher than the highest analysis temperature (whichever is lower), and age the GC column for 2-3 hours at this temperature.

Under normal circumstances, during the initial stage, the baseline shows a continuous upward trend. After reaching the aging temperature for 5-10 minutes, the baseline begins to decrease, lasting approximately 30-90 minutes. Finally, the baseline stabilizes.

Test the carrier gas flow rate again by using a sample of non-retained compounds to confirm.

Tab 5.4 Similar Column Pre-Pressure(Psig)

Inner diameter (mm)	Column length (m)				
	15	20/30	50/60	75	105
0.25	8-12	15-25	30-45		
0.32	5-10	10-20	20-30		
0.53	1-2	2-4	4-8	5-10	7-15

Tab 5.5 Common Non-Retention Compounds(Psig)

Detector	Compound
FID	Methane, butane
TCD	Methane, butane, argon, air
ECD	Methylene chloride, SF6, CF2Cl2
NPD	Acetonitrile
PID	acetylene, ethylene
MS	Methane, butane, argon, air



5.3 GC COLUMN TROUBLESHOOTING

5.3.1 Reasons for the Degradation of GC Column Performance

(1) Fracture of Column

For the GC capillary column, the polyimide coating can protect the elastic fused quartz tube, and the column rarely breaks naturally. Attention should be paid to avoid the label of column, metal edge in column oven and other articles with sharp edge scratching polyimide coating, resulting in the phenomenon of column fracture. Moreover, the 0.45-0.53 mm column tube is more prone to fracture than the inner diameter 0.18-0.32 mm column tube.

(2) Heat Damage

When the analytical temperature is higher than the maximum operating temperature, the stationary phase and the inner surface of the column tube will be damaged, resulting in the loss of the column, the decline of the column efficiency and the deterioration of the peak type. Thermal damage is a slow process, only if column operates upper limit is temperature for a long time, will obvious damage occur. However, in the presence of high concentration of oxygen, the overheating of the column will cause rapid and permanent damage to the column.

(3) Oxygen Damage

For most capillary columns, oxygen is a nuisance. Under the condition of oxygen, the stationary phase degrades rapidly with the increase of column temperature, resulting in column loss, column efficiency decrease and peak type variation. Compared with the thermal damage of the column, the column has been seriously damaged when oxygen damage is found. Especially for polar capillary column, the temperature and oxygen concentration which can cause serious damage to column are very low.

(4) Chemical damage

The compounds that produce chemical damage to the column are mainly inorganic or mineral acids and mineral bases. Acids include hydrochloric acid (HCl), sulfuric acid (H₂SO₄), nitric acid (HNO₃), phosphoric acid (H₃PO₄) and chromic acid (CrO₃). Bases include potassium hydroxide (KOH), sodium hydroxide (NaOH) and ammonium hydroxide (NH₄OH). They are less volatile, easy to remain at the front of the column. If you don't clear them in time, they will damage the stationary phase, resulting in column loss, reduced column efficiency and poor peak type. Among them, hydrochloric acid and ammonium hydroxide do least damage to stationary phase. The damage of the two substances to the column is often accompanied by the existence of water. These two kinds of damage often occur with the water in the sample. The retention time of HCl and NH₄OH in the column will be very short and the damage to the column will be weakened if the column has little or no retention of water under certain conditions.

Only compounds such as perfluorinated acids, including trifluoroacetic acid, pentafluoropropionic acid and heptafluorobutyric acid, have been reported to produce chemical damage to columns. A concentration of 1% or more of these substances can damage the stationary phase of the column. Most of the problems occur in direct injection of non-shunt or large diameter columns. Chemical damage is often limited to the front end of the column, cut off the front end of the column of 0.5-1 m and eliminate chromatographic problems. In more serious cases, it may be necessary to intercept longer columns. Using pre-columns or retaining gap tubes can minimize chemical damage to columns, but regular replacement of pre-columns is required.

(5) Contaminated Column

Column contamination is also a common problem in GC analysis. The pollutants in the column are divided into two categories: non-volatile and semi-volatile. The nonvolatile remains in the column and is distributed on the inner surface of the column, affecting the distribution of the components in the stationary phase. In addition, the nonvolatile also interacts with the active components (compounds containing hydroxyl, amino, mercapto or aldehyde groups), resulting in the α -type tailing of the active components and the decrease of the responder. Then semi-volatile contaminants will accumulate in the chromatography, causing peak type, response intensity, and baseline.

There are many sources of column pollution, and samples are the most common and direct source. such as biological fluids, soil, wastewater and groundwater, all contain large amounts of nonvolatile and semi-volatile components. The semi-volatile and non-volatile components in the sample are more easily accumulated in the column, resulting in column contamination.

Complete sample purification is the best way to prevent contamination, and the use of protective or protective clearance tubes can reduce the degree of contamination.



5.3.2 Troubleshooting

Problem 1: Tailing Peak and Solutions

1. Injector liner pollution: clean liner, or remove 1~2 laps of the column inlet to use.
2. Temperature of column or injector temperature is too low: rise temperature (do not exceed maximum temperature).
3. Overload caused by the too large injection volume: adjust the tailing blowing flow and split ratio.
4. Co-elution of two compounds: reduce the rate of rising column temperature and increase the resolution. Improve the sensitivity and reduce the injection volume.
5. Column damage: replace column
6. Column pollution: remove 1~2 laps from the inlet end of the column and reinstall; if it does not work, aging columns is required; furthermore, the clean column with solvent, but this method is only suitable for bonded crosslinked stationary phase.
7. Mismatch of solvent phase and polarity : earlier outflow peaks or peaks near the solvent front are more likely to tail and change the sample solvent.

Problem 2: Leading Peak and Solutions

1. Overload caused by injection volume: reduce sample injection volume.
2. Co-elution of two compounds: reduce the rate of rising column temperature and increase the resolution. Improve the sensitivity and reduce the injection volume.
3. Sample decomposition: reduce the inlet temperature and use deactivated liner.
4. Sample condensation: if necessary, increase the inlet temperature and column temperature.

Problem 3: No Peak and Solution

1. Injection needle leakage or blockage: clean or replace injection needle.
2. leakage of Injection pad: replace injection pad.
3. Inlet temperature is too low: increase the inlet temperature to ensure the complete gasification of the sample.
4. Column temperature is too low: rise column temperature, avoid sample condensation in column.
5. When injecting automatically, the sample quantity in the sample is insufficient, the sample needle can not absorb the sample: normally, the sample quantity should be 0.8-1.2ml.
6. Blockage or leakage at the connection between the column and the inlet, the column and the detector: leak detection and reinstall if necessary.
7. If FID detector was used the flame may be extinguished or the polarization voltage is not added: check and re-ignite.
8. Recorder line connection or damage: check the line or replace the recorder.

Problem 4: Split Peaks and Solutions

1. Mixed sample solvent: change the sample solvent to a single solvent;
2. Column incorrect installation: reinstall column;
3. Injection needle contamination: clean injection needle;
4. Sample degradation in injector: reduce injector temperature, and ensure sample gasification but can not decompose.

Problem 5: Baseline Instability and Solutions

1. Carrier gas deficiency: check carrier gas pressure, if less than 500 psi, timely replace gas cylinders
2. Gas purity is not enough or gas path pollution: replace gas cylinders or use gas purification devices
3. The flow rate of carrier gas is not within the limit of the instrument: measure the flow rate and adjust it according to the instrument manual.
4. sampler or detector contamination: cleaning
5. Injection pad leakage: replace injection pad
6. liner pollution: cleaning liner, replace quartz cotton;
7. Column loss or contamination: replace liner; or cut off 1-2 laps at the inlet end of column; or aging treatment.

Problem 6: Excessive Baseline Noise and Solutions

1. Injector or detector contamination: clean injector, replace liner and injection pad; clean detector;
2. Carrier gas purity is not enough or pollution: use high purity gas; check gas purifier for expiration or leakage;
3. Carrier gas flow rate is not suitable: adjust the gas flow rate to the recommended value;
4. Detector leakage: check leakage
5. Injector pad degradation: change sample pad.
6. liner pollution: cleaning liner, replace quartz cotton;
7. Column loss or contamination: replace liner or cut off 1-2 laps at the inlet end of column. Through aging treatment.

Problem 7: Retention Time Fluctuations and Solutions

1. Carrier gas flow rate change: check carrier gas flow rate;
2. Column temperature change: check column temperature;
3. Column specification change: check column specification model consistency;
4. Injector leakage: leak detection;
5. Injection spacer leakage: replace spacer;
6. Gas path blockage: cleaning or replacing gas pipeline.

Problem 8: Peak Broadening and Solutions

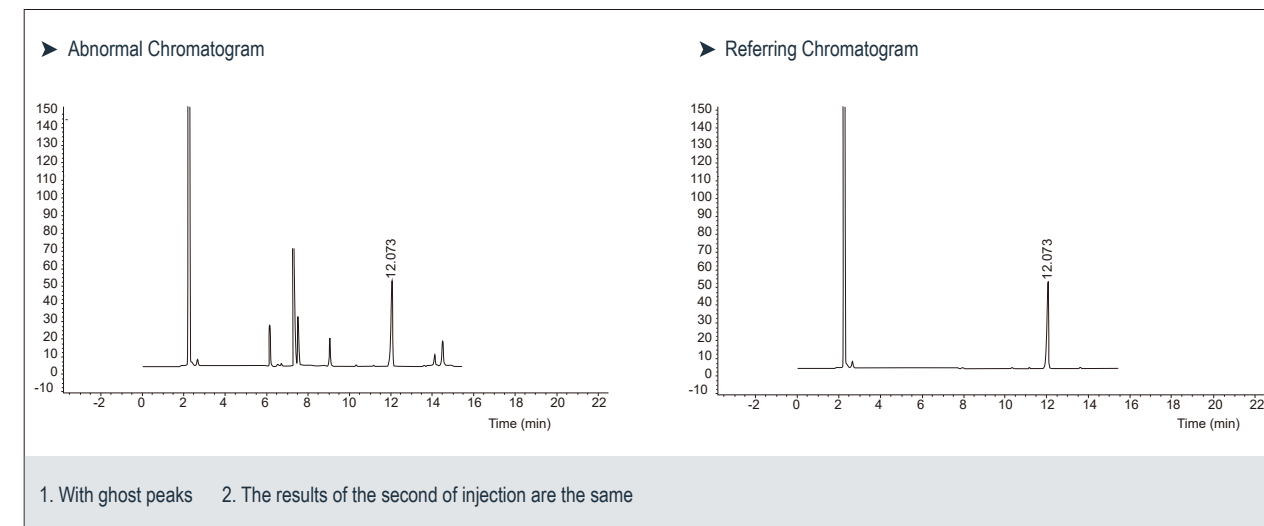
1. Injection technology: rapid and stable injection technology
2. Carrier gas flow rate: adopt recommended carrier gas flow rate
3. Sample concentration: reduce sample concentration
4. Sample solvent effect: when using ECD detector, you can not use dichloromethane and other solvents.
5. Column contaminated: cut the front end of the column 1-2 laps.

5.3.3 Troubleshooting Case Analysis

General troubleshooting requires several steps: identify problems, collect information, think about plans, test, repair, and record.

Ghost Peaks

(1) Confirm Question:



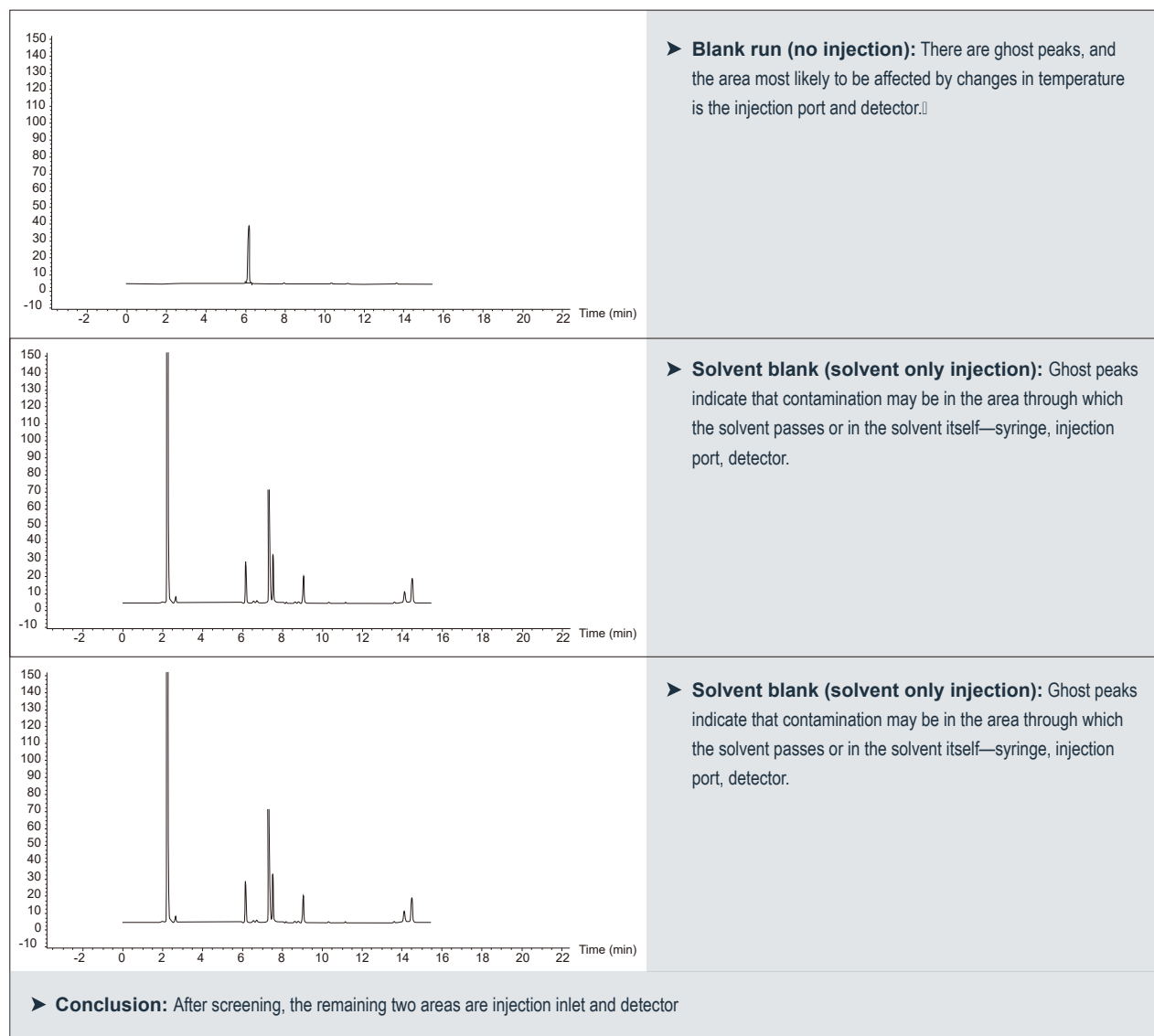
(2) Information Collection:

- EPC system, Manual injection, S/SLinlet, FID
- All the operational parameters are correct
- Without other phenomena
- Using the same gas source and column to do the same batch of samples with another GAS FID has no problem Device has not maintained recently

(3) Possible Reasons:

- Possible sources of ghost peaks: sample, solvent, injection needle, gas cylinder, gas purification pipe, gas pipeline, inlet, column, detector.
- Using another GC FID but the same column to do the same batch of samples has no problem, exclude the problems of solvent, samples, gas cylinders, gas purification pipe, gas pipeline, column problems.
- Contamination of injection needle, injection port and detector should be further checked in the following experiments.

(4) Confirm Question:



(5) Repair:

- Injection inlet maintenance: replace the injection pad, replace the liner and quartz cotton
- Detector maintenance: cleaning nozzle

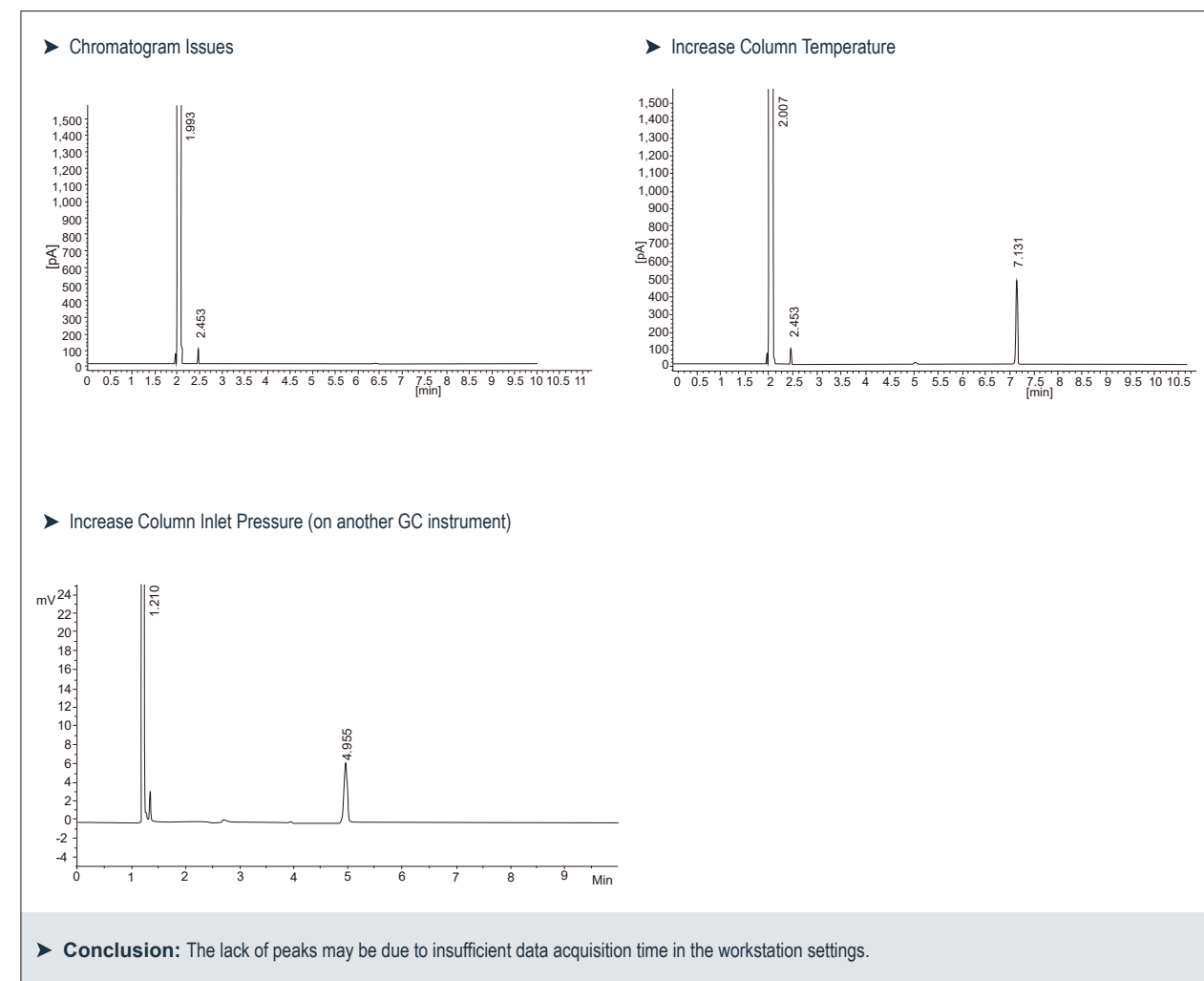
(6) Record:

- System performance can be restored to reference conditions

No Peak

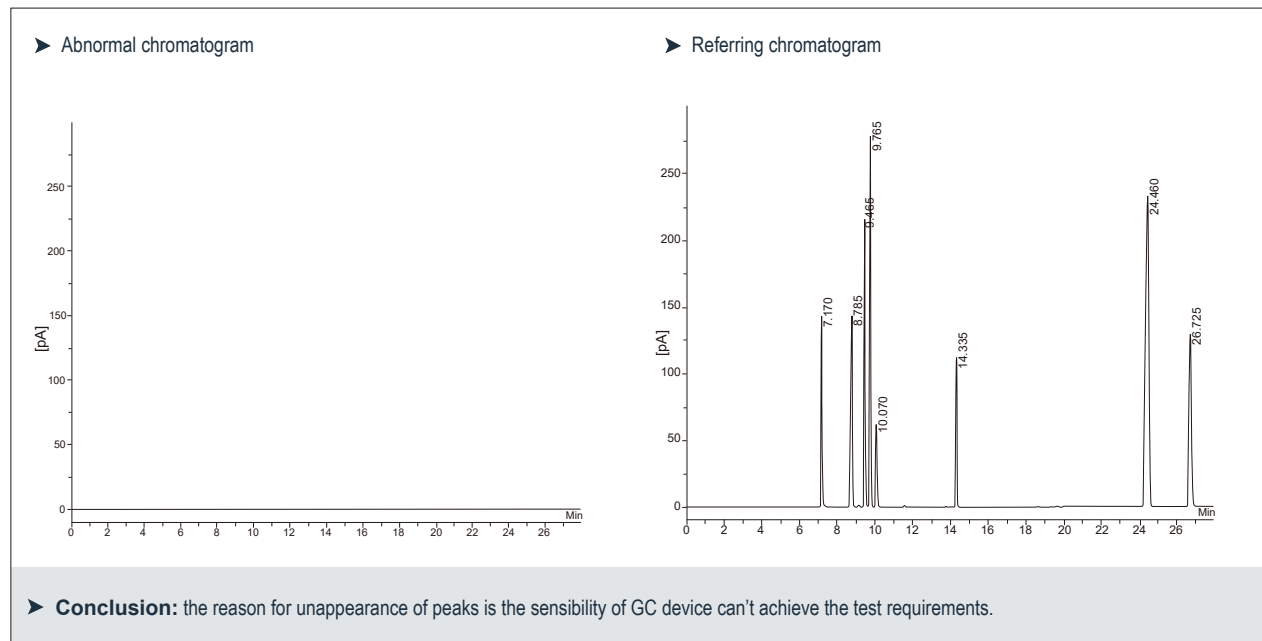
The absence of peaks is usually attributed to signal acquisition errors, issues with the injection needle, column installation problems, FID not ignited, or detector sensitivity.

(1) Solvent Peak Only:





(2) Water as Solvent (FID Detector):



(3) There's no Solvent Peak:

