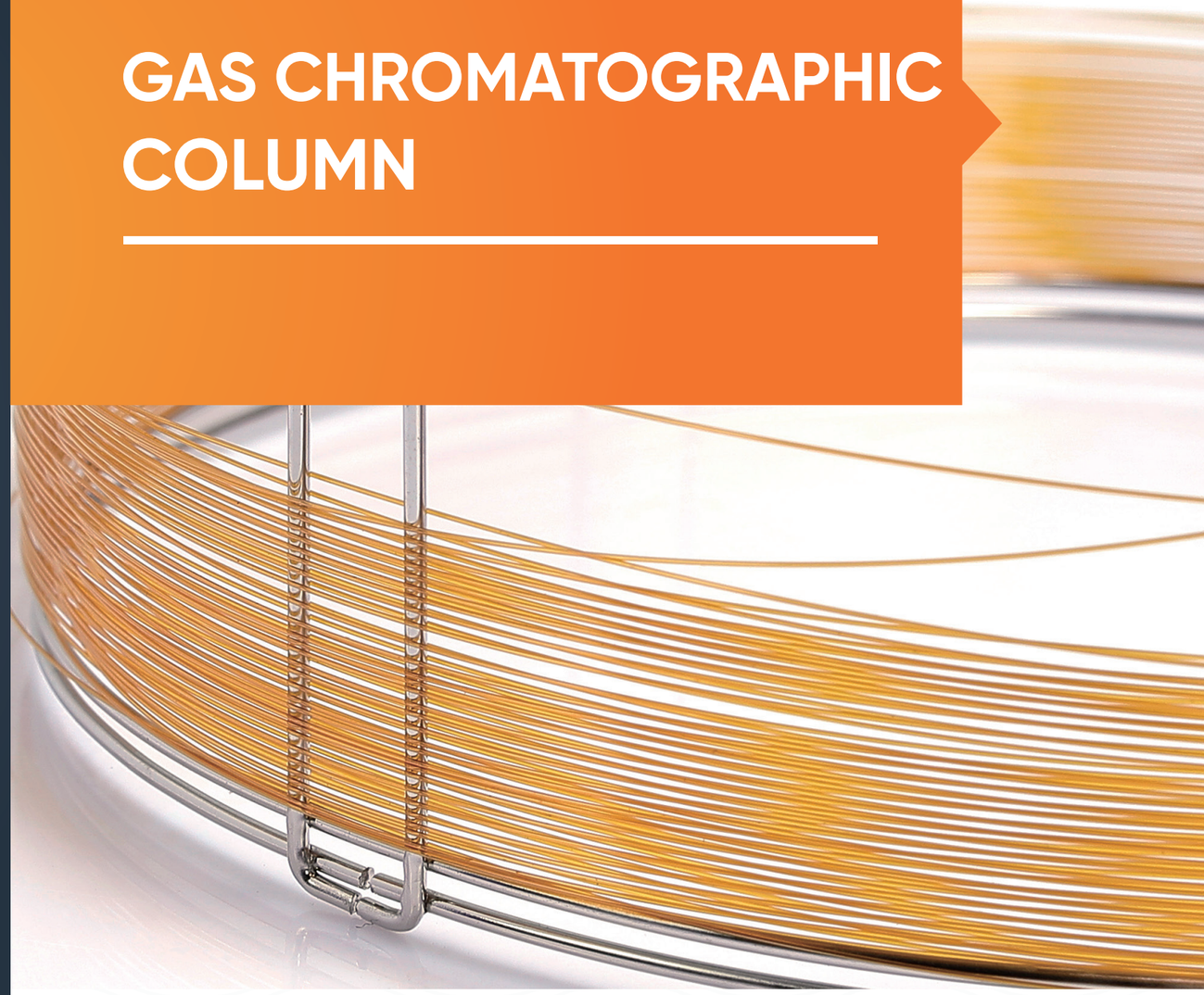
INNOVATIVE | REPRODUCIBLE | RUGGED

WELCH MATERIALS, INC.

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

welch

GAS CHROMATOGRAPHIC COLUMN



WELCH MATERIALS, INC.

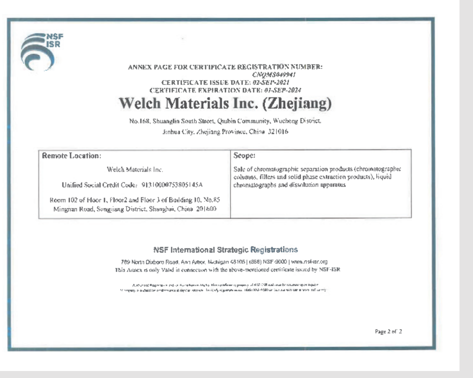
COMPANY PROFILE

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.



NSF ISR

ANNEX PAGE FOR CERTIFICATE REGISTRATION NUMBER: *CNQMS049941*
CERTIFICATE ISSUE DATE: *02-SEP-2021*
CERTIFICATE EXPIRATION DATE: *01-SEP-2024*

Welch Materials Inc. (Zhejiang)

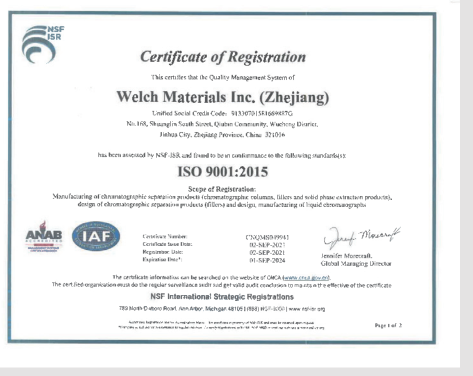
No.168, Shuanglin South Street, Qiubin Community, Wucheng District, Jinhua City, Zhejiang Province, China 321016

Remote Location:	Scope:
Welch Materials Inc. Unified Social Credit Code: 91310000753805145A Room 102 of Floor 1, Floor2 and Floor 3 of Building 10, No.85 Mingnan Road, Songjiang District, Shanghai, China 201600	Sale of chromatographic separation products (chromatographic columns, fillers and solid phase extraction products), liquid chromatographs and dissolution apparatus

NSF International Strategic Registrations

789 North Dixboro Road, Ann Arbor, Michigan 48105 | (888) NSF-9000 | www.nsf-isr.org
This Annex is only Valid in connection with the above-mentioned certificate issued by NSF-ISR

Page 2 of 2



NSF ISR

Certificate of Registration

This certifies that the Quality Management System of

Welch Materials Inc. (Zhejiang)

Unified Social Credit Code: 91330701581669887G
No.168, Shuanglin South Street, Qiubin Community, Wucheng District, Jinhua City, Zhejiang Province, China 321016

has been assessed by NSF-ISR and found to be in conformance to the following standards(s):

ISO 9001:2015

Scope of Registration:
Manufacturing of chromatographic separation products (chromatographic columns, fillers and solid phase extraction products), design of chromatographic separation products (fillers) and design, manufacturing of liquid chromatographs

ANAB IAF

Certificate Number: CNQMS049941
Certificate Issue Date: 02-SEP-2021
Registration Date: 02-SEP-2021
Expiration Date*: 01-SEP-2024

Jennifer Morecraft, Global Managing Director

The certificate information can be searched on the website of CNCA (www.cnca.gov.cn).
The certified organization must do the regular surveillance audit and get valid audit conclusion to maintain the effective of the certificate

NSF International Strategic Registrations

789 North Dixboro Road, Ann Arbor, Michigan 48105 | (888) NSF-9000 | www.nsf-isr.org

Page 1 of 2

CONTENT

01 OUTLINE OF GC COLUMN

OUTLINE OF GC COLUMN

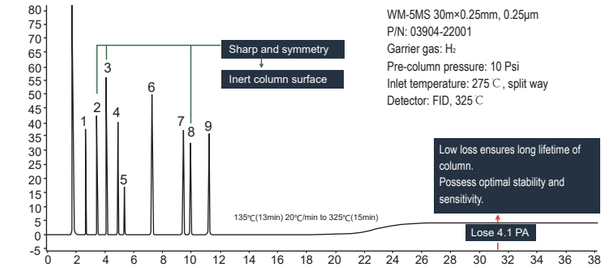
Welch Materials has concentrated on GC R&D and production for many years, and each column would be tested strictly before selling with attached column report. Welch columns are characterized by stable properties, high column efficiency and good reproducibility. Welch GC column can be divided into two 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

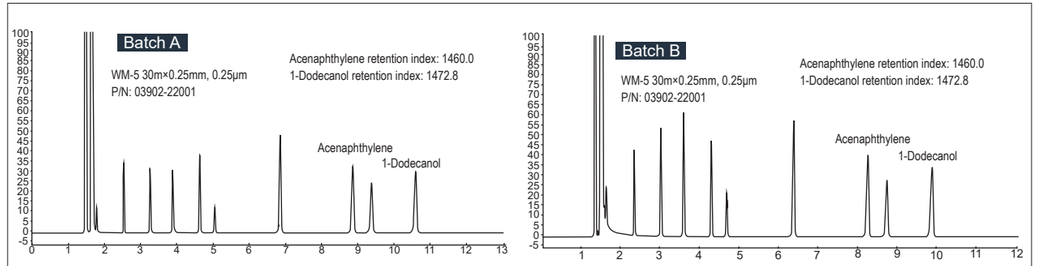
WM series capillary columns adopt strict technique and performance detection with strength in super inertness, low loss, high column efficiency, high selectivity, stable reproducibility and long lifetime.

(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



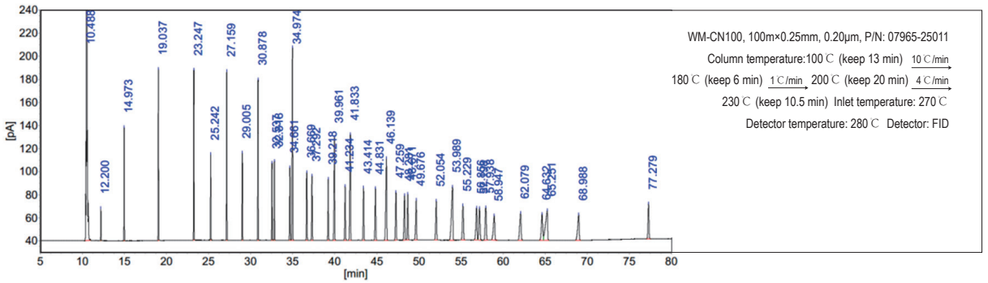
- The consistency of column inertness and superior inter-column reproducibility can be guaranteed by mixed standards samples test.
- Higher detection sensitivity and more accurate analysis results.

(3) Cases of Excellent Performance of WM Column

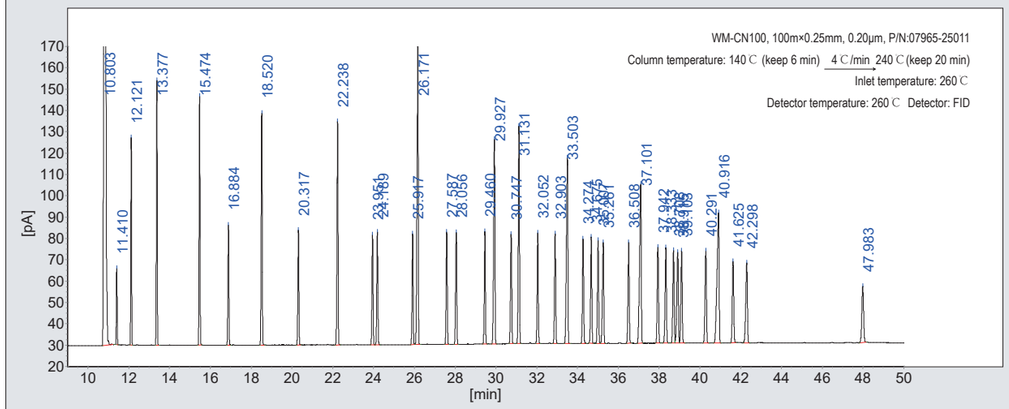
Determination of 37 fatty acids:

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.

Refer to GB 5009.168-2016:



Method Optimization

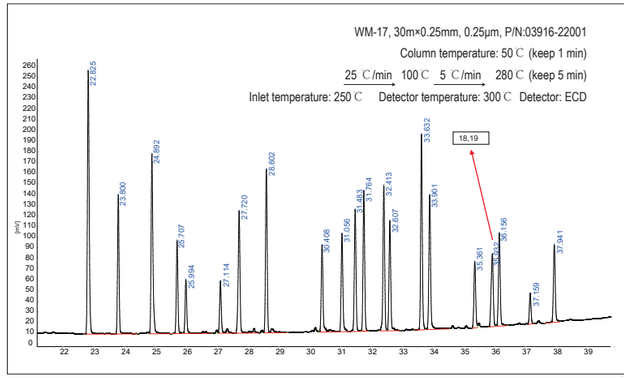


Determination of 22 Kinds of Organochlorine Pesticide Residues:

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

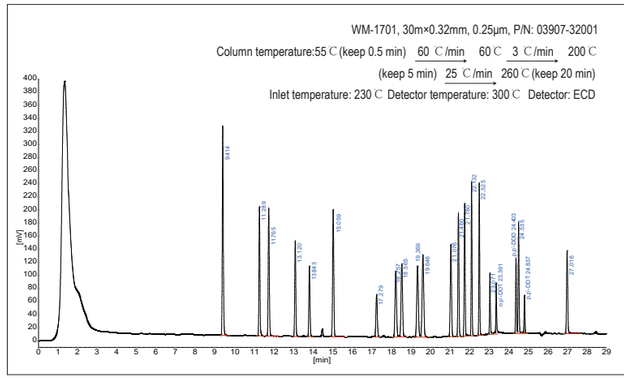
Refer to the 2020 edition of the "Chinese Pharmacopoeia":



No.	Component	No.	Component
1	Hexachlorobenzene	12	Trans-chlordane
2	α- benzene hexachloride	13	Cis-chlordane
3	Quintozene	14	α-endosulfan
4	γ- benzene hexachloride	15	p,p'-DDE
5	β- benzene hexachloride	16	Dieldrin
6	Heptachlor	17	Endrin
7	δ- benzene hexachloride	18	o,p'-DDT+ p,p'-DDD
8	Aldrin	19	o,p'-DDT+ p,p'-DDD
9	Oxychlordane	20	β-endosulfan
10	Heptachlor epoxide	21	p,p'-DDT
11	Trans-heptachlor epoxide	22	Endosulfan sulfate

(Names of components in chromatogram are inferred according to references and experience)

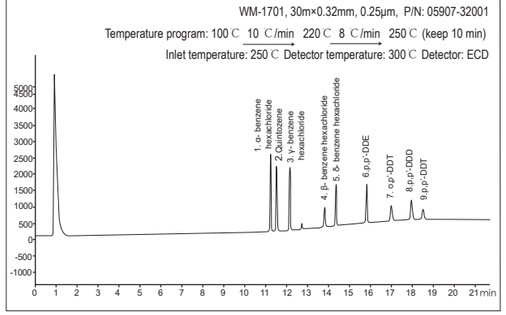
Reference to the 2020 edition of the "Chinese Pharmacopoeia" (Part One):



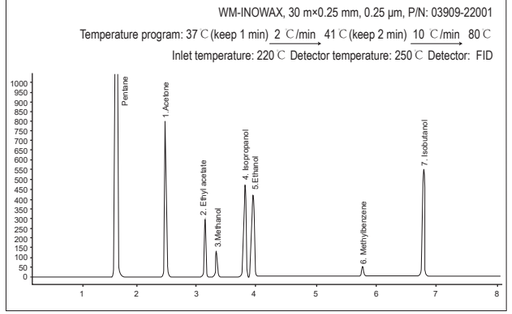
No.	Component	No.	Component
1	Hexachlorobenzene	12	α-endosulfan
2	α- benzene hexachloride	13	Trans-chlordane
3	Quintozene	14	Cis-chlordane
4	γ- benzene hexachloride	15	p,p'-DDE
5	Heptachlor	16	Dieldrin
6	Aldrin	17	Endrin
7	β- benzene hexachloride	18	o,p'-DDT
8	Oxychlordane	19	p,p'-DDD
9	δ- benzene hexachloride	20	β-endosulfan
10	Heptachlor epoxide	21	p,p'-DDT
11	Trans-heptachlor epoxide	22	Endosulfan sulfate

(Names of components in chromatogram are inferred according to references and experience)

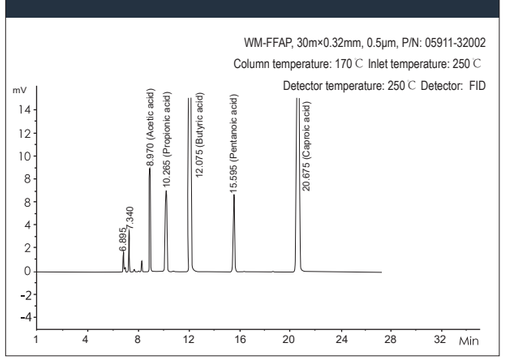
Determination of 9 Kinds of Organochlorine Pesticides Residues



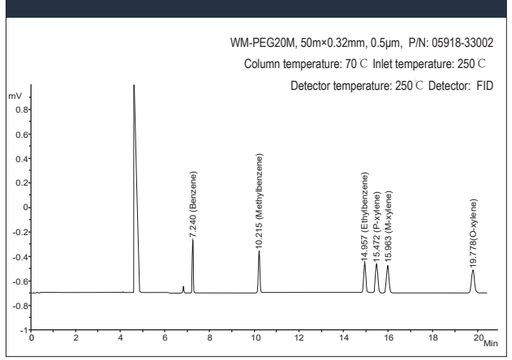
WM-INOWAX Column with Excellent Selectivity and Separation Performance



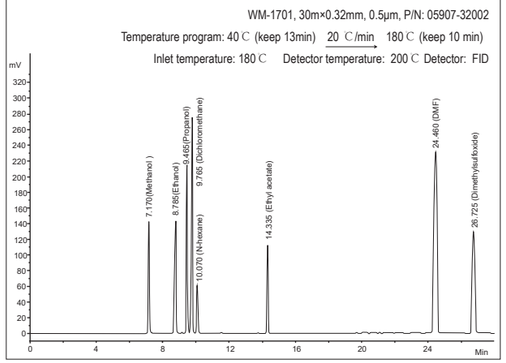
Analysis of Organic Acids



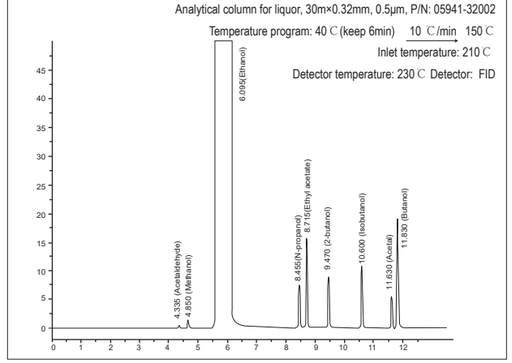
Analysis of Benzene Series



Determination of Organic Substances Residues



Determination of Volatile Impurities in Ethanol



INNOVATIVE/REPRODUCIBLE/RUGGED

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	Staionary Phase Type	Polarity	Temp. limit (℃)	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	14% Cyanopropyl-phenyl 86% Dimethyl Polysiloxane	Moderate polarity	40 to 300/320	Drugs, ethylene glycol, steroids, herbicides, pesticides
WM-1701	6% Cyanopropyl 94% Dimethyl Polysiloxane	Moderate polarity	-20 to 280/300	Aromatic chlorine, insecticide, herbicide
WM-624	6% Cyanopropyl 94% Dimethyl Polysiloxane	Moderate polarity	-20 to 260	Solvent residual, volatile compounds
WM-225	50% Cyanopropyl 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℃
- 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		

INNOVATIVE/REPRODUCIBLE/RUGGED

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℃
- 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

INNOVATIVE/REPRODUCIBLE/RUGGED

WM-1301, WM-624

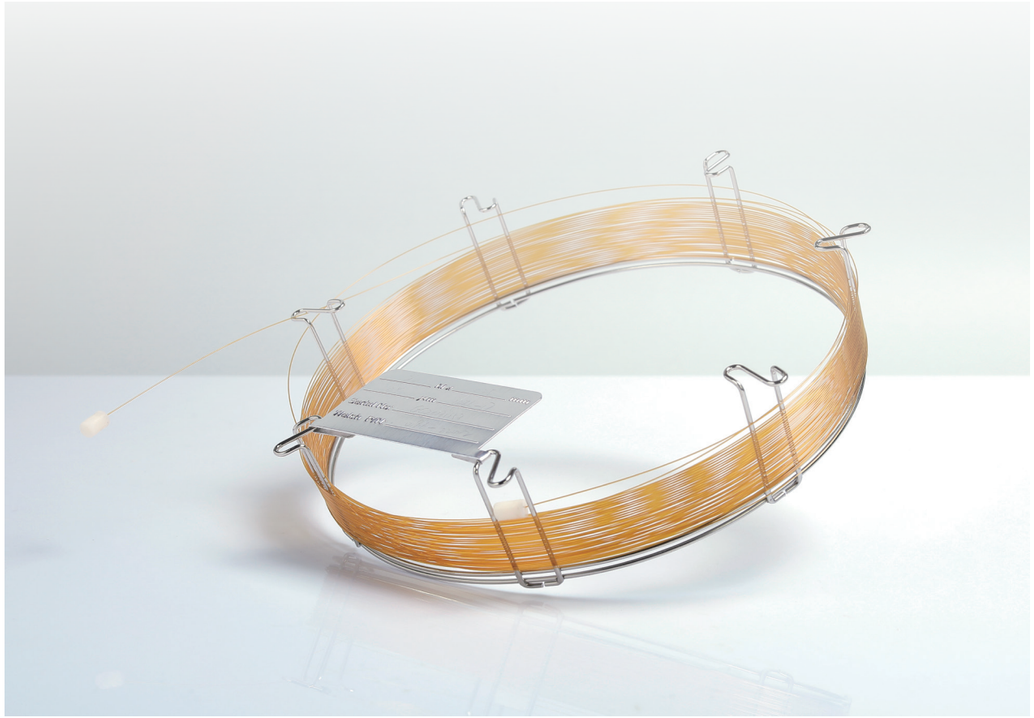
- 6% Cyanopropyl phenyl, 94% dimethyl polysiloxane
- Comply with USP G43 specific stationary liquid
- Bond and crosslink with medium polarity
- It is specially used for the analysis of volatile organic compounds and residual solvents in drugs
- Has excellent inertness for most compounds
- Temperature 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



INNOVATIVE/REPRODUCIBLE/RUGGED

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		

WELCH MATERIALS, INC.

WM-17, WM-17MS

- 50% diphenyl 50% dimethyl polysiloxane
- General low-polarity stationary phase
- Thermal stability is up to 320 ℃
- 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		

INNOVATIVE/REPRODUCIBLE/RUGGED

WM-1701

- 14% Cyanopropylphenyl 86% dimethyl polysiloxane
- General medium-polarity stationary phase
- Thermal stability is up to 300 ℃
- 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% Cyanopropylphenyl, 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 ℃
- 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		

INNOVATIVE/REPRODUCIBLE/RUGGED

WM-FFAP

- Nitroterephthalic acid modified polyethylene glycol
- Stationary phase has strong polarity
- Has special advantagesIn the analysis of volatile fatty acids and phenol and other substances
- Thermal stability is is up to 260 ℃
- 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

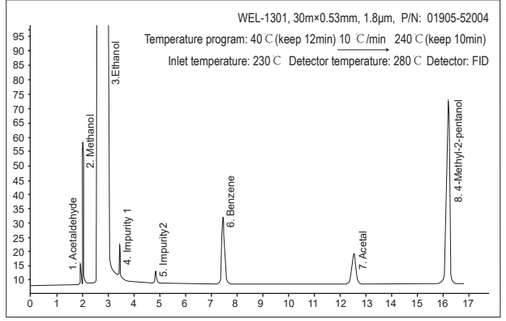
Each of the WEL series capillary columns has been strictly tested with attached evaluation chromatogram. For high column efficiency and sensitivity, our products are popular among new and regular customers. We can provide sample analysis for customers to ensure the superior performance of columns and 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

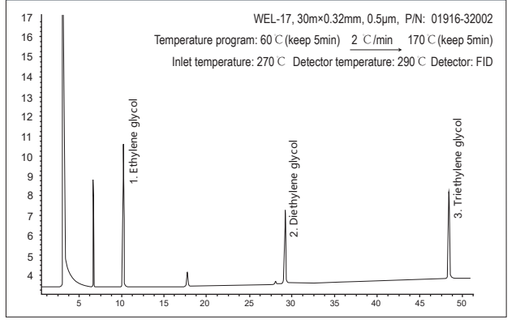
INNOVATIVE/REPRODUCIBLE/RUGGED

Chromatogram of Typical Applications

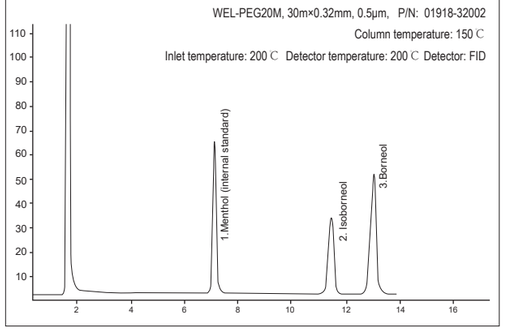
Detection of Volatile Impurities in Ethanol



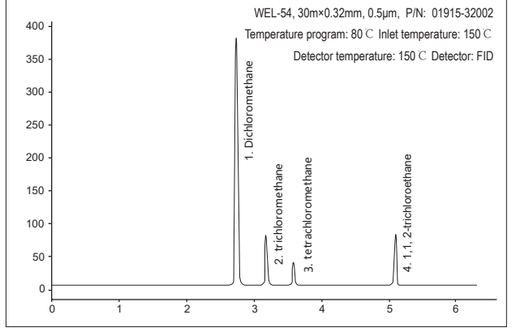
Detection of Ethylene Glycol, Diethylene Glycol and Triethylene Glycol in Polyethylene Glycol 400



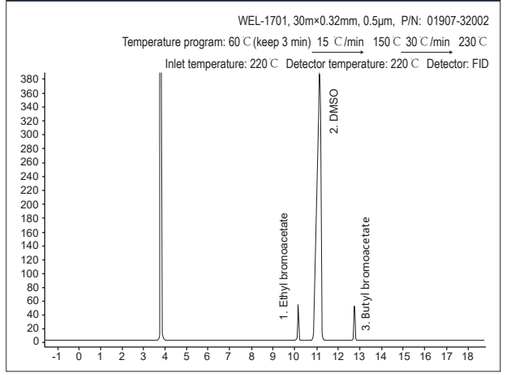
Determination of Effective Composition of Borneol



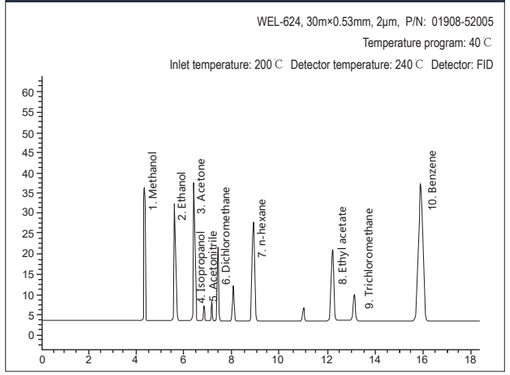
Analysis of Chloroalkanes



Determination of Ethyl Bromoacetate



Determination of Organic Solvent Residue



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

WELCH MATERIALS, INC.

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

INNOVATIVE/REPRODUCIBLE/RUGGED

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 AL_2O_3/KCl (Modified by KCl)
- ➤ WEL-AL_2O_3/S (Na_2SO_4)
- ➤ WEL-AL_2O_3/M (Modified by Na_2MoO_4)

*Polarity is similar to GS-Alumina, HP PLOT S, HP PLOT M, Alumina-PLOT, AT-Alumina, CP-Al_2O_3/Na_2SO_4

2. Use divinylbenzene - polystyrene as the stationary phase

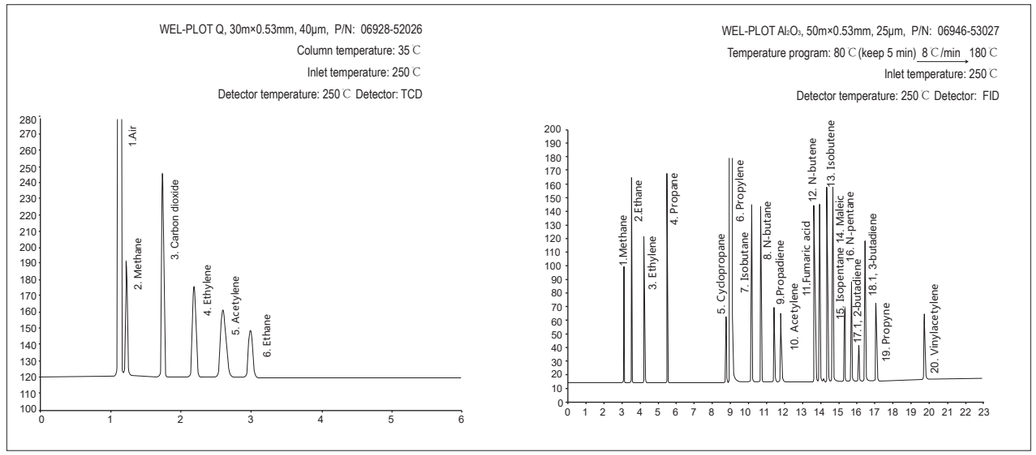
Used for analysis of alkanes, methane, air/carbon monoxide, oxides and sulfides of C1-C3 isomers, to C12.

➤ 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×20um
06928-32040	WEL-PLOT Q 30m×0.32mm×10μm	06928-52026	WEL-PLOT Q 30m×0.53mm×40μm
06951-53027	WEL-PLOT Al_2O_3/S 50m×0.53mm×25μm	05951-52020	WEL-PLOT Al_2O_3/S 30m×0.53mm×20μm
06952-53001	WEL-PLOT Al_2O_3/M 50m×0.53mm×0.25μm	05951-53020	WEL-PLOT Al_2O_3/S 50m×0.53mm×20μm
06928-52027	WEL-PLOT Q 30m×0.53mm×25μm	01951-33037	WEL-PLOT Al_2O_3/S 50m×0.32mm×8μm
01951-52020	WEL-PLOT Al_2O_3/S 30m×0.53mm×20μm		

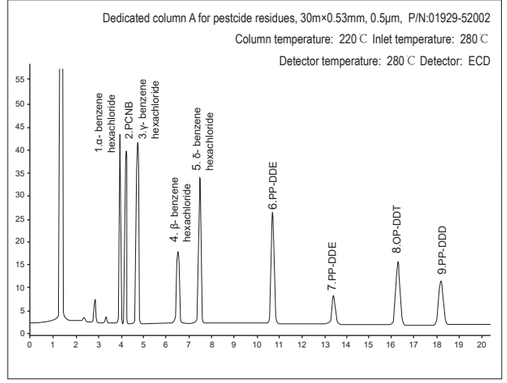
INNOVATIVE/REPRODUCIBLE/RUGGED

1.3 DEDICATED GC COLUMN

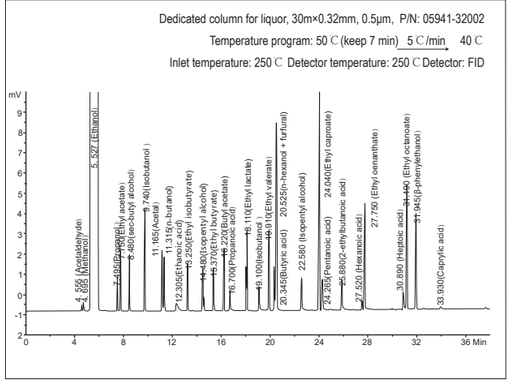
For separation problem of some complex samples, Welch developed the dedicated column which can be applied to pesticide analysis, volatile organic compounds analysis, petrochemical analysis, liquor analysis and other aspects with unique performance. It requires short analysis time with good separation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

P/N	Product	Specification	Application
01929-32002	Dedicated column A for pestcide residues	30m×0.32mm×0.5μm	Organochlorine pesticide
01929-52002		30m×0.32mm×0.5μm	
01937-32002	Dedicated column B for pestcide 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

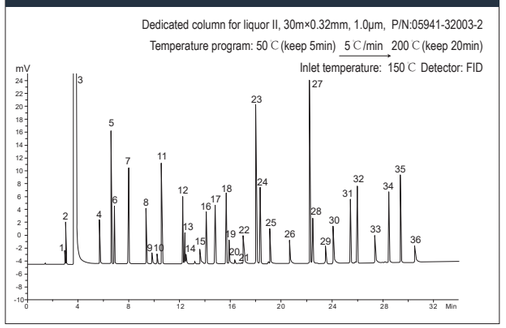
Analysis of Organochlorine Pesticide Residues



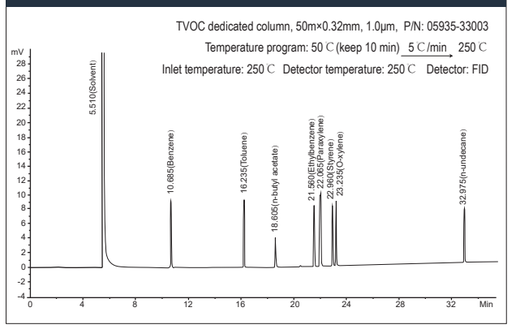
Analysis of Liquor



Analysis of Liquor 2



TVOC Analysis



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

INNOVATIVE/REPRODUCIBLE/RUGGED

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

e.g. Agilent 7890A/ Shimadzu 2014 C

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.

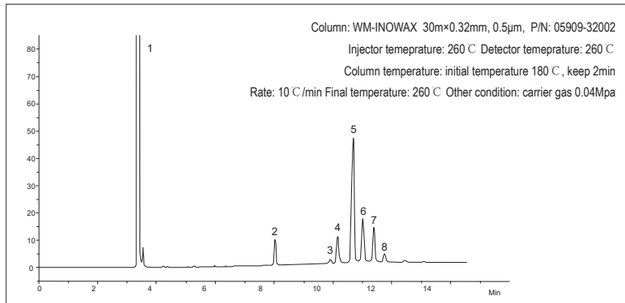
02 APPLICATION OF GC COLUMN

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

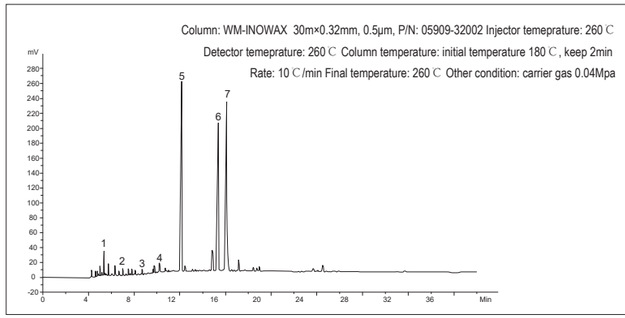
➤ **Charactertics:** The high carbon fatty acid methyl ester can be analyzed to solve the difficulty of high temperature resistance of polar column. The maximum temperature of modified column can reach 320 ℃.



No.	Component
1	Solvent
2	Methyl palmitate
3	Methyl stearatev
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

➤ **Charactertics:** 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 ℃.

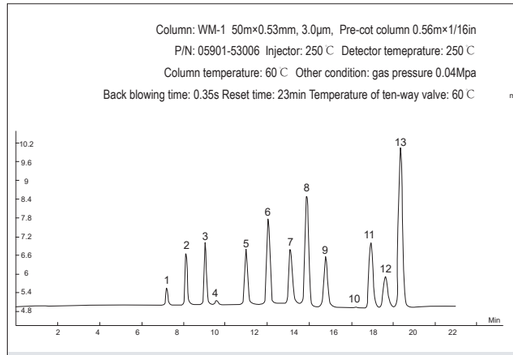


No.	Component
1	N-dodecane
2	N-tridecane
3	N-heptadecane
4	N-nonadecane
5	Methyl hexadecanoate
6	Methyl stearate
7	Methyl linoleate

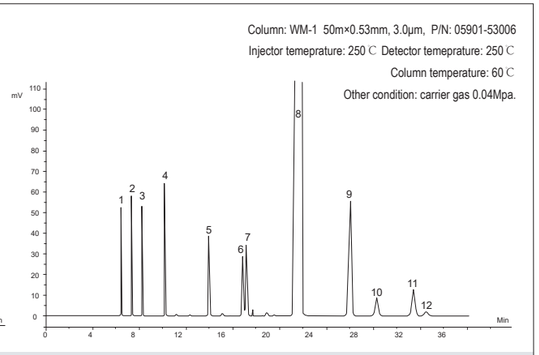
Analysis of Oxidation and Aromatics in Gasoline

➤ **Charactertics:** comply with SH/T 0663 analysis requirements for alcohols and ethers in gasoline

➤ **Charactertics:** comply with SH/T 0693 aromatics analysis requirements in gasoline



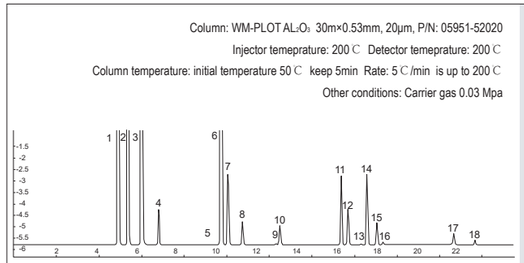
No.	Component	No.	Component
1	Methanol	8	Diisopropyl ether
2	Ethanol	9	Isobutanol
3	Isopropanol	10	N-hexane
4	Impurity	11	1,2-Dimethoxyethane
5	Propanol	12	1-butanol
6	Methyl tert-butyl ether	13	Benzene
7	2-butyl alcohol		



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

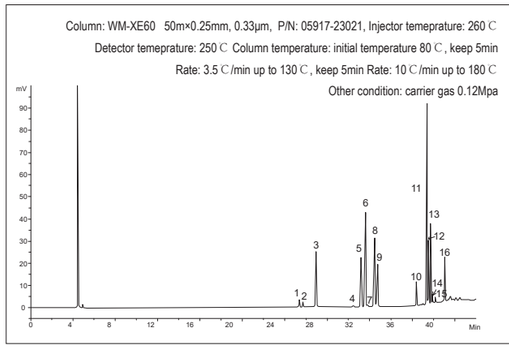
➤ **Charactertics:** analyze C1-C7, the olefins are effectively separated from the olefins



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

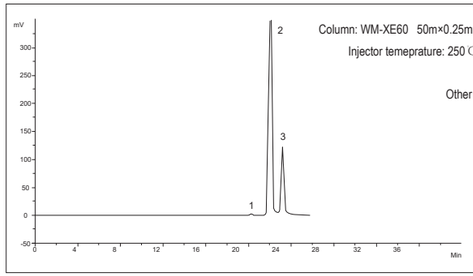
➤ **Charactertics:** analyze the components of phenolic products



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

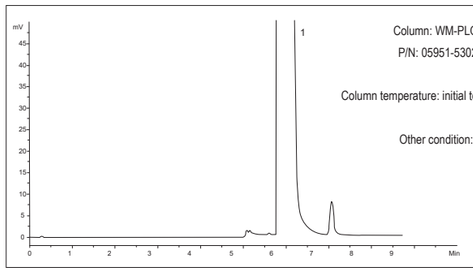
Analyze Purity of P-Methoxyphenol by Phenolic Dedicated Column

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



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

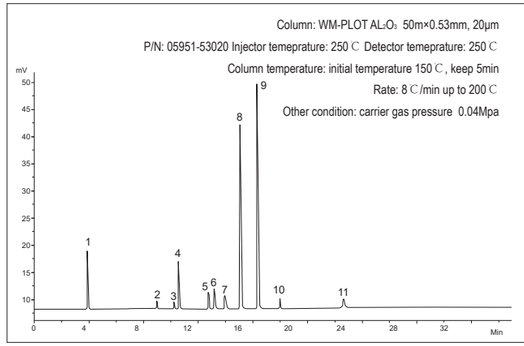
Analyze Refrigerant R22 by Dedicated column



No.	Component
1	R22

INNOVATIVE/REPRODUCIBLE/RUGGED

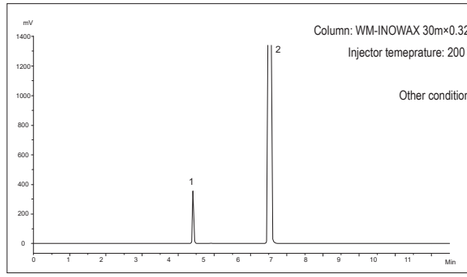
Analyze Mixed Gas Refrigerant by Dedicated Column



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		

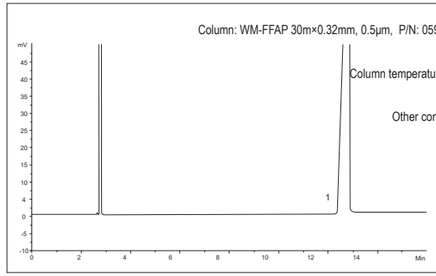
Analyze Cyclohexane and Benzene

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



No.	Component
1	Cyclohexane
2	benzene

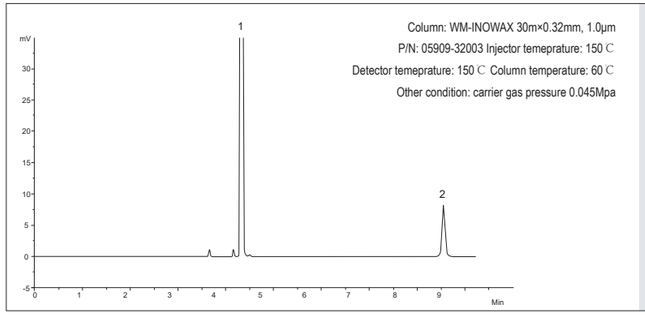
Analyze Purity of P-Phthalic Anhydride by Dedicated Column



No.	Component
1	Phthalic anhydride

Analyze Chloroethane Purity by Capillary Column

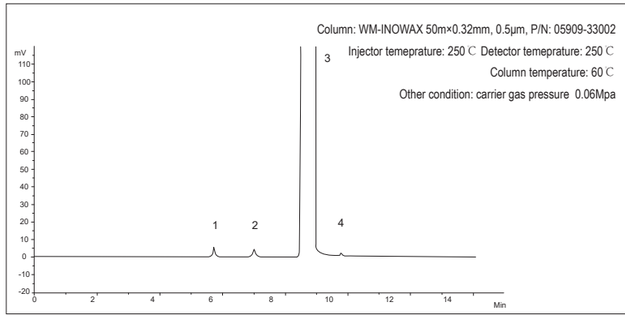
➤ **Charactertics:** analyze purity of chloroethane and the content of ethanol in chloroethane by capillary column



No.	Component
1	Chloroethane
2	Ethanol

Analyze Methanol Purity by Capillary Column

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



No.	Component
1	Acetaldehyde
2	Acetone
3	Methanol
4	Ethanol

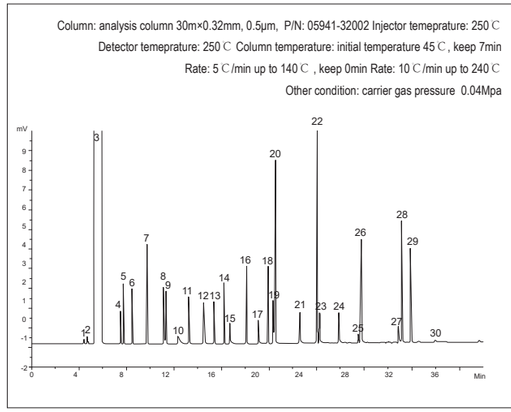
2.2 APPLICATION IN BREWING

➤ **Charactertics:** 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.

INNOVATIVE/REPRODUCIBLE/RUGGED

Liquor Capillary Column C1

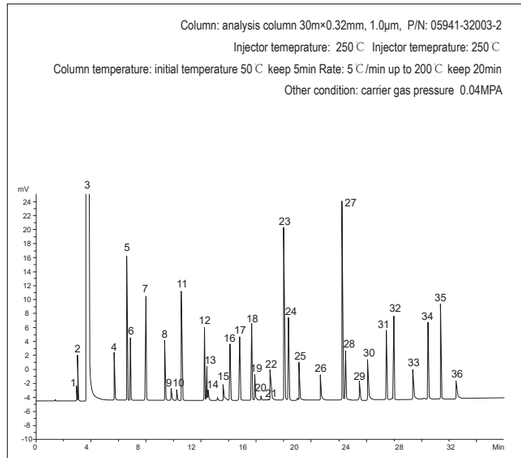
C1 column can be used to analyze various mixed components of liquor, and there are up to 30 qualitative components at present.



No.	Component	No.	Component
1	Acetaldehyde	16	ethyl lactate
2	Methanol	17	Isobutyric acid
3	Ethanol	18	Ethyl valerate
4	n-propanol	19	Butyrate
5	Ethyl acetate	20	n-hexanol+furfural
6	2-butanol	21	Common valeric acid
7	Isobutanol	22	Ethyl hexanoate
8	Acetal	23	Pentanoic acid
9	n-butanol	24	2-ethylbutanoic acid
10	Ethanoic acid	25	Hexanoic acid
11	Ethyl isobutyrate	26	Ethyl oenanthate
12	Isoamyl alcohol	27	Heptanoic acid
13	n-butyl butyrate	28	Ethyl octanoate
14	n-butyl acetate	29	β-phenylethanol
15	propanoic acidl	30	Caprylic acid

Liquor Capillary Column C2

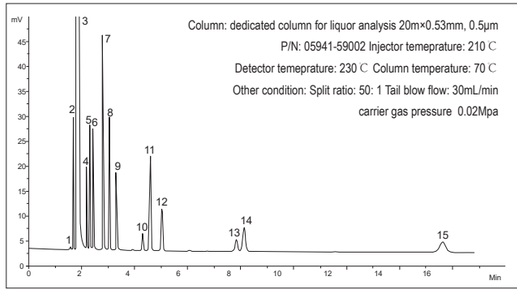
C2 column has been upgraded on the basis of Liquor analysis C1 column, which can analyze more components such as 3-methiopropyl alcohol, n-hexanol, etc. Suitable for separation of acids. At present, there are 36 qualitative components



No.	Component	No.	Component
1	Acetaldehyde	19	Isobutyric acid
2	Methanol	20	Ethyl isovalerate
3	Ethanol	21	Furfural
4	n-propanol	22	Butyric acid
5	Ethyl acetate	23	Hexanol
6	2-butanol	24	Ethyl valerate
7	Isobutanol	25	Isopropylacetic acid
8	n-butanol	26	Pentanoic acid
9	Ethanoic acid	27	Ethyl hexanoate
10	Unknown	28	2-Ethyl butyraldehyde
11	Acetal	29	3-Methylthiopropanol
12	Ethyl isobutyrate	30	Hexanoic acid
13	Isoamyl alcohol	31	Unknown
14	Unknown	32	Ethyl heptanoate
15	Propanoic acid	33	Heptanoic acid
16	Ethyl butyrate	34	β-phenylethanol
17	n-butyl acetate	35	Ethyl octanoate
18	Ethyl lactate	36	Caprylic acid

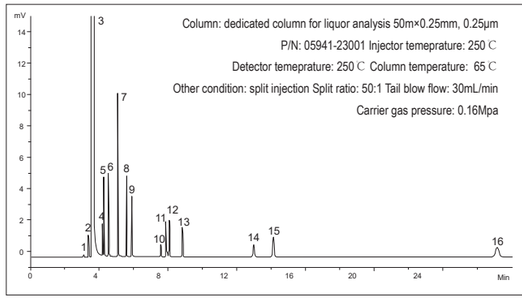
Analyze with Large Diameter Dediacted Column for Liquor

➤ **Charactertics:** 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		

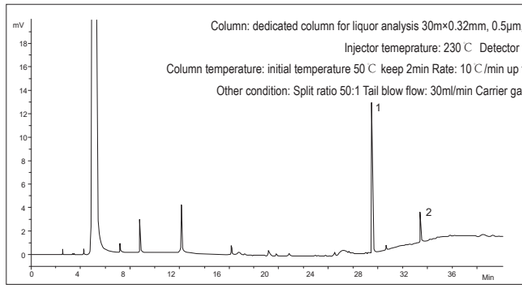
Constant Temperature Analysis of by Small Diameter Dediacted Column for Liquor



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

➤ **Charactertics:** 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

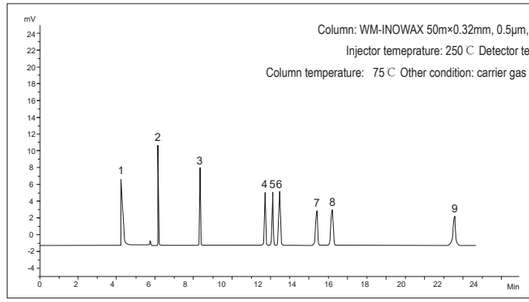


No.	Component
1	2-ethyln-butyric acid
2	β-benzyl ethanol

2.3 APPLICATION IN ENVIRONMENTAL ANALYSIS

Separation of Benzene Series Samples by Capillary Column

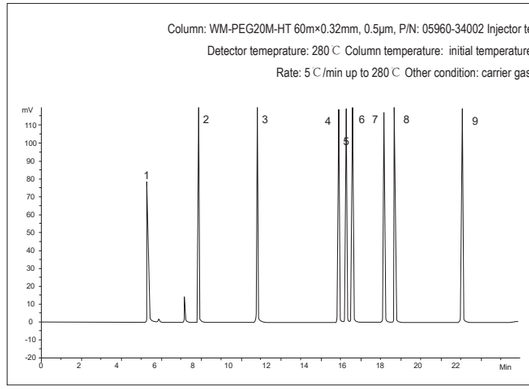
➤ **Charactertics:** analyze eight kinds of benzene series samples



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

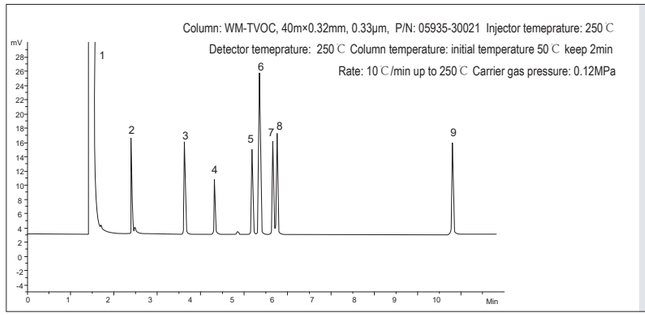
➤ **Charactertics:** comply with HJ 583/584 standards, analyze the maximum temperature of 8 benzene series samples up to 320 ℃, more durable than normal benzene column.



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

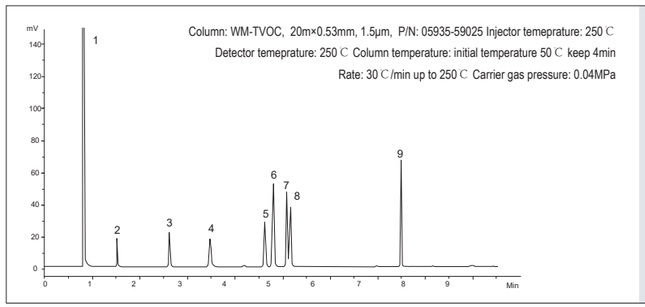
➤ **Charactertics:** 8 kinds of volatile toxic and harmful substances in the indoor environment can achieve baseline separation within 10 min.



No.	Component
1	Solvent
2	Benzene
3	Toluene
4	n-butyl acetate
5	Ethylbenzene
6	m-xylene
7	Styrene
8	O-xylene
9	n-Hendecane

TVOC Special Capillary Column for Portable Micrometer

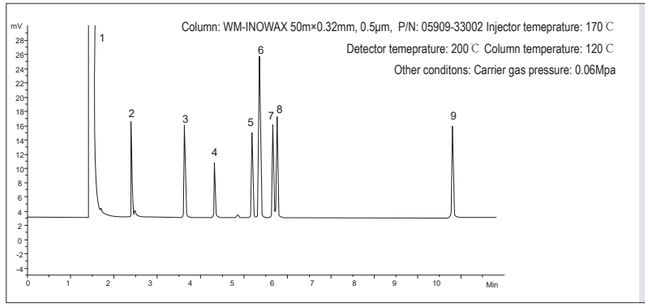
➤ **Charactertics:** it can be used for portable miniature TVOC detector, which has the advantages of fast speed, good efficiency and convenient analytical conditions, etc., and is specially customized for miniature chromatograph



No.	Component
1	Solvent
2	Benzene
3	Methylbenzene
4	n-butyl acetate
5	Ethylbenzene
6	m-Xylene
7	Styrene
8	Ortho-xylene
9	Undecane

Residue Analysis of Styrene

➤ **Charactertics:** analyze the residue of styrene in polystyrene

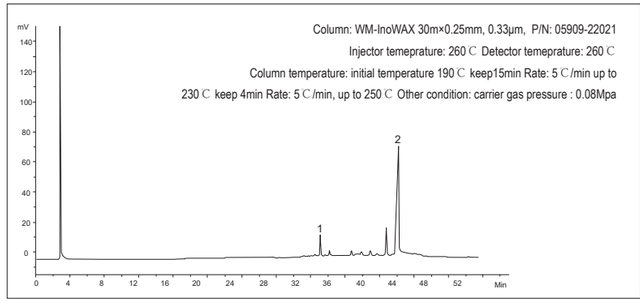


No.	Component
1	Styrene
2	Cyclopentanol

2.4 APPLICATION IN FOOD

DHA, EPA Analysis

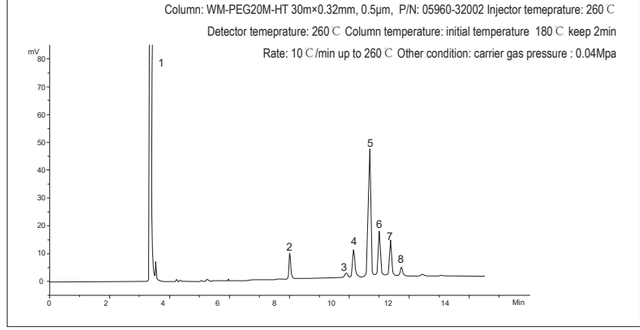
➤ **Charactertics:** determine the content of DHA and EPA in fish oil by GC capillary column



No.	Component
1	EPA
2	DHA

Analyze Fatty Acid Component

➤ **Charactertics:** select GC capillary column to detect fatty acid components with good separation effect. The maximum temperature of the column can be up to 320 ℃

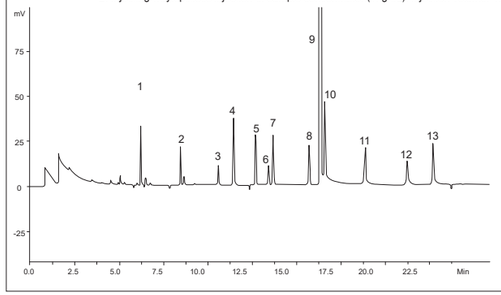


No.	Component
1	Solvent
2	Methyl hexadecanoate
3	Methyl stearate
4	Methyl oleate
5	Methyl ester
6	γ-methyl oleate
7	α-methyl oleate
8	Ethyl linolenate

Analysis of Organophosphorus Pesticide Residues in Food

➤ **Charactertics:** according to the pharmacopoeia, the content of menthol and camphor was detected by the capillary column

Column: Organic phosphorus pesticide residue analysis column 30m×0.32mm, 0.5μm
P/N: 05939-32002 Injector temperature: 280 ℃ Detection temperature: 270 ℃
Column temperature: initial temperature 80 ℃ keep 2min Rate: 30 ℃/min up to 180 ℃, keep 0min
Rate: 2 ℃/min, up to 230 ℃ keep 0min Rate: 10 ℃/min up to 270 ℃
Other: 1. carrier gas: N_2 : 0.08Mpa H_2: 40mL/min Air 1: 30ml/min Air 2: 20mL/min tailing blow: 30mL/min
2. Injecting way:splitless injection 3. sample concentration(1ng/uL): injection volume: 4uL

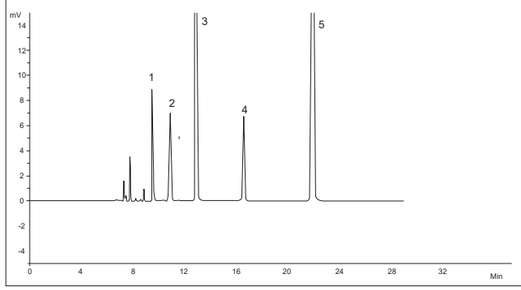


No.	Component	No.	Component
1	Dichlorodiphenyltrichloroethane	8	Pirimiphos-ethyl
2	Malathion	9	Chlorpyrifos
3	Parathion	10	Pirimiphos-methyl
4	Methyl parathion	11	Isocarbophos
5	Diazinon	12	Phenthoate
6	O-dimethylphosphorothioate	13	Ethion
7	Parhamidophos		

Chromatogram Analysis of C1-C6 Organic Acids

➤ **Charactertics:** constant temperature analysis of capillary column to achieve baseline separation benzene hexachloridex and DDT eight components

Column: WM-FFAP 30m×0.32mm, 0.5μm, P/N: 05911-32002 Injector temeprature: 250℃
Detector temeprature: 250 ℃ Column temperature: 170 ℃
Other condition: carrier gas pressure 0.04Mpa

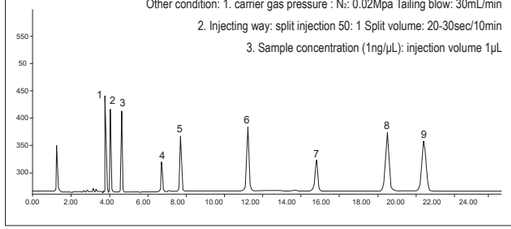


No.	Component
1	Ethanoic acid
2	Propanoic acid
3	Butyric acid
4	Pentanoic acid
5	Caproic acid

Analysis of Organochlorine Pesticide Residues in Food

➤ **Charactertics:** constant temperature analysis of capillary column to achieve baseline separation benzene hexachloridex and DDT eight components

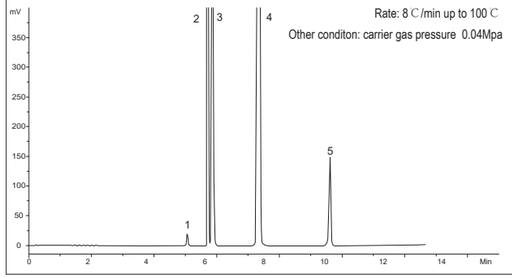
Column: WM-1701 30m×0.32mm, 0.25μm, P/N: 05907-32001
Injector temeprature: 230 ℃ Detector temeprature: 230 ℃ Column temperature: 210 ℃
Other condition: 1. carrier gas pressure : N_2: 0.02Mpa Tailing blow: 30mL/min
2. Injecting way: split injection 50: 1 Split volume: 20-30sec/10min
3. Sample concentration (1ng/μL): injection volume 1μL



No.	Component
1	α- benzene hexachloride
2	Quintozene
3	γ- benzene hexachloride
4	β- benzene hexachloride
5	δ- benzene hexachloride
6	pp'-dde
7	op'-ddt
8	pp'-ddd
9	pp'-ddt

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

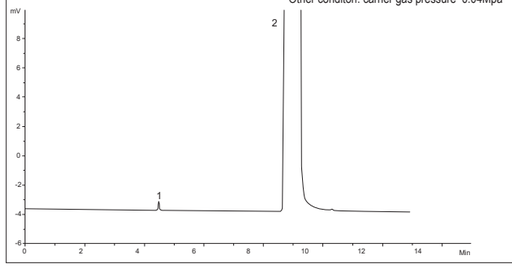
Column: WM-INOWAX 30m×0.32mm, 1.0μm, P/N: 05909-32003 Detector temeprature: 250 ℃
Injector temeprature: 250 ℃ Colum temperature: initial temperature 50 ℃ keep 5min
Rate: 8 ℃/min up to 100 ℃
Other conditon: carrier gas pressure 0.04Mpa



No.	Component
1	Formaldehyde
2	Methylal
3	Methyl formate
4	Methanol
5	Trimethyl orthoformate

Analysis of N-Methylpyrazine Residue

Column: WM-INOWAX 30m×0.32mm, 0.33μm, P/N: 05909-32021 Injector temeprature: 240 ℃
Detector temeprature: 240 ℃ Colum temperature: 140 ℃
Other conditon: carrier gas pressure 0.04Mpa



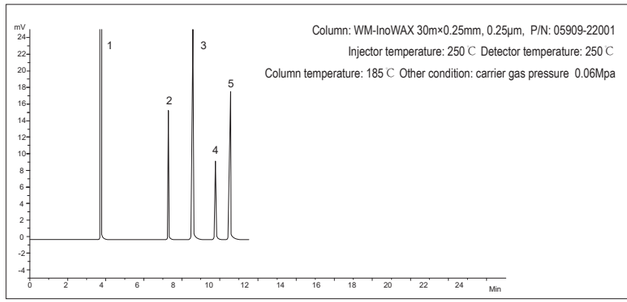
No.	Component
1	n-methylpyrazine
2	Dimethyl sulfoxide

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 excel-lentinter-batch reproducibility, which provides a strong guarantee for pharmaceutical enterprises to monitor drug quality.

Analysis of Tropine Mixed Samples

➤ **Charactertics:** analyze the reactants of tropine in medicine

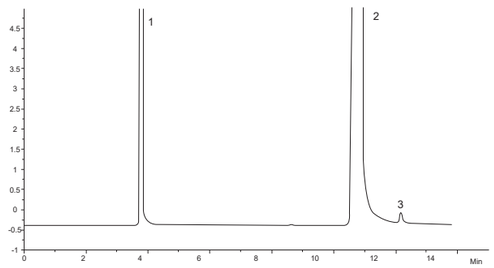


Column: WM-InoWAX 30m×0.25mm, 0.25μm, P/N: 05909-22001
Injector temperature: 250 ℃ Detector temperature: 250 ℃
Column temperature: 185 ℃ Other condition: carrier gas pressure 0.06Mpa

No.	Component
1	Solvent methanol
2	Tropinone
3	α-tropine
4	β-tropine
5	Nortropine

Analysis of the Purity of Noratropine

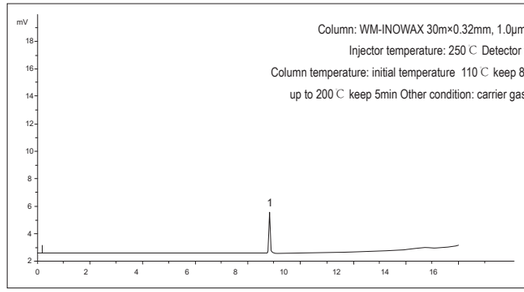
Column: WM-InoWAX 30m×0.25mm, 0.25μm, P/N:05909-22001 Injector temperature: 250 ℃
Detector temperature: 250 ℃ Column temperature: 185 ℃ Other condition: carrier gas pressure 0.06Mpa



No.	Component
1	Solvent methanol
2	Nortropine
3	Impurity

Analysis of Chloroethanol in Water

➤ **Charactertics:** 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

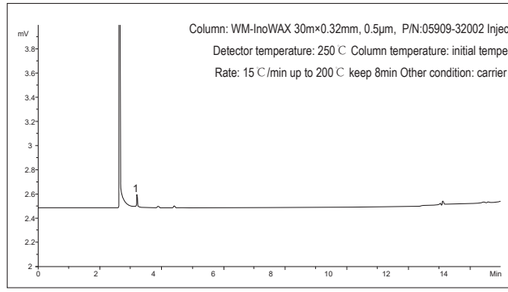


Column: WM-INOWAX 30m×0.32mm, 1.0μm, P/N:05909-32003
Injector temperature: 250 ℃ Detector temperature: 250 ℃
Column temperature: initial temperature 110 ℃ keep 8min Rate: 15 ℃/min
up to 200 ℃ keep 5min Other condition: carrier gas pressure 0.07Mpa

No.	Component
1	Chloroethanol

Analysis of Ethylene Oxide

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

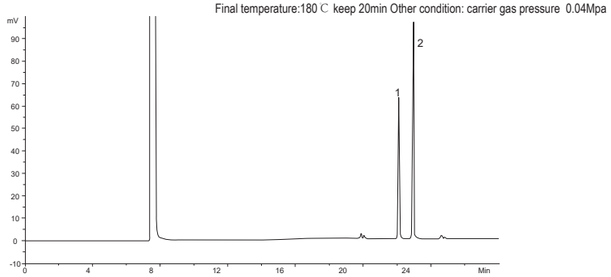


Column: WM-InoWAX 30m×0.32mm, 0.5μm, P/N:05909-32002 Injector temperature: 250 ℃
Detector temperature: 250 ℃ Column temperature: initial temperature 60 ℃ keep 6min
Rate: 15 ℃/min up to 200 ℃ keep 8min Other condition: carrier gas pressure 0.05Mpa

No.	Component
1	Ethylene oxide

Analysis of Borneol Capillary Column 1

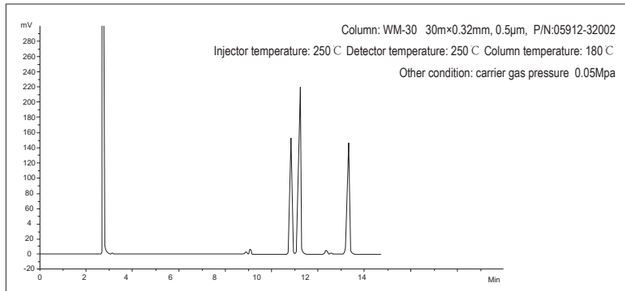
➤ **Charactertics:** referring to the analysis requirements of natural borneol and synthetic borneol in the pharmacopoeia, select the capillary column specified in the pharmacopoeia to detect the content of isobornol and borneol in borneol, and the analysis effect was better than that of packed column



No.	Component
1	d-borneol
2	l-borneol

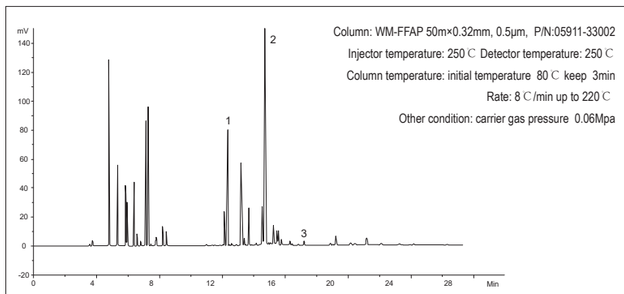
Analysis of Borneol by Capillary Column 2

➤ **Charactertics:** 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



No.	Component
1	d-borneol
2	l-borneol
3	n-dodecane

Analysis of Camphor, Camphor and Safrol in Essential Oil

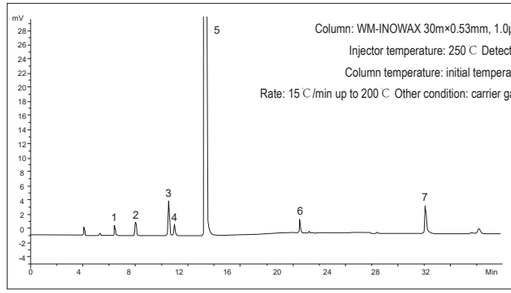


No.	Component
1	Camphor
2	Borneol
3	Safrole

INNOVATIVE/REPRODUCIBLE/RUGGED

Analysis of Coarse Morpholine

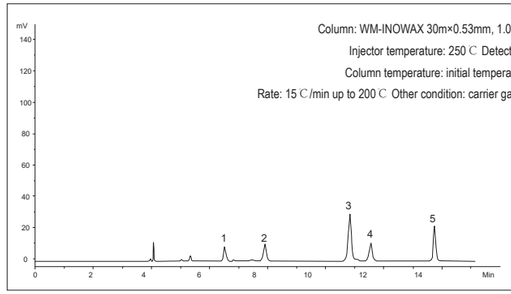
➤ **Charactertics:** the capillary column is suitable for detecting the purity of morpholine raw material and the composition of morpholine treated with dehydrogenation



No.	Component
1	Ethanol
2	n-methylmorpholine
3	Ethyl morpholine
4	Hqmme
5	Diethylene Glycol
6	diethylene glycol
7	2-(2-chloroethoxy) ethanol

Analysis of Morpholine

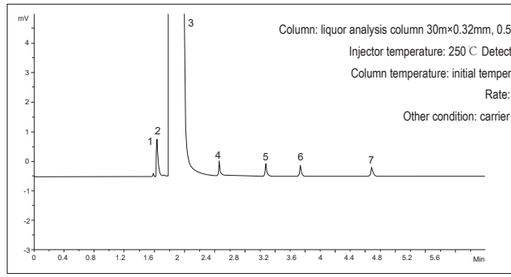
➤ **Charactertics:** The column can be used for analysis of related components of morpholine with good reproducibility and high resolution



No.	Component
1	Ethanol
2	n-methylmorpholine
3	n-ethylmorpholine
4	Hqmme
5	Morpholine

Determination of Ethanol Volatile Substance

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

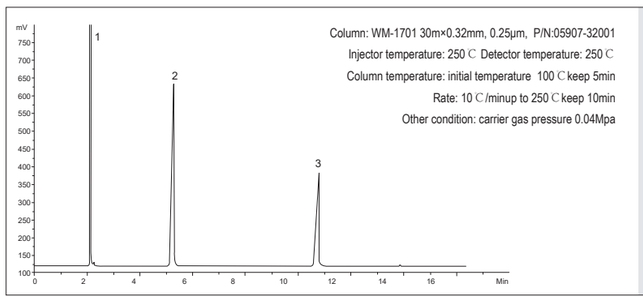


No.	Component
1	Acetaldehyde
2	Methanol
3	Ethanol
4	n-propanol
5	n-butanol
6	1-pentanol
7	Benzene

WELCH MATERIALS, INC.

Analysis of Maleic Anhydride and Succinic Anhydride

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

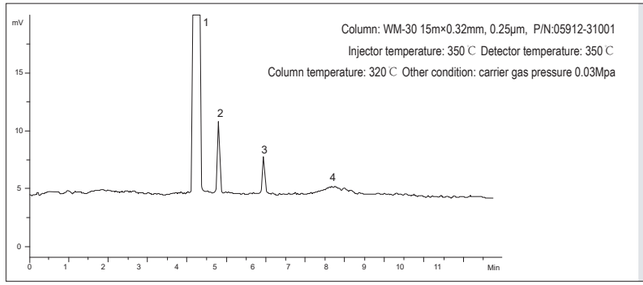


Column: WM-1701 30m×0.32mm, 0.25μm, P/N:05907-32001
Injector temperature: 250 ℃ Detector temperature: 250 ℃
Column temperature: initial temperature 100 ℃ keep 5min
Rate: 10 ℃/minup to 250 ℃ keep 10min
Other condition: carrier gas pressure 0.04Mpa

No.	Component
1	Acetonitrile
2	Maleic anhydride
3	Succinic anhydride

Analysis of Plasticizer

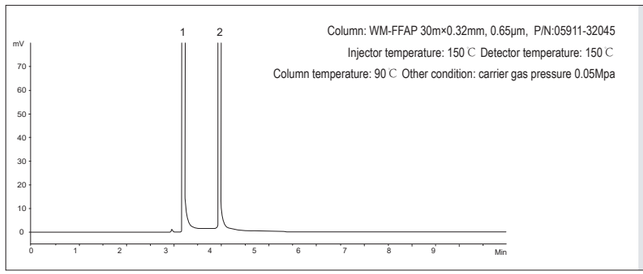
➤ **Charactertics:** this capillary column is suitable for detecting the components of phthalate plasticizer in medical packaging



Column: WM-30 15m×0.32mm, 0.25μm, P/N:05912-31001
Injector temperature: 350 ℃ Detector temperature: 350 ℃
Column temperature: 320 ℃ Other condition: carrier gas pressure 0.03Mpa

No.	Component
1	Butanone
2	Dibutyl phthalate
3	Dioctyl phthalate
4	Diisodecyl ortho-phthalate

Separation of Acetic Acid and Acetic Anhydride by Capillary Column



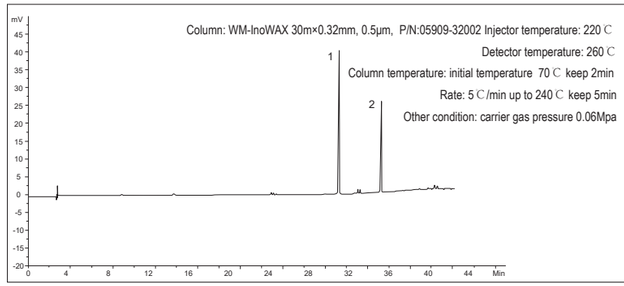
Column: WM-FFAP 30m×0.32mm, 0.65μm, P/N:05911-32045
Injector temperature: 150 ℃ Detector temperature: 150 ℃
Column temperature: 90 ℃ Other condition: carrier gas pressure 0.05Mpa

No.	Component
1	Ethanoic acid
2	Acetic anhydride

INNOVATIVE/REPRODUCIBLE/RUGGED

Analysis of Magnesium Stearate

➤ **Charactertics:** according to the requirement of magnesium stearate analysis in the pharmacopoeia, convert the magnesium stearate into methyl stearate by capillary column

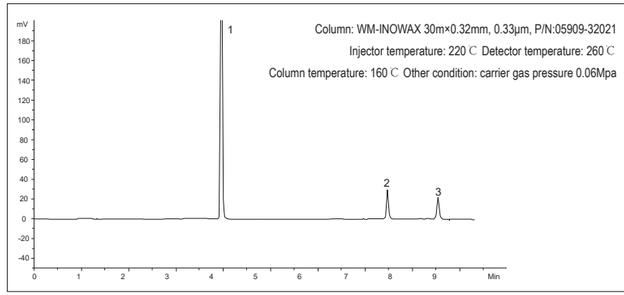


Column: WM-InoWAX 30m×0.32mm, 0.5μm, P/N:05909-32002 Injector temperature: 220 ℃
Detector temperature: 260 ℃
Column temperature: initial temperature 70 ℃ keep 2min
Rate: 5 ℃/min up to 240 ℃ keep 5min
Other condition: carrier gas pressure 0.06Mpa

No.	Component
1	Palmitate methyl ester
2	Methyl stearate

Analysis of Menthol Camphor

➤ **Charactertics:** according to the pharmacopoeia, use the capillary column to detect menthol camphor content

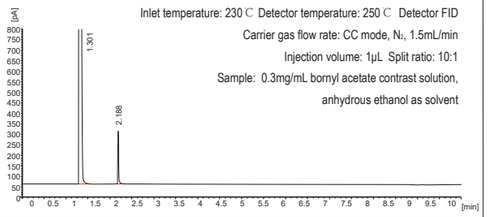


Column: WM-INOWAX 30m×0.32mm, 0.33μm, P/N:05909-32021
Injector temperature: 220 ℃ Detector temperature: 260 ℃
Column temperature: 160 ℃ Other condition: carrier gas pressure 0.06Mpa

No.	Component
1	Solvent
2	Camphor
3	Menthol

Amomum

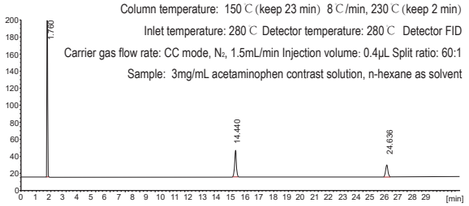
WEL-30, 30m×0.25mm, 0.25μm, P/N: 01912-22001 Column temperature: 200℃
Inlet temperature: 230℃ Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 10:1
Sample: 0.3mg/mL bornyl acetate contrast solution,
anhydrous ethanol as solvent



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

Pogostemon Cablin

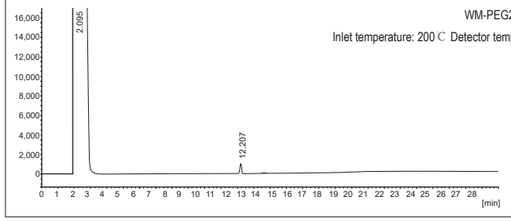
WM-54, 30m×0.32mm, 0.25μm, P/N: 05915-32001
Column temperature: 150℃(keep 23 min) 8℃/min, 230℃(keep 2 min)
Inlet temperature: 280℃ Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume: 0.4μL Split ratio: 60:1
Sample: 3mg/mL acetaminophen contrast solution, n-hexane as solvent



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

Fructus Anisi Stellati

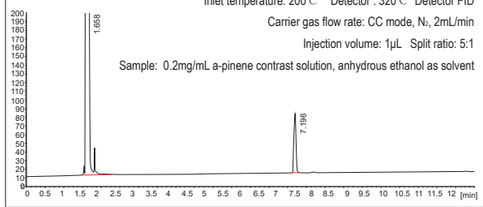
WM-PEG20M, 30m×0.32mm, 0.25μm, P/N: 05918-32001 Column temperature: 100℃ 5℃/min 200℃ (keep 8min)
Inlet temperature: 200℃ Detector temperature: 200℃ Detector FID Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume 1μL Splitless
Sample: 0.4mg/mL trans-anethole contrast solution, anhydrous ethanol as solvent



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

Pine Nodular Branch

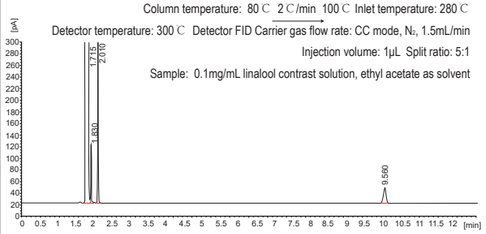
WM-54, 30m×0.32mm, 0.25μm, P/N: 05915-32001
Column temperature: 60℃(keep 5 min) 5℃/min 160℃ 30℃/min 300℃(keep 10 min)
Inlet temperature: 200℃ Detector : 320℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 2mL/min
Injection volume: 1μL Split ratio: 5:1
Sample: 0.2mg/mL a-pinene contrast solution, anhydrous ethanol as solvent



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

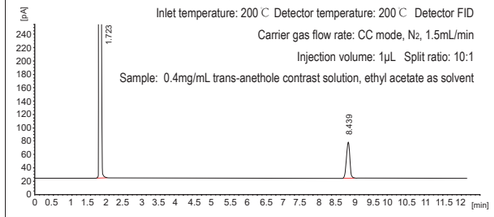
WEL-17, 30m×0.25mm, 0.25μm, P/N: 01916-22001
Column temperature: 80℃ 2℃/min 100℃ Inlet temperature: 280℃
Detector temperature: 300℃ Detector FID Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 5:1
Sample: 0.1mg/mL linalool contrast solution, ethyl acetate as solvent



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

Fennel

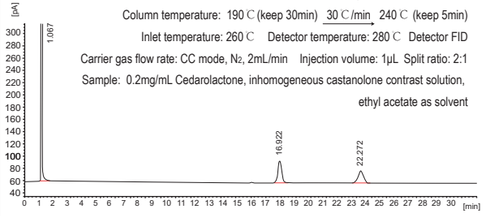
WM-PEG20M, 30m×0.32mm, 0.25μm, P/N: 05918-32001 Column temperature: 145℃
Inlet temperature: 200℃ Detector temperature: 200℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 10:1
Sample: 0.4mg/mL trans-anethole contrast solution, ethyl acetate as solvent



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

Elecampane

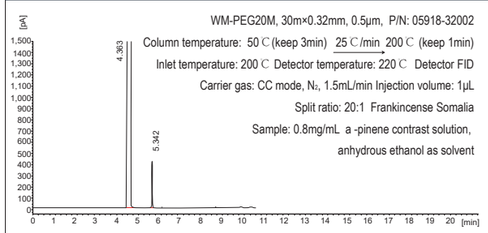
WM-PEG20M, 30m×0.25mm, 0.25μm, P/N: 05918-22001
Column temperature: 190℃(keep 30min) 30℃/min 240℃ (keep 5min)
Inlet temperature: 260℃ Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 2mL/min Injection volume: 1μL Split ratio: 2:1
Sample: 0.2mg/mL Cedarolactone, inhomogeneous castanolone contrast solution,
ethyl acetate as solvent



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

Frankincense Somalia

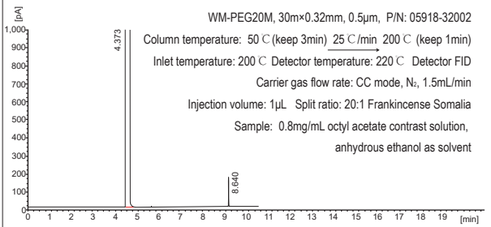
WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 50℃(keep 3min) 25℃/min 200℃ (keep 1min)
Inlet temperature: 200℃ Detector temperature: 220℃ Detector FID
Carrier gas: CC mode, N_2, 1.5mL/min Injection volume: 1μL
Split ratio: 20:1 Frankincense Somalia
Sample: 0.8mg/mL a -pinene contrast solution,
anhydrous ethanol as solvent



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

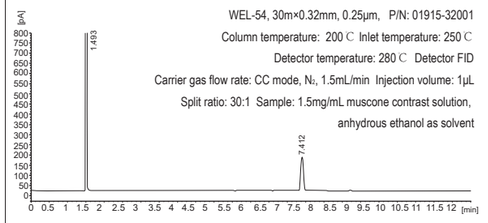
WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 50℃(keep 3min) 25℃/min 200℃ (keep 1min)
Inlet temperature: 200℃ Detector temperature: 220℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 20:1 Frankincense Somalia
Sample: 0.8mg/mL octyl acetate contrast solution,
anhydrous ethanol as solvent



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

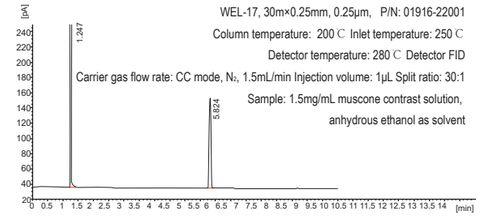
Moschus

WEL-54, 30m×0.32mm, 0.25μm, P/N: 01915-32001
Column temperature: 200℃ Inlet temperature: 250℃
Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume: 1μL
Split ratio: 30:1 Sample: 1.5mg/mL muscone contrast solution,
anhydrous ethanol as solvent



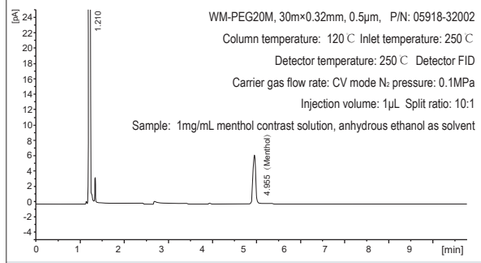
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.493	23616	2.403	27792	
2	Muscone	7.412	783	0.922	59574	75.45

WEL-17, 30m×0.25mm, 0.25μm, P/N: 01916-22001
Column temperature: 200℃ Inlet temperature: 250℃
Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume: 1μL Split ratio: 30:1
Sample: 1.5mg/mL muscone contrast solution,
anhydrous ethanol as solvent



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

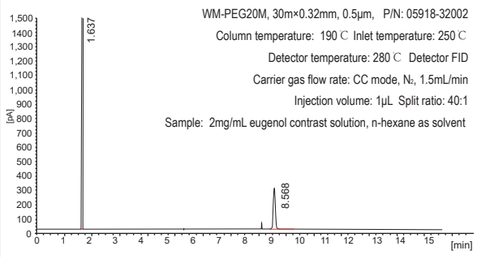
Menthol



WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 120℃ Inlet temperature: 250℃
Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CV mode N_2 pressure: 0.1MPa
Injection volume: 1μL Split ratio: 10:1
Sample: 1mg/mL menthol contrast solution, anhydrous ethanol as solvent

No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Ethanol	1.210	2355206	1.0	8089	
2	Menthol	4.955	26378	1.0	32194	45.7

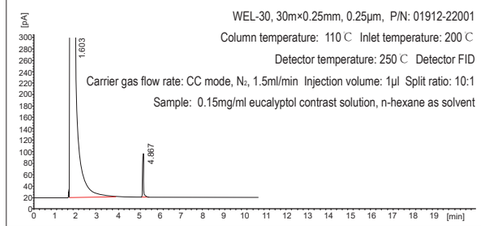
Cloves



WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 190℃ Inlet temperature: 250℃
Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 40:1
Sample: 2mg/mL eugenol contrast solution, n-hexane as solvent

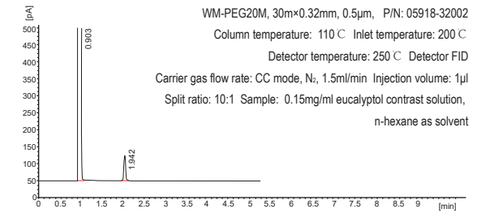
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	1.637	32780	1.728	72668	
2	Eugenol	8.568	173	1.110	48854	77.50

Folium Artemisiae Argyi



WEL-30, 30m×0.25mm, 0.25μm, P/N: 01912-22001
Column temperature: 110℃ Inlet temperature: 200℃
Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5ml/min Injection volume: 1μl Split ratio: 10:1
Sample: 0.15mg/ml eucalyptol contrast solution, n-hexane as solvent

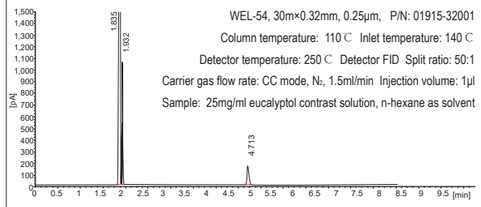
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	1.603	706081	3.835	9921	
2	Eucalyptol	4.867	212	1.074	72224	47.84



WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 110℃ Inlet temperature: 200℃
Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5ml/min Injection volume: 1μl
Split ratio: 10:1 Sample: 0.15mg/ml eucalyptol contrast solution,
n-hexane as solvent

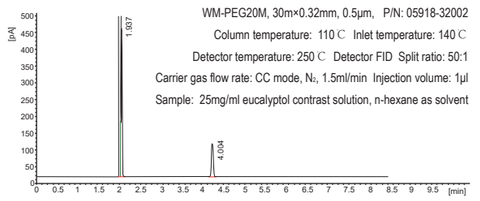
No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	0.903	1733619	2.246	5342	
2	Eucalyptol	1.942	196	1.040	13510	17.91

Nutmeg



WEL-54, 30m×0.32mm, 0.25μm, P/N: 01915-32001
Column temperature: 110℃ Inlet temperature: 140℃
Detector temperature: 250℃ Detector FID Split ratio: 50:1
Carrier gas flow rate: CC mode, N_2, 1.5ml/min Injection volume: 1μl
Sample: 25mg/ml eucalyptol contrast solution, n-hexane as solvent

No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	1.853	169869	2.005	47971	
2		1.932	590	1.020	117519	2.79
3	Eucalyptol	4.713	140	1.033	78871	62.20



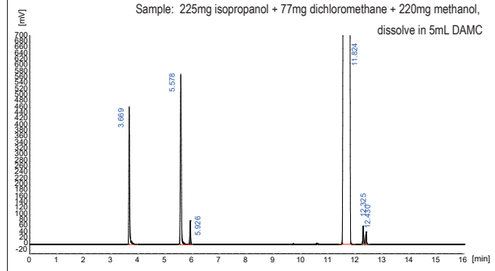
WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 110℃ Inlet temperature: 140℃
Detector temperature: 250℃ Detector FID Split ratio: 50:1
Carrier gas flow rate: CC mode, N_2, 1.5ml/min Injection volume: 1μl
Sample: 25mg/ml eucalyptol contrast solution, n-hexane as solvent

No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	n-hexane	1.883	112432	1.799	52231	
2		1.937	623	1.103	56959	1.66
3	Eucalyptol	4.004	284	1.031	46674	38.90

INNOVATIVE/REPRODUCIBLE/RUGGED

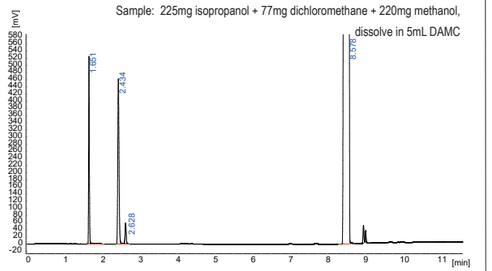
2.6 APPLICATION IN OTHER FIELDS

Amoxicillin Residual Solvent



WM-624, 60m×0.32mm, 1.8μm, P/N: 03908-34004
Column temperature: 40℃(keep 4 min) 30 ℃/min 200℃ Inlet temperature: 240℃
Detector temperature: 250℃ Detector FID Carrier gas flow rate: H_2, 14psi Injection volume: 1μL
Sample: 225mg isopropanol + 77mg dichloromethane + 220mg methanol,
dissolve in 5mL DAMC

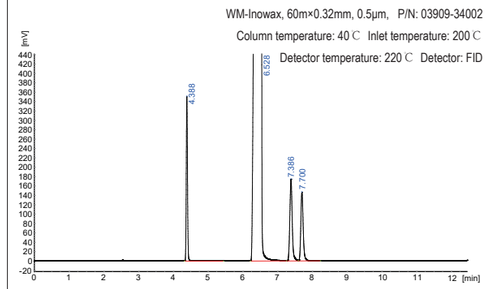
No.	Componet	Retention	Width	Tailing Factor	Resolution
1	Methanol	3.669	0.028	1.32	0
2	Isopropanol	5.578	0.036	1.075	35.122
3	Methylene chloride	5.926	0.03	1.031	6.211
4	DAMC	11.824	0.26	0.556	23.942



WM-624, 30m×0.53mm, 2.0μm, P/N: 03908-52005
Column temperature: 40℃(keep 4 min) 30℃/min 200℃ Inlet temperature: 240℃
Detector temperature: 250℃ Detector FID Carrier gas flow rate: H_2, 14psi Injection volume: 1μL
Sample: 225mg isopropanol + 77mg dichloromethane + 220mg methanol,
dissolve in 5mL DAMC

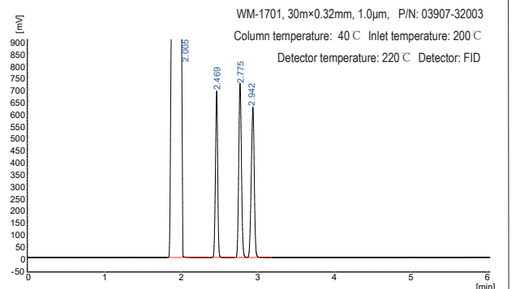
No.	Componet	Retention	Width	Tailing Factor	Resolution
1	Methanol	1.651	0.02	1.156	0
2	Isopropanol	2.434	0.034	1.159	16.964
3	Methylene chloride	2.628	0.031	1.03	3.479
4	DAMC	8.578	0.161	0.582	36.471

Solvent Separation



WM-Inowax, 60m×0.32mm, 0.5μm, P/N: 03909-34002
Column temperature: 40℃ Inlet temperature: 200℃
Detector temperature: 220℃ Detector: FID

No.	Componet	Retention	Half width	Tailing Factor	Resolution
1	Acetone	4.388	0.036	1.1	0
2	Methanol	6.528	0.226	0.564	9.611
3	Isopropanol	7.386	0.067	1.14	3.445
4	Ethanol	7.7	0.066	1.185	2.787

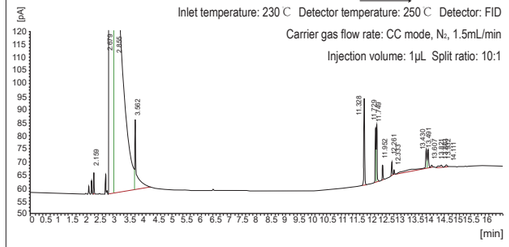


WM-1701, 30m×0.32mm, 1.0μm, P/N: 03907-32003
Column temperature: 40℃ Inlet temperature: 200℃
Detector temperature: 220℃ Detector: FID

No.	Componet	Retention	Half width	Tailing Factor	Resolution
1	Methanol	2.005	0.145	0.559	0
2	Ethanol	2.469	0.029	0.929	3.135
3	Acetone	2.775	0.035	1.069	5.55
4	Isopropanol	2.942	0.039	0.943	2.625

Related Substance of Propanediol

WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 80℃(keep 3min) 15℃/min → 220℃ (keep 4min)
Inlet temperature: 230℃ Detector temperature: 250℃ Detector: FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 10:1

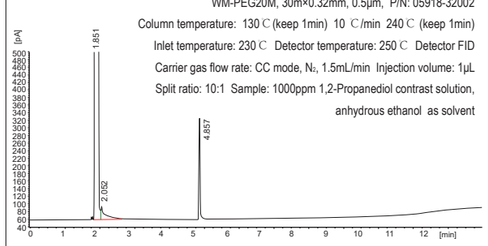


Sample: 12mg/ml Diethylene glycol+242.2mg/ml Dipropylene glycol +68.8mg/ml Tripropylene glycol+8.4mg/m Epoxy propane contrast solution, anhydrous ethanol as solvent

No.	Componet	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

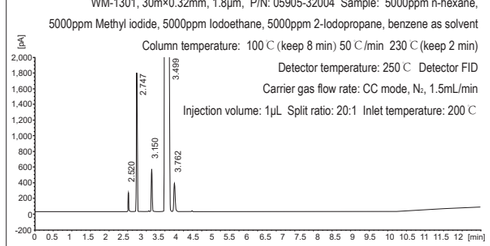
WM-PEG20M, 30m×0.32mm, 0.5μm, P/N: 05918-32002
Column temperature: 130℃(keep 1min) 10 ℃/min 240℃ (keep 1min)
Inlet temperature: 230℃ Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume: 1μL
Split ratio: 10:1 Sample: 1000ppm 1,2-Propanediol contrast solution, anhydrous ethanol as solvent



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

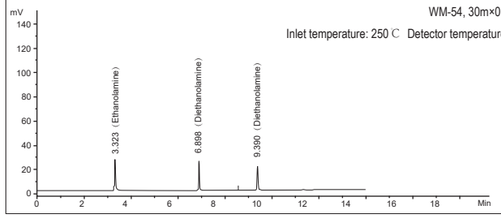
WM-1301, 30m×0.32mm, 1.8μm, P/N: 05905-32004 Sample: 5000ppm n-hexane, 5000ppm Methyl iodide, 5000ppm Iodoethane, 5000ppm 2-Iodopropane, benzene as solvent
Column temperature: 100℃(keep 8 min) 50℃/min 230℃(keep 2 min)
Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min
Injection volume: 1μL Split ratio: 20:1 Inlet temperature: 200℃



No.	Componet	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	0.970	45821	2.87

Triethanolamine

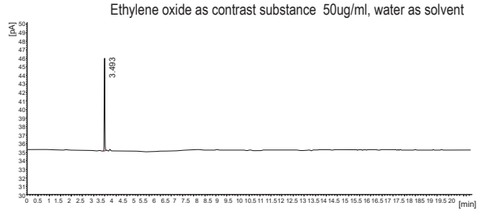
WM-54, 30m×0.53mm, 3.0μm, P/N: 05915-52006 Column temperature: 60℃(keep 2min) 30 ℃/min 230℃ (keep 10min)
Inlet temperature: 250℃ Detector temperature: 250℃ Detector FID Carrier gas flow rate: CV mode N_2, 0.04MPa Injection volume: 1μL Split ratio: 50:1
Sample: 2uL/mL ethanolamine. diethanolamine triethanolamine contrast solution, water as solvent



No.	Componet	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

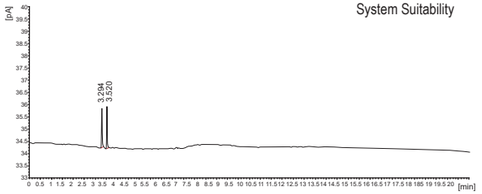
Ethylene oxide as contrast substance 50ug/ml, water as solvent



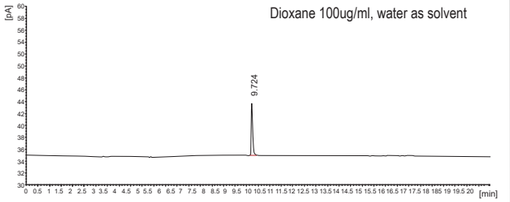
WM-1, 30m×0.53mm, 1.0μm, P/N: 05901-52003 Column temperature: 190℃
Inlet temperature: 250℃ Detector temperature: 280℃ Detector FID
Carrier gas flow rate: CC mode, N_2, 1.5mL/min Injection volume: 1μL Split ratio: 40:1

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

System Suitability



Dioxane 100ug/ml, water as solvent

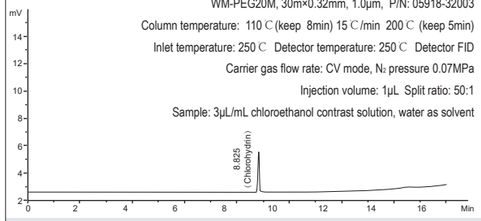


No.	Componet	Retention	Area	Tailing Factor	Plates	Resolution
1	Acetaldethyde	3.294	2.8	1.395	97748	0
2	Ethylene oxide	3.520	3.2	1.297	97930	5.197

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

Gelatin Hollow Capsules Containing Chloroethanol

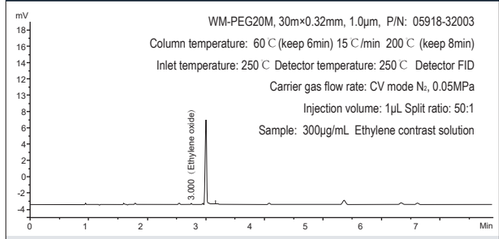
WM-PEG20M, 30m×0.32mm, 1.0μm, P/N: 05918-32003
Column temperature: 110℃(keep 8min) 15℃/min 200℃ (keep 5min)
Inlet temperature: 250℃ Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CV mode, N_2 pressure 0.07MPa
Injection volume: 1μL Split ratio: 50:1
Sample: 3μL/mL chloroethanol contrast solution, water as solvent



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

Gelatin Hollow Capsules Containing Ethylene Oxide

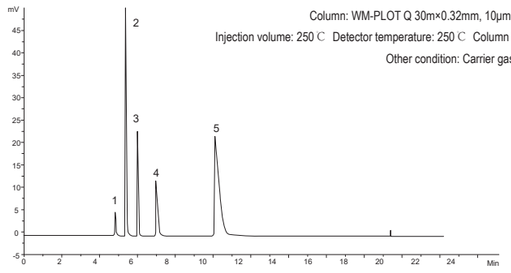
WM-PEG20M, 30m×0.32mm, 1.0μm, P/N: 05918-32003
Column temperature: 60℃(keep 6min) 15℃/min 200℃ (keep 8min)
Inlet temperature: 250℃ Detector temperature: 250℃ Detector FID
Carrier gas flow rate: CV mode N_2, 0.05MPa
Injection volume: 1μL Split ratio: 50:1
Sample: 300μg/mL Ethylene contrast solution



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

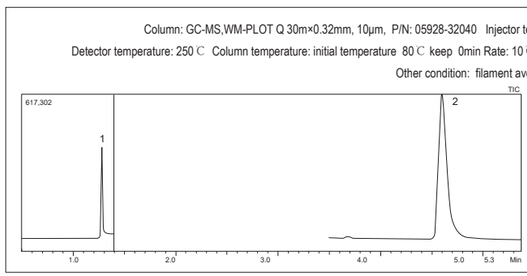
Analysis of Alcohol in Blood

➤ **Charactertics:** 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.



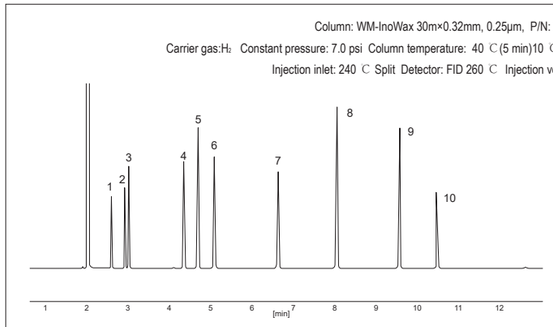
No.	Component
1	Formaldehyde
2	Ethanol
3	n-propanol
4	Tert-butanol
5	n-butanol

Analysis of Methylsilane and Propylsilane in Ethylsilane



No.	Component
1	Silane
2	Trisilane

Analysis of Alcohol Compounds

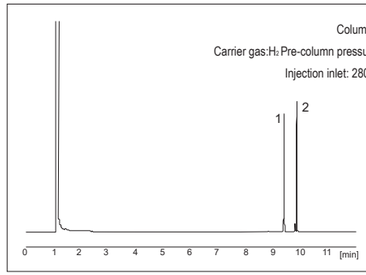


No.	Component
1	Methanol
2	Isopropanol
3	Ethanol
4	2-Methyl-2-butanol(tert-amyl alcohol)
5	2-Butanol(sec-Butanol)
6	Propanol
7	Isobutol
8	Butanol
9	Isopentanol
10	Pentanol

INNOVATIVE/REPRODUCIBLE/RUGGED

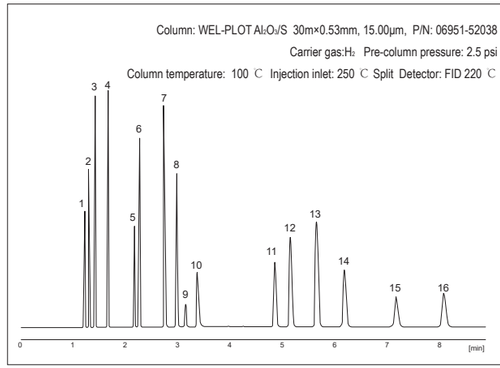
BHA (carcinogen, butylhydroxyanisole) and BHA Determination of BHT (dibutyl hydroxytoluene)

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



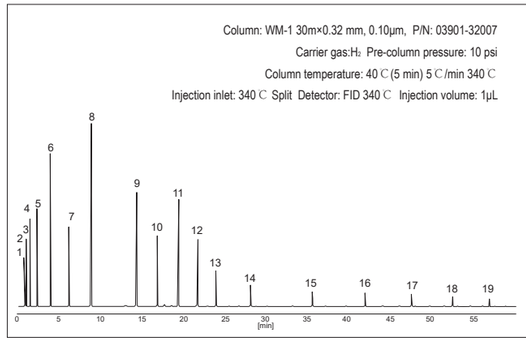
No.	Component
1	BHT
2	BHA

C1-C5 Hydrocarbons (analysis of hydrocarbons)



No.	Component	No.	Component
1	Methane	9	Propadiene
2	Ethane	10	Acetylene
3	Ethylene	11	t-2-Butylene
4	Propane	12	1-Butene
5	Cyclopropane	13	iso-Butylene
6	Propylene	14	c-2-Butene
7	iso-Butane	15	iso-Pentane
8	Butane	16	Pentane

C5-C40 Hydrocarbons (Analysis of Hydrocarbons)

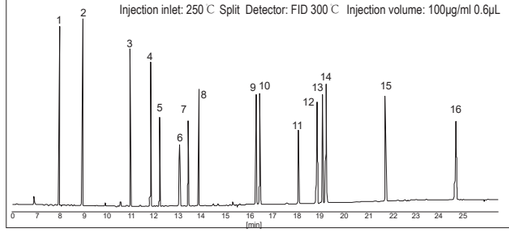


No.	Component	No.	Component
1	n-C5	11	n-C16
2	n-C6	12	n-C17
3	n-C7	13	n-C18
4	n-C8	14	n-C20
5	n-C9	15	n-C24
6	n-C10	16	n-C28
7	n-C11	17	n-C32
8	n-C12	18	n-C36
9	n-C14	19	n-C40
10	n-C15		

WELCH MATERIALS, INC.

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

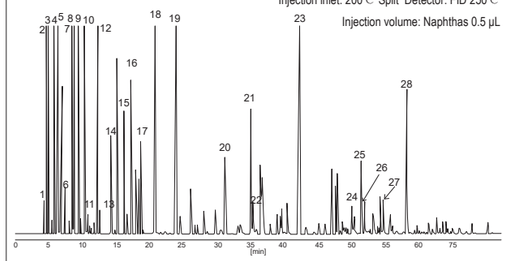
Column: WM-5MS 30m×0.25mm, 0.25μm, P/N: 03904-22001
Carrier gas:H_2 Pre-column pressure: 12 psi
Column temperature: 60℃(1 min) 20℃/min to 220℃(1 min)5℃/min to 280℃(5 min)
Injection inlet: 250℃ Split Detector: FID 300℃ Injection volume: 100μg/ml 0.6μL



No.	Component	No.	Component
1	Dimethyl phthalate(DMP)	9	Dihexyl phthalate(DHXP)
2	Diethyl phthalate(DEP)	10	Benzyl butyl phthalate(BBP)
3	Disobutyl phthalate(DIBP)	11	Bis(2-n-Butoxyethyl) phthalate (DBEP)
4	Dibutyl phthalate(DBP)	12	Dicyclohexyl phthalate(DCHP)
5	Bis(2-Methoxyethyl) phthalate(DMEP)	13	Bis(2-Ethylhexyl) phthalate (DEHP)
6	Bis(4-Methyl-2-pentyl) phthalate(BMPP)	14	Diphenyl phthalate
7	Bis(2-Ethoxyethyl)phthalate(DEEP)	15	Di-n-octyl phthalate (DNOP)
8	Dipentyl phthalate(DPP)	16	Dinonyl phthalate (DNP)

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

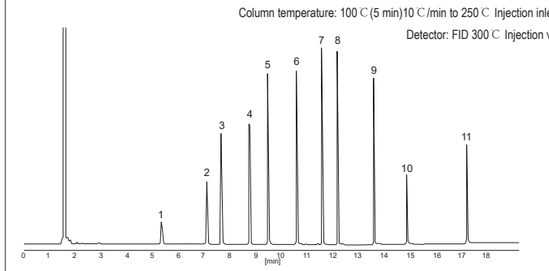
Column: WEL-PONA 50m×0.20mm, 0.50μm, P/N: 01936-13002
Carrier gas:H_2 Pre-column pressure: 13 psi
Column temperature: 35℃(30min) 2℃/min to 200℃
Injection inlet: 200℃ Split Detector: FID 250℃
Injection volume: Naphthas 0.5 μL



No.	Component	No.	Component
1	Propane	15	2-Methylhexane
2	Isobutane	16	2, 3-Dimethylpentane
3	Butane	17	3-Methylhexane
4	Isopentane	18	Heptane
5	Pentane	19	Methylcyclohexane
6	2, 2-Dimethyl butane	20	Toluene
7	Cyclopentane	21	2-Methylheptane
8	2-Methyl pentane	22	4-Methylheptane
9	3-Methyl pentane	23	Octane
10	Hexane	24	Ethylbenzene
11	2, 2-Dimethyl pentane	25	m-Xylene
12	Methylcyclopentane	26	p-Xylene
13	2, 4-Dimethylpentane	27	o-Xylene
14	Benzene	28	Nonane

Small Molecular Organic Acids Determination

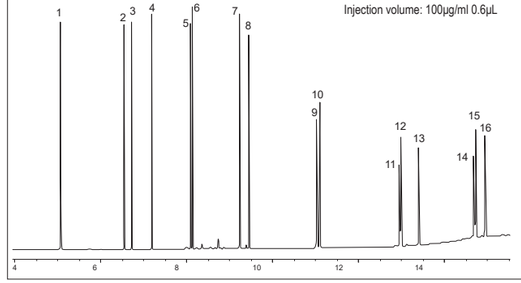
Column: WM-FFAP 30m×0.25mm, 0.25μm, P/N: 03911-22001 Carrier gas:H_2 Pre-column pressure: 10.0 psi
Column temperature: 100℃(5 min)10℃/min to 250℃ Injection inlet: 250℃ Split
Detector: FID 300℃ Injection volume: 0.5 μL



No.	Component
1	Acetic acid
2	Propionic acid
3	Isobutyric acid
4	Butyric acid
5	Isovaleric acid
6	Valeric acid
7	Isocaproic acid
8	Caproic acid
9	Heptanoic acid
10	Octanoic acid
11	Decanoic acid

Determination of Polycyclic Aromatic Hydrocarbons (PAHS)

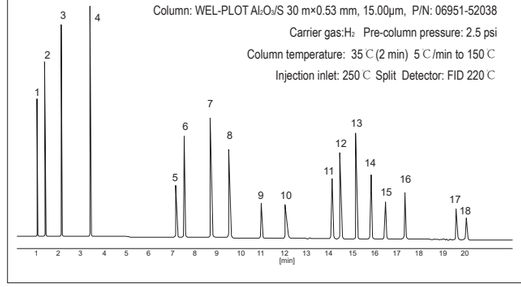
Column: WM-5MS 30m×0.25mm, 0.25μm, P/N: 03904-22001
Carrier gas:H_2 60 cm/sec Column temperature: 45℃(1 min)25℃/min to 250℃
5℃/min to 265℃ 25℃/min to 325℃ Injection inlet: 300℃ Split Detector: FID 320℃
Injection volume: 100μg/ml 0.6μL



No.	Component	No.	Component
1	Naphthalene	9	Benz(a)anthracene
2	Acenaphthylene	10	Chrysene
3	Acenaphthene	11	Benzo(b)fluoranthene
4	Fluorene	12	Benzo(k)fluoranthene
5	Phenanthrene	13	Benzo(a)pyrene
6	Anthracene	14	Indeno(1, 2, 3-cd)pyrene
7	Fluoranthene	15	Dibenz(a, h)anthracene
8	Pyrene	16	Benzo(g, h, i)perylene

Determination of Refinery Gas

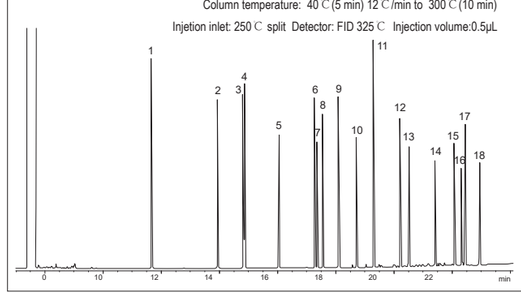
Column: WEL-PLOT Al_2O_3/S 30 m×0.53 mm, 15.00μm, P/N: 06951-52038
Carrier gas:H_2 Pre-column pressure: 2.5 psi
Column temperature: 35℃(2 min) 5℃/min to 150℃
Injection inlet: 250℃ Split Detector: FID 220℃



No.	Component	No.	Component
1	Methane	10	Acetylene
2	Ethane	11	t-2-Butylene
3	Ethylene	12	1-Butene
4	Propane	13	iso-Butylene
5	Cyclopropane	14	c-2-Butene
6	Propylene	15	iso-Pentane
7	iso-Butane	16	Pentane
8	Butane	17	1,3-Butadiene
9	Propadiene	18	Propyne

Determination of Substituted Aniline Compounds

Column:WM-5ms 30m×0.25mm, 0.50μm, P/N: 03904-22002
Carrier gas: H_2 33 cm/sec Measured at 150℃
Column temperature: 40℃(5 min) 12℃/min to 300℃(10 min)
Injetion inlet: 250℃ split Detector: FID 325℃ Injection volume:0.5μL



No.	Component	No.	Component
1	Aniline	10	2,4,5-Trichloroaniline
2	2-Chloroaniline	11	4-Nitroaniline
3	3-Chloroaniline	12	2-Chloro-4-nitroaniline
4	4-Chloroaniline	13	2,6-Dichloro-4-nitroaniline
5	4-Bromoaniline	14	2-Bromo-6-chloro- 4-nitroaniline
6	2-Nitroaniline	15	2-Chloro-4,6-dinitroaniline
7	,4,6-Trichloroaniline	16	2,6-Dibromo-4-nitroaniline
8	3,4-Dichloroaniline	17	2,4-Dinitroaniline
9	3-Nitroaniline	18	2-Bromo-4,6-dinitroaniline

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				

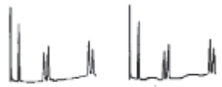
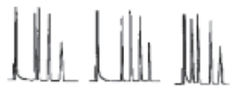
3.2 GC COLUMN ACCESSORIES

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 possibile
- ➤ 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

INNOVATIVE/REPRODUCIBLE/RUGGED

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:

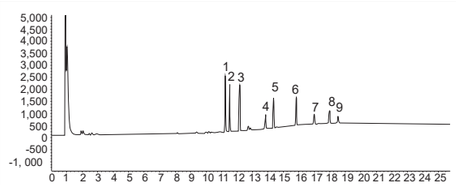
After homogenization, the sample is subjected to extraction with water and acetone, followed by addition of sodium chloride and dichloromethane to achieve phase separation. The organic phase is then concentrated and redissolved in petroleum ether, treated with concentrated sulfuric acid for sulfonation,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

➤ Sample Preparation:

1. After precise weighing and homogenizing, put 2g samples into 100ml conical flask and soaked in 20ml water overnight.
2. Add acetone 40ml precisely, ultrasoundfor 30 mins (using acetone to make up the reduced weight);
3. Add 6g NaCl, 30ml dichloromethane, ultrasound for 15 mins(using acetone to make up the reduced weight);
4. Transfer organic phase to a 100ml conical flask containing an appropriate amount of anhydrous sodium sulfate and placed for 4 hours.
5. Weigh 35ml precisely and through decompression and concentration under 40℃ to nearly dry, then add a small amount of petroleum ether (60~90℃) to converse several times.
6. Dissolve in petroleum ether and transfer to a centrifuge tube, then dilute with petroleum ether (60-90°C) to 5mL.
7. Carefully add 1ml sulfuric acid, shake for 1 minute.
8. Centrifuge at 3000rpm for 10 minutes. Take 2ml of the supernatant for precision measurement and place it in a graduated concentrator.
9. Through decompression and concentration under 40℃ to nearly dry, add petroleum ether (60~90℃) to 1mL for GC-ECD analysis.

➤ GC Chromatographic Condition:

GC-ECD Chromatogram of 9 organochlorine standard solutions



Column: WM-1701 (30m×0. 32mm, 0.25μm)
Column temperature: 100℃ (0min) 10℃/min→220℃ (0min) 8℃/min →250℃ (10min)
Carrier gas: N_2 Injector: 250℃, splitless injection Detector: ECD 300℃
Peak: 1- α- benzene hexachloride, 2-quintozene, 3-γ- benzene hexachloride, 4-β- benzene hexachloride
5-δ- benzene hexachloride, 6- p,p'-DDE, 7- o,p'-DDT, 8- p,p'-DDD, 9- p,p'-DDT

➤ 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.

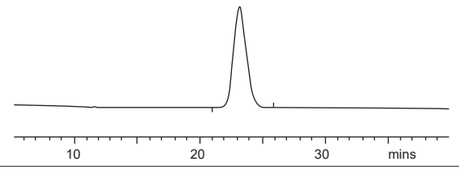
➤ Sample Preparation:

1. After precisely weigh and homogeneity, put 1.5g samples in a 50mL centrifuge tube and soak it in 10ml water for 2 hours.
2. Carefully add 15 mL of acetonitrile, vigorously shake for 1 minute to extract.
3. Add QuEChERS extraction bag (4g anhydrous magnesium sulfate +1g sodium chloride) and shake violently for 1 min.
4. After centrifugation at 4000rpm for 1 min precisely transfer 10mL acetonitrile phase and through decompression and concentration at 40℃.
5. Transfer 10mL solution of ethyl acetate - cyclohexane (1:1) to a 10mL measuring flask by seversl times, and keep volume at 10ml.
6. Take 5 ml of supernatant to be purified by Gel Column (Welch Bio-Beads S-X3 400×25mm).
7. Collect the eluate from 18 to 30 minutes of purification, concentrate it under vacuum at 40°C to near dryness, and then redissolve it in 1mL of n-heptane. Alternatively, you can collect the eluate based on the detector's indication of the peak corresponding to organic chlorides.
8. Use Florisil SPE Cartridge for purification (Florisil PR 1000mg/6ml).
9. The purified sample is concentrated to near dryness using a nitrogen evaporator, then dissolved in 1 mL of iso-octane by vortexing, and finally supplied for GC-ECD analysis.

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

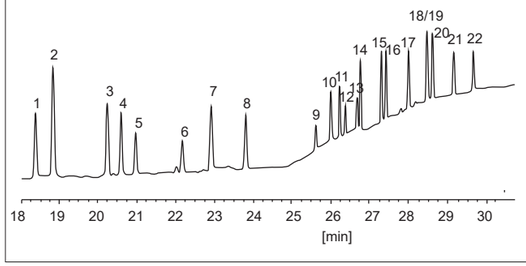
➤ Chromatographic Analysis:

(1) Chromatogram of 22 kinds of organochlorine standard solutions GPC



Column: Welch Bio-Beads S-X3 400×25mm
Flow rate: 5ml/min Mobile phase: cyclohexane/ethyl acetate=1:1
Column temperature: room temperatrue(about 24℃)

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



GC Column: WM-17 (30m×0.25mm, 0.25μm),
Column temperature: 70 ℃(1min)10 ℃/min→180 ℃(5 min)5 ℃/min →220 ℃(0 min)100 ℃/min→280 ℃(8 min)
Carrier gas: N_2, 1.3ml/min Injector: 240 ℃, splitless injection
Detector: ECD 300 ℃ Peaks: 1-Hexachlorobenzene, 2-α-Benzene hexachloride, 3-Quintozene,4-γ-benzene hexachloride, 5-β-benzene hexachloride, 6-Heptachlor, 7-δ--benzene hexachloride, 8-Aldrin, 9-Oxychlordane Isomer, 10-Ethylcarboxamido Adenosine, 11-Heptachlor-endo-epoxide, 12-Trans-chlordane, 13-Cis-chlordane, 14-α-endosulfan, 15- p, p'-DDE, 16-Dieldrin, 17-Endrin, 18-o, p'-DDT, 19- p, p'-DDD, 20-β-endosulfan, 21- p, p'-DDT, 22- Sulfate

➤ 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 extration 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:

1. Precisely weigh 5g of homogenized (passed through a No. 3 sieve) sample into a 100mL conical flask, then add 5g of anhydrous sodium sulfate.
2. Add ethyl acetate for 50~100ml to through ultrasonic extraction in ice bath for 3min. Keep still.
3. Filtrate the upper layer, and extract the residue repeatedly, then combine the extract.
4. Wash the drug residue and filter paper with ethyl acetate, combine the filtrate, and concentrate under reduced pressure at 40°C to near dryness.
5. Redissolve it with ethyl acetate and add to 5ml.
6. Take 1ml, purified with Graphic carbon SPE cartridge (250mg/3mL) Activation: activate the column with ethyl acetate 50mL, do not collect. Sample loading add 1ml ethyl acetate solution to the cartridge without collection. Elution: elute with 5ml n-hexane-ethyl acetate (1:1) mixed solution, collect the effeunt.
7. Concentrate the eluent to near dry with nitrogen evaporator.
8. Add ethyl acetate to 1ml, vortex to dissolve.

➤ 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

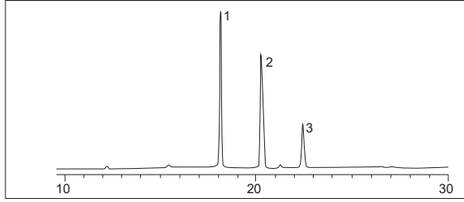
➤ Sample Preparation:

1. Precisely weigh 1-2g homogenized samples passed through a No. 3 sieve into 100ml conical flask with plug.
2. The petroleum ether-acetone (4:1) solution was added to 30ml and extracted by ultrasonic for 15min.
3. Transfer the extraction solution, and extract the crude drug samples twice and combine with the extraction solution.
4. After dehydration with anhydrous sodium sulfate, reduce the filtrate to nearly dry by decompression.
5. Used a small amount of petroleum ether repeatedly until acetone was removed and then dissolve with 5ml petroleum ether. Purify with special SPE cartridge for pyrethroid:Activation: Activate the cartridge by petroleum ether-ethyl ether (4:1) mixed solution of 20mL, without collection. Sample loading: add 5ml petroleum ether solution to the cartridge and collect the outflow. Elution: elute with 90ml mixed solution of Petroleum ether - ethyl ether (4:1) and collect the elution. Reduce pressure and concentrate the sample effluent and eluent under 40 ℃ to nearly dry. Repeat the operation with 4ml of petroleum ether until the ethyl ether is removed, dissolve with a small amount of petroleum ether and transfer it to a 5ml measuring bottle, make a constant volume with petroleum ether, shake well.

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

➤ Chromatographic Analysis:

Chromatogram of substances of three kinds of permethrin



Column: WM-5 30m×0.32mm, 0.25μm, Detector: ECD
Inlet temperature: 270 ℃, detector temperature 330 ℃, splitless injection
Temperature program: 160 ℃(1min)10 ℃/min→278 ℃(0.5min), 1 ℃/min →290 ℃(5min)

➤ 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:

1. Precisely weigh tested product 3g to 50mL polystyrene centrifuge tube with plug
2. Add 15ml 1% glacial acetic acid solution and vortex for 30min.
3. Precisely add 15ml acetonitrile and 100μl internal standard solution;
4. Vigorously shake for 5 min to extract.
5. Add QuEChERS extraction bag and shake violently for 3min, then cool in the ice bath for 10 min.
6. After centrifugation at 4000rpm for 5min, take 9ml supernatant and added into the QuEChERS clean-up tube, vigorously shake for 5 min to extract.
7. After centrifugation at 4000 rpm for 5 minutes, 5 mL of the supernatant is collected and then concentrated to approximately 0.4 mL using a nitrogen evaporator at 40°C. Subsequently, it is made up to 1mL with acetonitrile for further analysis.
8. After thorough vortex mixing, the solution is filtered through a 0.22 μm nylon membrane filter for analysis using the instrument.

➤ 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 MgSO4,300mg 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/NH_2, 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.

INNOVATIVE/REPRODUCIBLE/RUGGED

➤ 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 stabilty 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:

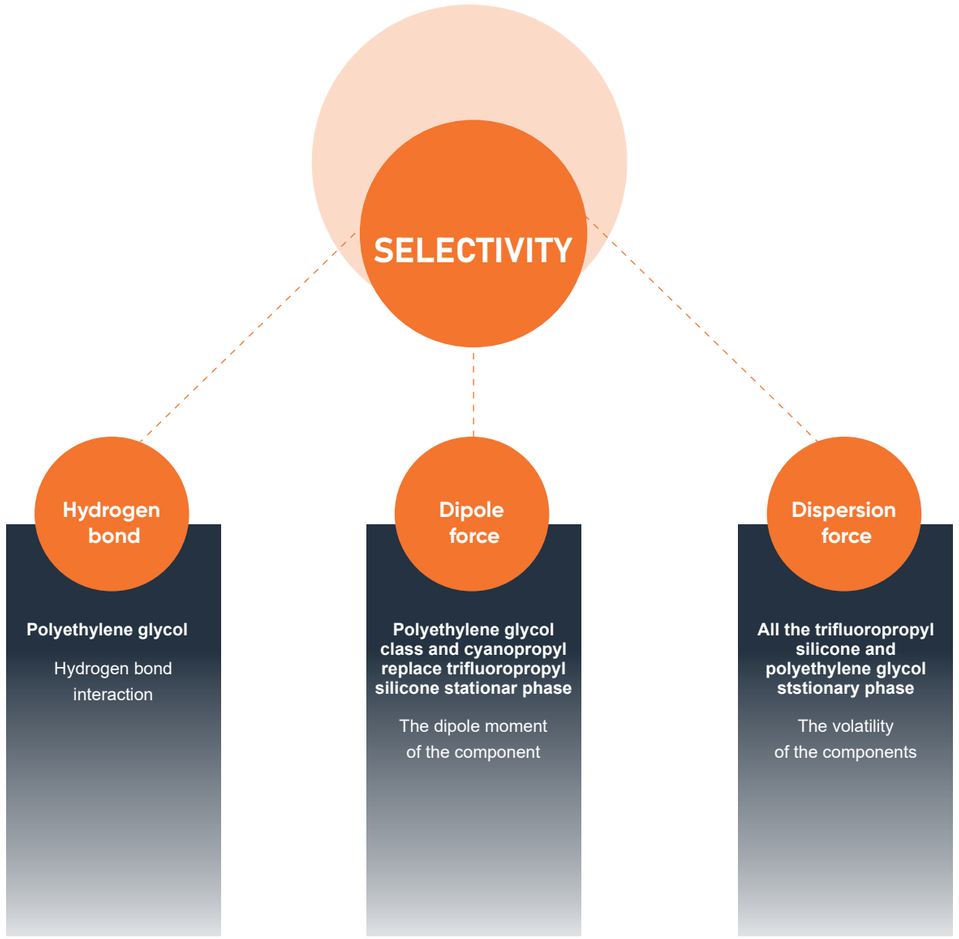
1. The sample component should have suitable retention value
2. The analysis speed should be fast
3. The analysis time should be short.

*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 Staionary Phase

➤ Stationary phase of polydimethylsiloxane has high thermal stability and it keeps liquid state from -60 ℃ to 350 ℃, 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 ℃.



➤ 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.

INNOVATIVE/REPRODUCIBLE/RUGGED

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.

INNOVATIVE/REPRODUCIBLE/RUGGED

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

25-30 m 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.

INNOVATIVE/REPRODUCIBLE/RUGGED

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

INNOVATIVE/REPRODUCIBLE/RUGGED

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 declination 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 (H_2S0_4), nitric acid (HNO_3), phosphoric acid (H_3PO_4) and chromic acid (CrO_3). Bases include potassium hydroxide (KOH), sodium hydroxide (NaOH) and ammonium hydroxide (NH_4OH). 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 NH_4OH 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-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.

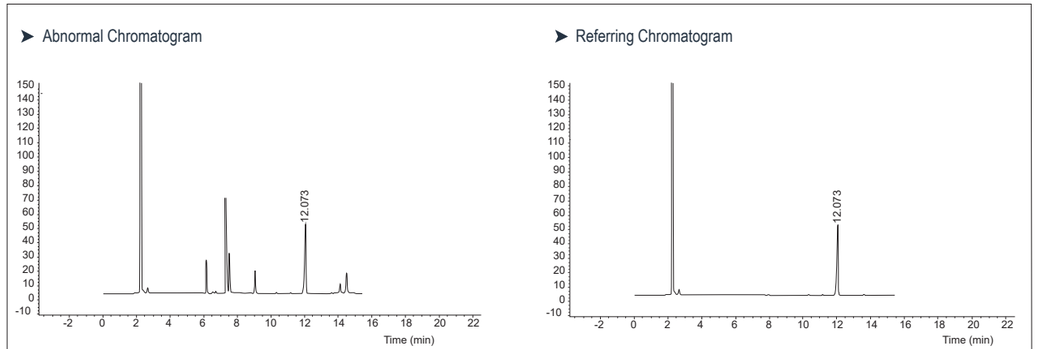
INNOVATIVE/REPRODUCIBLE/RUGGED

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:



1. With ghost peaks 2. The results of the second of injection are the same

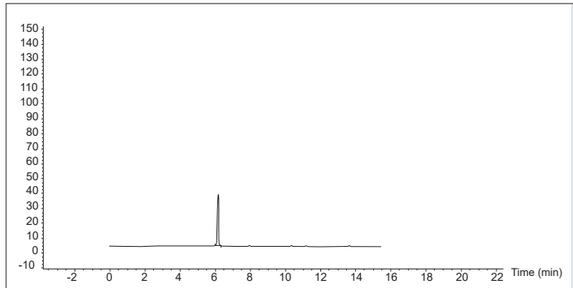
(2) Information Collection:

- 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

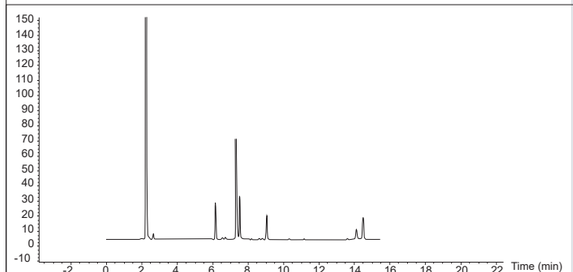
(3) Possible Reasons:

- 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.

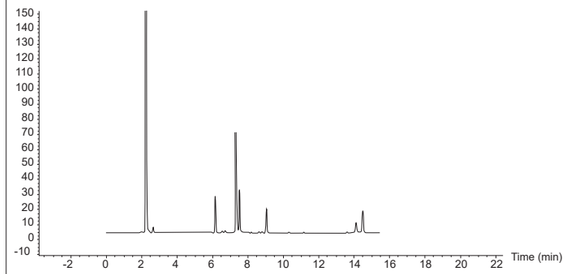
(4) Confirm Question:



➤ **Blank run (no injection):** There are ghost peaks, and the area most likely to be affected by changes in temperature is the injection port and detector.



➤ **Solvent blank (solvent only injection):** Ghost peaks indicate that contamination may be in the area through which the solvent passes or in the solvent itself—syringe, injection port, detector.



➤ **Solvent blank (solvent only injection):** Ghost peaks indicate that contamination may be in the area through which the solvent passes or in the solvent itself—syringe, injection port, detector.

➤ **Conclusion:** After screening, the remaining two areas are injection inlet and detector

(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

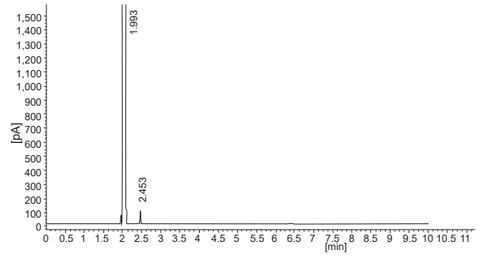
INNOVATIVE/REPRODUCIBLE/RUGGED

No Peak

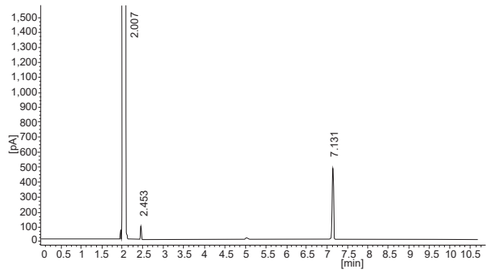
The absence of peaks is usually attributed to signal acquisition errors, issues with the injection needle, column installation problems, FID not ignited, or detector sensitivity.

(1) Solvent Peak Only:

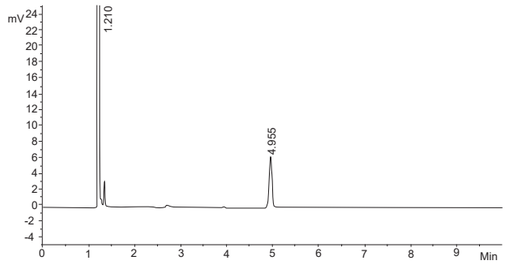
➤ Chromatogram Issues



➤ Increase Column Temperature



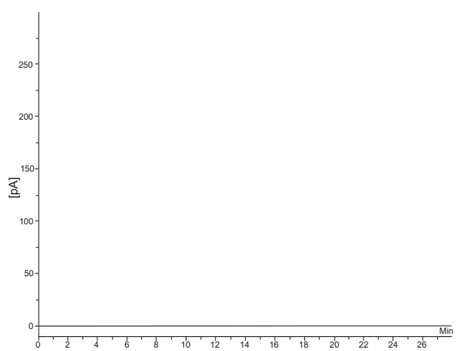
➤ Increase Column Inlet Pressure (on another GC instrument)



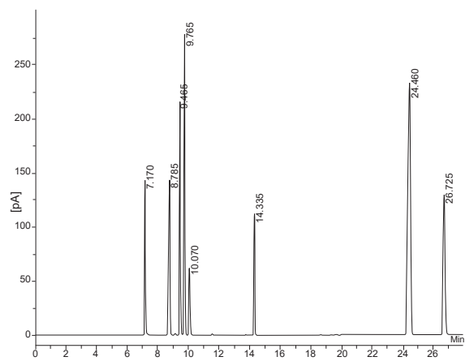
➤ **Conclusion:** The lack of peaks may be due to insufficient data acquisition time in the workstation settings.

(2) Water as Solvent (FID Detector):

➤ Abnormal chromatogram



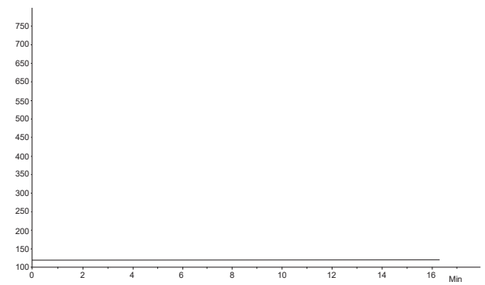
➤ Referring chromatogram



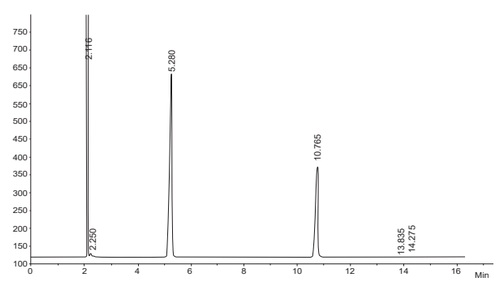
➤ **Conclusion:** the reason for unappearance of peaks is the sensibility of GC device can't achieve the test requirements.

(3) There's no Solvent Peak:

➤ Abnormal chromatogram



➤ Chromatogram for reinstalling the column



➤ **Conclusion:** the reason for unappearance of peaks is thst the column is not installed accurately or there is air leakage at the connection between the column and the inlet of detector.