Agilent CrossLab
From Insight to Outcome

Performance and Durability for High-Temperature GC

Agilent J&W high-temperature GC columns and consumables


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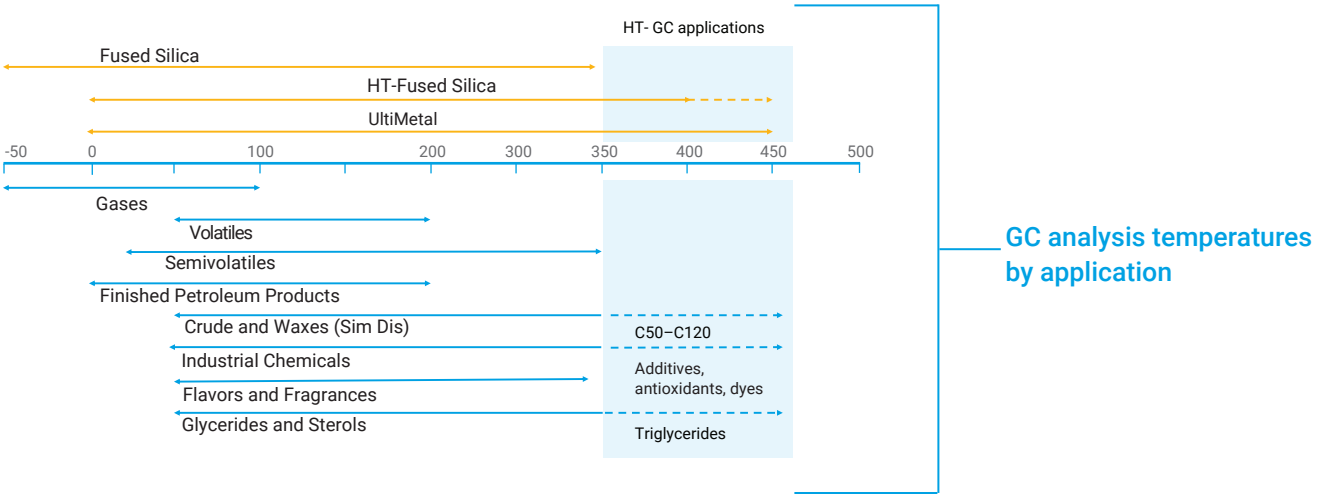
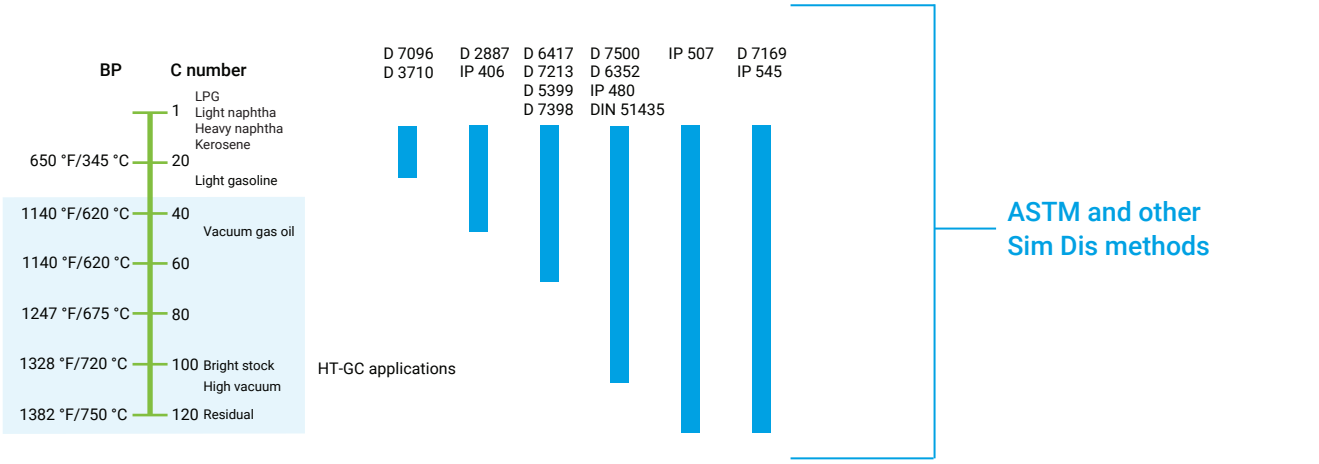
What Is High-Temperature Gas Chromatography?

High-temperature GC (HT-GC) is the analysis of compounds with boiling points in the 500 to 800 °C range. It can also apply to any GC analysis with a final oven temperature between 350 and 450 °C.

Simulated distillation (Sim Dis) is a typical HT-GC method for determining the boiling point distribution of petroleum products. However, there are many other HT-GC applications, including biodiesel, polymer additives, nonionic surfactants, waxes, and certain food applications.





Agilent J&W High-Temperature GC Columns Can Take the Heat

Applications operating between 360 and 400 °C often use a high-temperature, polyimide-coated, fused silica GC column to meet the challenges of routine analysis. However, if the columns are heated above 360 °C for an extended time, the polyimide will begin to flake. And that leaves the column brittle and prone to breakage.

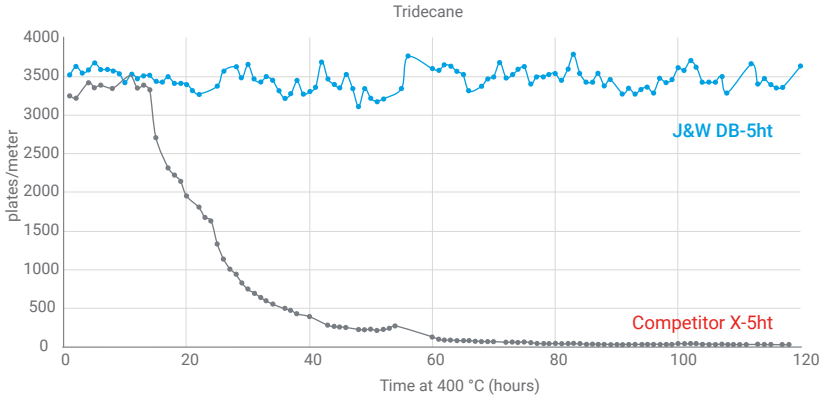
Agilent J&W high-temperature GC columns feature a special high-temperature polyimide that can operate in temperatures of up to 400 °C. They are engineered to combine robustness with advanced surface deactivation for improved column lifetime and peak shape. In addition, proprietary Agilent J&W technology enhances stationary phase bonding for low bleed performance at high temperatures.

Agilent (column on the right) versus the competition (column on the left). After operating at 400 °C for 25 hours, the competitor's 5ht GC column flaked off, showing signs of depolymerization. The coating on the Agilent J&W DB-5ht GC column remained uniform, and the column maintained its flexibility.

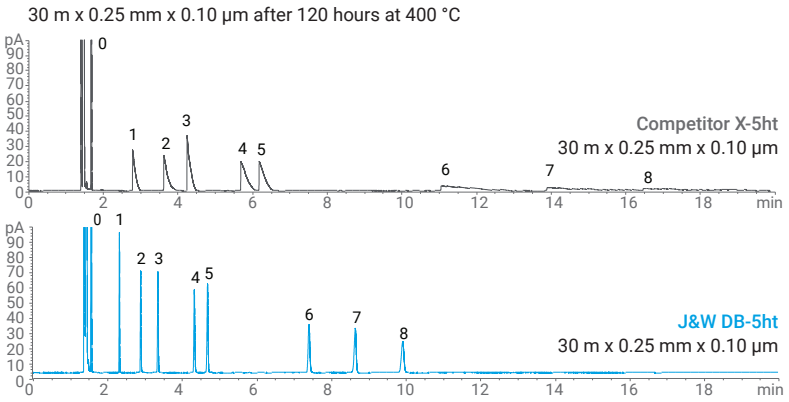
Why are most high-temperature columns short with thin films?

- High molecular weight compounds: Reasonable retention times for these compounds can only be achieved if the phase ratio (β) of the GC column is large. A large phase ratio is only possible with thin-film stationary phases.
- Bleed: Acceptable bleed levels depend on several criteria, such as temperature, column length, and film thickness. Since high bleed is almost inevitable at high temperatures, shorter column lengths and thinner films are necessary to keep bleed at adequate levels for most applications.

Performance and Durability That Outperform the Competition



An Agilent J&W DB-5ht column and a competitor's 5ht column were held at 400 °C for 120 hours to evaluate performance and stability. In just 15 hours, the competitor's column drastically lost its performance, measured by plates/meter, despite claiming a 430 °C maximum temperature stability. The J&W DB-5ht column remained stable—even after 40+ hours at the same conditions.



A closer look at the chromatograms after 120 hours at 400 °C. With the competitor's 5ht column, peak tailing is visible for most analytes. Tailing of an alkane, such as *n*-tridecane, proves that the active sites that cause peak tailing are due to stationary phase breakdown. The J&W DB-5ht column shows no sign of phase degradation under the same conditions, proving that the phase is stable after prolonged periods at 400 °C.

Peak Identification

0. Methane
1. Decane
2. 1-Octanol
3. 2,6-Dimethylphenol
4. 2,6-Dimethylaniline
5. Naphthalene
6. 1-Decanol
7. Tridecane
8. Methyl decanoate

Can I heat my DB-1ht or DB-5ht column to 430 °C?

Yes. If you operate your GC column beyond 400 °C, it will not immediately be ruined. However, the column will bleed more, and its overall lifetime will be shorter.

Every GC column supplier sets upper temperature limits according to their internal specifications. Agilent GC column temperature limits are defined by the industry's most rigorous evaluations to ensure superior quality and column lifetime.

For a more in-depth look, consult application note **5994-1013EN**.

Durable and Inert Stainless Steel GC Columns for Extreme Conditions

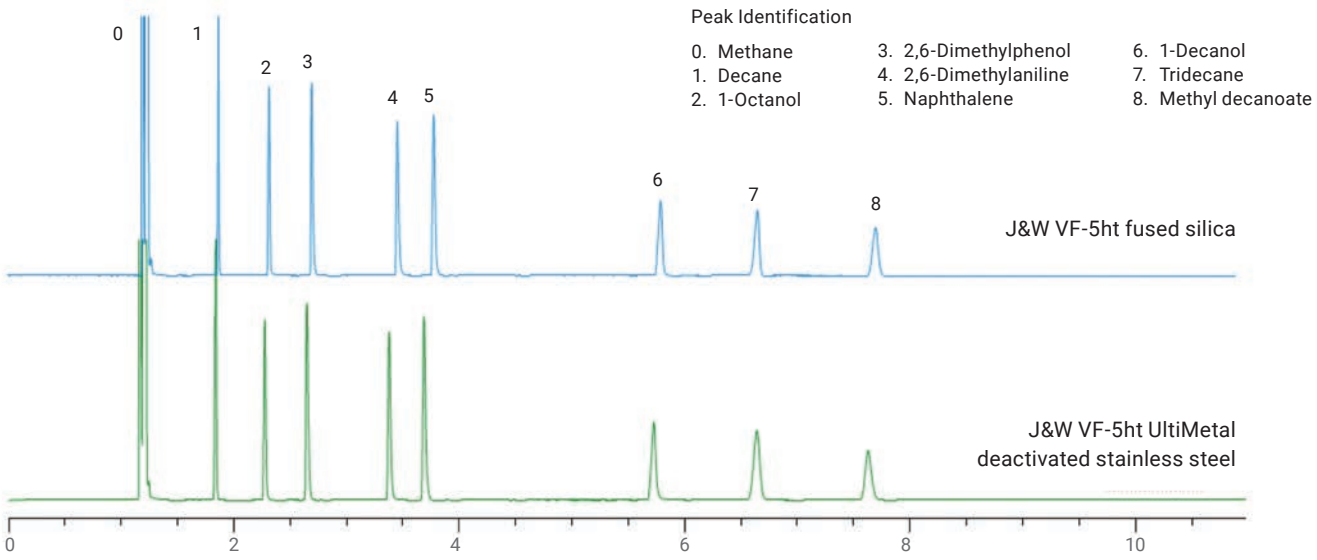
Traditional GC columns are made from fused silica with a polyimide outer coating. This construction is ideal for most applications below 350 to 360 °C, as fused silica offers flexibility, strength, and easy installation. A special fused silica tubing is necessary for operations up to 400 °C. However, even high-temperature fused silica will degrade above 400 °C—leading to polyimide burn off, column breakage, and productivity loss.

For applications above 400 °C, stainless steel GC columns offer better durability and ruggedness than fused silica tubing. Agilent J&W UltiMetal and ProSteel GC deactivated stainless steel columns last long even under extreme conditions. Their deactivation renders the stainless steel inert and enhances stationary phase bonding—lowering column bleed and improving detection limits.

The result is a GC column with the best combination of high resolution and long column lifetime.

Agilent J&W stainless steel GC columns offer comparable efficiency to fused silica GC columns

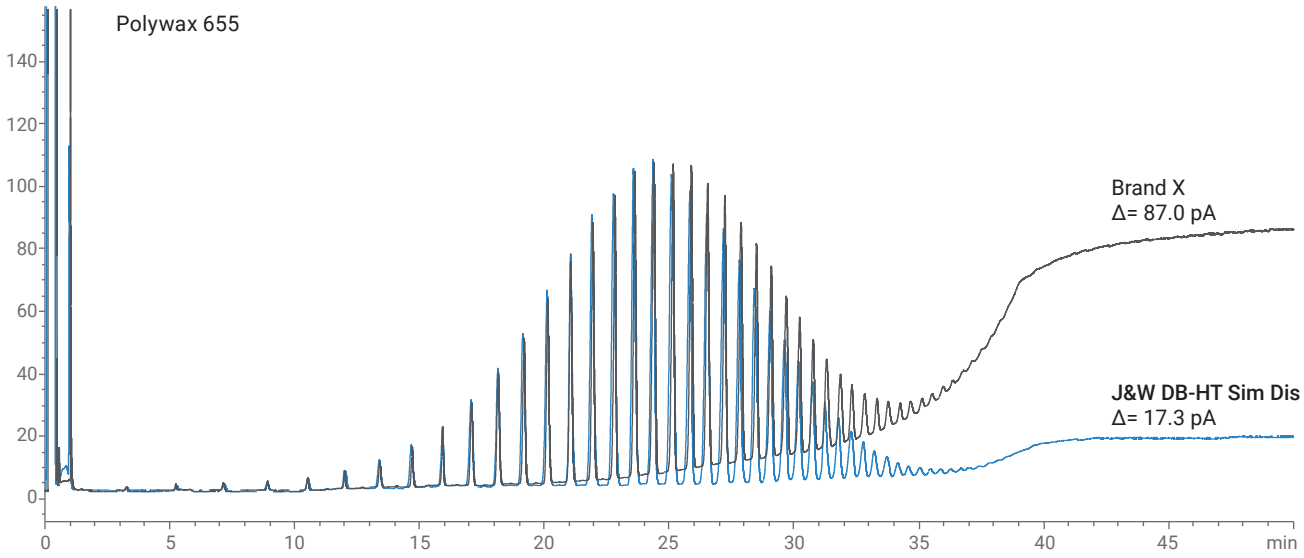
Advanced phase chemistry stabilizes the stationary phase of Agilent UltiMetal and ProSteel columns without limiting chromatographic performance.



Fused silica and VF-5ht UltiMetal deactivated stainless steel columns after 5 hours at 430 °C.

Excellent resolution of high-boiling compounds: a stabilized liquid phase coating ensures low bleed and low baselines

Improved chromatography for high-temperature applications. Agilent stainless steel GC columns use a proprietary stabilization technology that maximizes signal-to-noise ratios for better detection limits with high boilers, less detector contamination, and faster stabilization.



Comparison of Agilent J&W DB-HT Sim Dis and Competitor X Sim Dis columns for polywax 500 analysis. The Agilent column displayed very low bleed and low baseline, even with a 430 °C final temperature.

Columns:	Brand X Stainless Steel Sim Dis and Agilent J&W DB-HT Sim Dis ProSteel 5 m x 0.535 mm x 0.15 µm
Carrier:	Helium, constant flow, 18 mL/min
Oven:	40 °C (0 min), ramp 10 °C/min to 430 °C (20 min)
Inlet:	MMI splitless mode, 100 °C (0.5 min), ramp 10 °C/min to 430 °C

Which injector should I use for high-temperature GC?

Programmable temperature vaporizing (PTV) and cool on-column inlets are best for HT-GC analysis. That's because they allow the solute bands to refocus before separation in the GC column.

Although splitless and direct injection are possible with HT-GC, you should avoid solute discrimination in the inlet. If you must use splitless or direct injection, keep your injector temperature as hot as possible, use a high-boiling solvent, and minimize your injection volume.

The Agilent J&W High-Temperature GC Column Portfolio

With a wide range of general purpose and specialty columns, Agilent high-temperature GC columns make method development fast and easy.

Category		Agilent J&W GC Column	Maximum Temperature (°C)
High-temperature fused silica	General-purpose columns	DB-1ht	400 °C
		DB-5ht	400 °C
		VF-5ht	400 °C
		DB-17ht	340/365 °C
	Specialty columns	CP-SimDist	400 °C
		Select Biodiesel	400 °C
		Select Mineral Oil	375/400 °C
		CP-TAP CB for triglycerides	350/360 °C
Stainless steel	General-purpose columns	VF-5 UltiMetal	450 °C
	Specialty columns	DB-HT Sim Dis	430 °C
		CP-SimDist UltiMetal	450 °C
		Select Biodiesel UltiMetal	400 °C
		Select Mineral Oil UltiMetal	375/400 °C
		CP-TAP CB UltiMetal	355/370 °C

Which column best fits your application?

DB-1ht and DB-5ht

- Nonpolar, 100% dimethylpolysiloxane and (5% phenyl)-methylpolysiloxane
- Extended temperature limit of 400 °C
- High-temperature, polyimide-coated, fused silica tubing
- Excellent peak shape and faster elution times for high boilers

VF-5ht

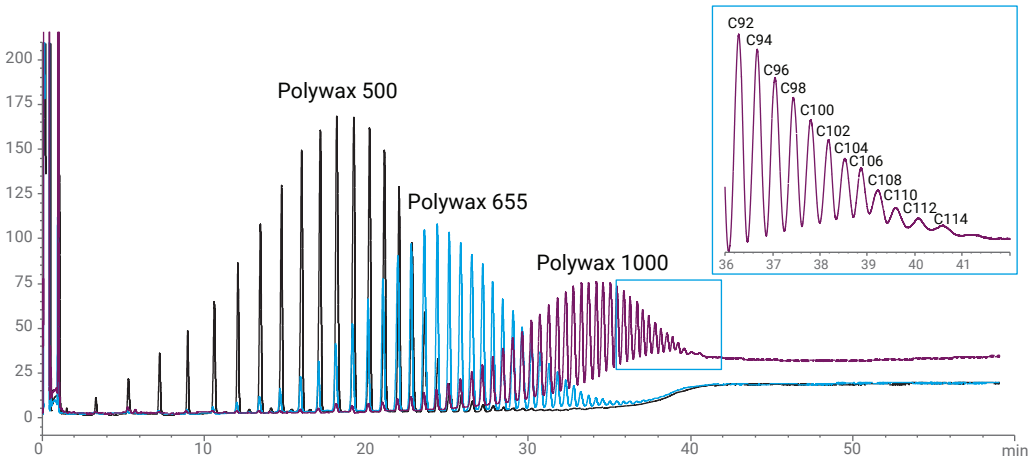
- Nonpolar, (5% phenyl)-methylpolysiloxane
- Ideal for high-boiling compounds
- Ultralow bleed at high temperatures
- Optimized sensitivity and accuracy for compounds with high molecular weight

DB-17ht

- Midpolar, (50% phenyl)-methylpolysiloxane
- Extended upper temperature limit of 365 °C
- High-temperature, polyimide-coated, fused silica tubing
- Improved resolution for triglycerides
- Ideal for conformational analyses

Application examples: low-resolution boiling point distribution

Analysis of polywaxes using a DB-HT Sim Dis column



Column advantages:

- "Boiling point" phase for high-temperature Sim Dis
- Distillation range of C6 to C110+ with a 430 °C upper temperature limit
- 100% dimethylpolysiloxane
- Durable stainless steel tubing
- Low bleed, even at 430 °C

Column:	5 m x 0.53 mm x 0.15 µm DB-HT Sim Dis (p/n 145-1001)
Carrier:	Helium, constant flow, 18 mL/min
Oven:	40 °C (0 min), ramp 10 °C/min to 430 °C (20 min)
Inlet:	MMI splitless mode, 100 °C (0.5 min), ramp 10 °C/min to 430 °C

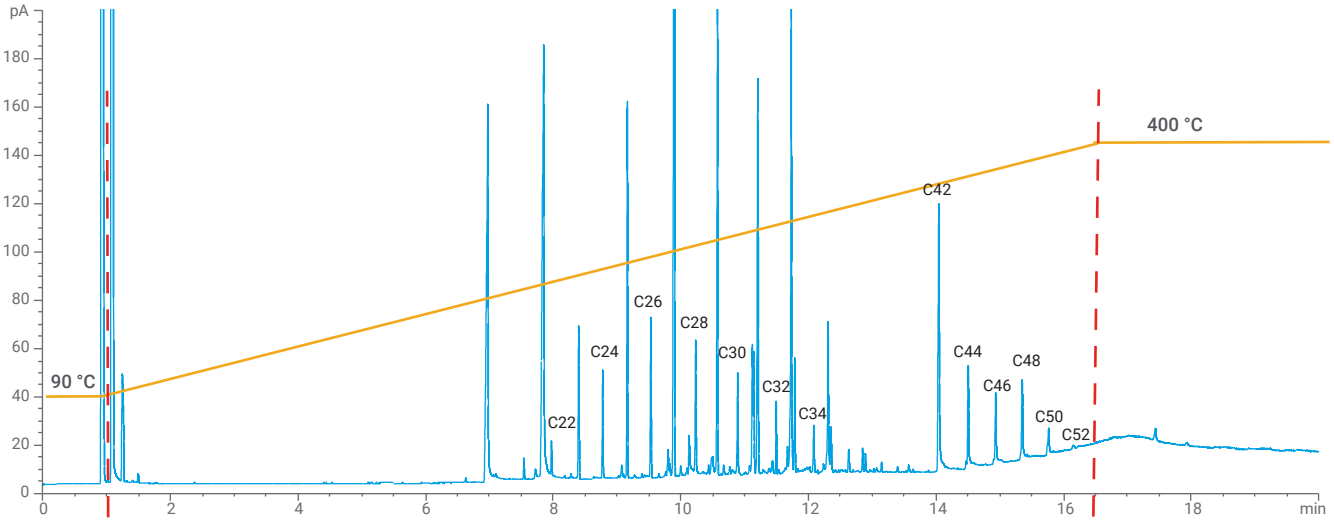
Worried about cutting an Agilent J&W stainless steel capillary GC column? Don't be.

You might think that stainless steel columns are difficult to cut, based on a bad experience with a competitor's column. However, with a little practice, Agilent J&W stainless steel capillary GC columns are no more difficult to cut than a fused silica column—with no additional tools needed.

Our **new column cutting video** shows you just how easy it is.

Application examples: higher resolution high-temperature GC up to 400 °C

Analysis of hydrocarbons in beeswax using a DB-5ht column



Column: Agilent J&W DB-5ht (p/n 122-5711)
15 m x 0.25 mm x 0.10 µm

Carrier: Helium, constant flow, 1 mL/min

Oven: 90 °C (1.0 min), ramp 20 °C/min to 400 °C (30 min)

Inlet: MMI split mode, split ratio 20:1, 300 °C (12 min), ramp 20 °C/min to 400 °C

Inlet liner: Ultra Inert, split, low pressure drop, glass wool (p/n 5190-2295)

IGC/FID: Agilent 7890B GC equipped with FID

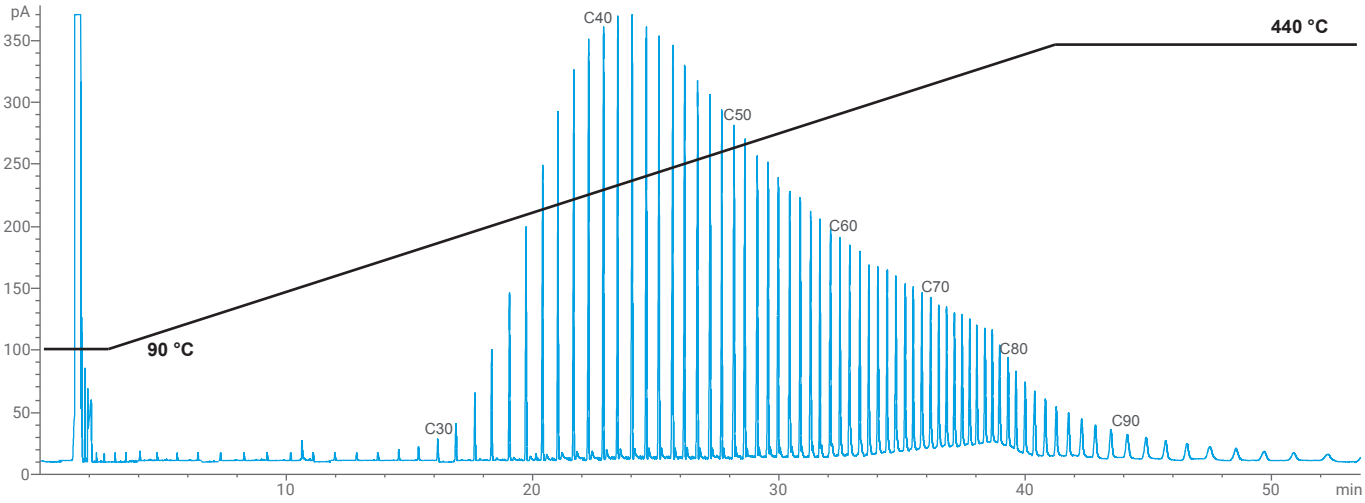
Triton Analytics Corporation testimonial

Watch as industry expert Dan Villalanti, PhD, chairman of ASTM Committee D02.04.0K on Correlative Methods and referee for *Journal of Chromatographic Science*, shares his 30+ years of experience with Agilent products.

www.agilent.com/chem/high-temp-video

Application examples: higher resolution high-temperature GC up to 450 °C

High-temperature GC analysis of Fischer–Tropsch reaction products



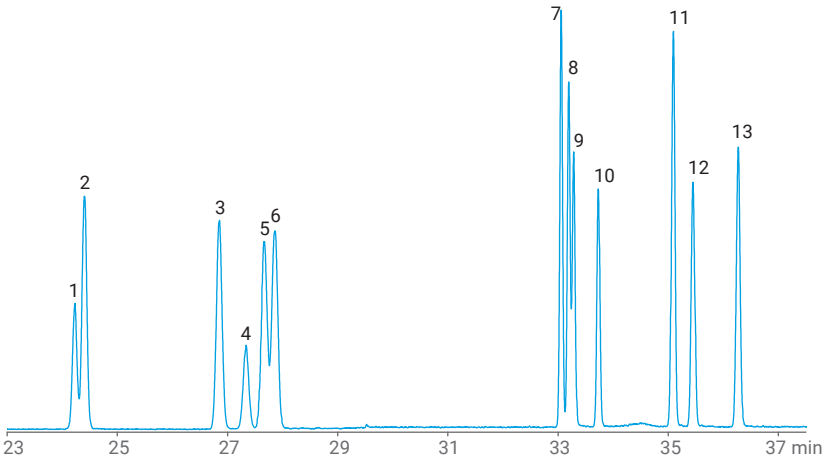
Column: Agilent J&W VF-5ht UltiMetal, 30 m x 0.32 mm x 0.10 µm (p/n CP9096)
Sample volume: 1 µL
Carrier gas: Hydrogen, constant flow, 2.5 mL/min
Injector: Cool on-column
Temperature: 90 °C, 25 °C/min, 150 °C, 8 °C/min, 440 °C (15 min)
Detector: FID, 440 °C

Column advantages (VF-5ht):

- Nonpolar, (5% phenyl)-methylpolysiloxane
- Enhanced stability improves column longevity and reduces downtime
- Optimized sensitivity and accuracy for analyzing compounds with high molecular weight
- Identical selectivity to VF-5ms

Choosing the Right GC Column: Are High-Temperature GC Columns Ideal for Semivolatiles?

No. Analyzing semivolatiles is not considered a high-temperature application. Although you can use high-temperature GC columns to analyze semivolatiles, there are other choices that offer improved inertness, better selectivity, and extended column lifetime. Most semivolatiles have boiling points below 500 ºC (925 ºF), and can be analyzed using GC columns with a 350 to 360 °C upper temperature limit. Column options like Agilent J&W Ultra Inert GC columns deliver consistent inertness performance to ensure better peak shape and sensitivity for trace-level analysis of semivolatiles. Other columns are specifically designed for resolving critical isomers for faster and more reliable analysis of challenging semivolatiles.



Peak	Compounds	Ions
1.	Benzo[g,h,i]fluoranthene	226
2.	Benzo[c]phenanthrene	228
3.	Benz[a]anthracene	228
4.	Cyclopenta[c,d]pyrene	226
5.	Triphenylene	228
6.	Chrysene	228
7.	Benzo[b]fluoranthene	252
8.	Benzo[k]fluoranthene	252
9.	Benzo[j]fluoranthene	252
10.	Benzo[a]fluoranthene	252
11.	Benzo[e]pyrene	252
12.	Benzo[a]pyrene	252
13.	Perylene	252

PAHs analyzed on a Select PAH column.

Technique: GC/MS

Column: **Agilent J&W Select PAH**, 30 m x 0.25 mm, df = 0.15 µm (p/n CP7462)

Sample conc: Approx 1 µg/mL

Injection volume: 1 µL

Temperature: 70 °C (0.5 min), 60 °C/min, 210 °C, 5 °C/min, 250 °C, 10 °C/min, 280 °C (3 min), 10 °C/min, 350 °C (3 min)

Carrier gas: Helium, constant flow, 2 mL/min

Injection: 100 °C, 180 °C/min, 300 °C (20 min), splitless

Detection: Triple quadrupole MS, EI in SIM, source 275 °C, transfer line 300 °C

Product spotlight: Agilent Inert Flow Path

Agilent Ultra Inert GC columns and consumables deliver the inertness that today's analyses demand. So you can achieve lower detection limits and more accurate data for semivolatiles such as pesticides, PAHs, and drugs of abuse.

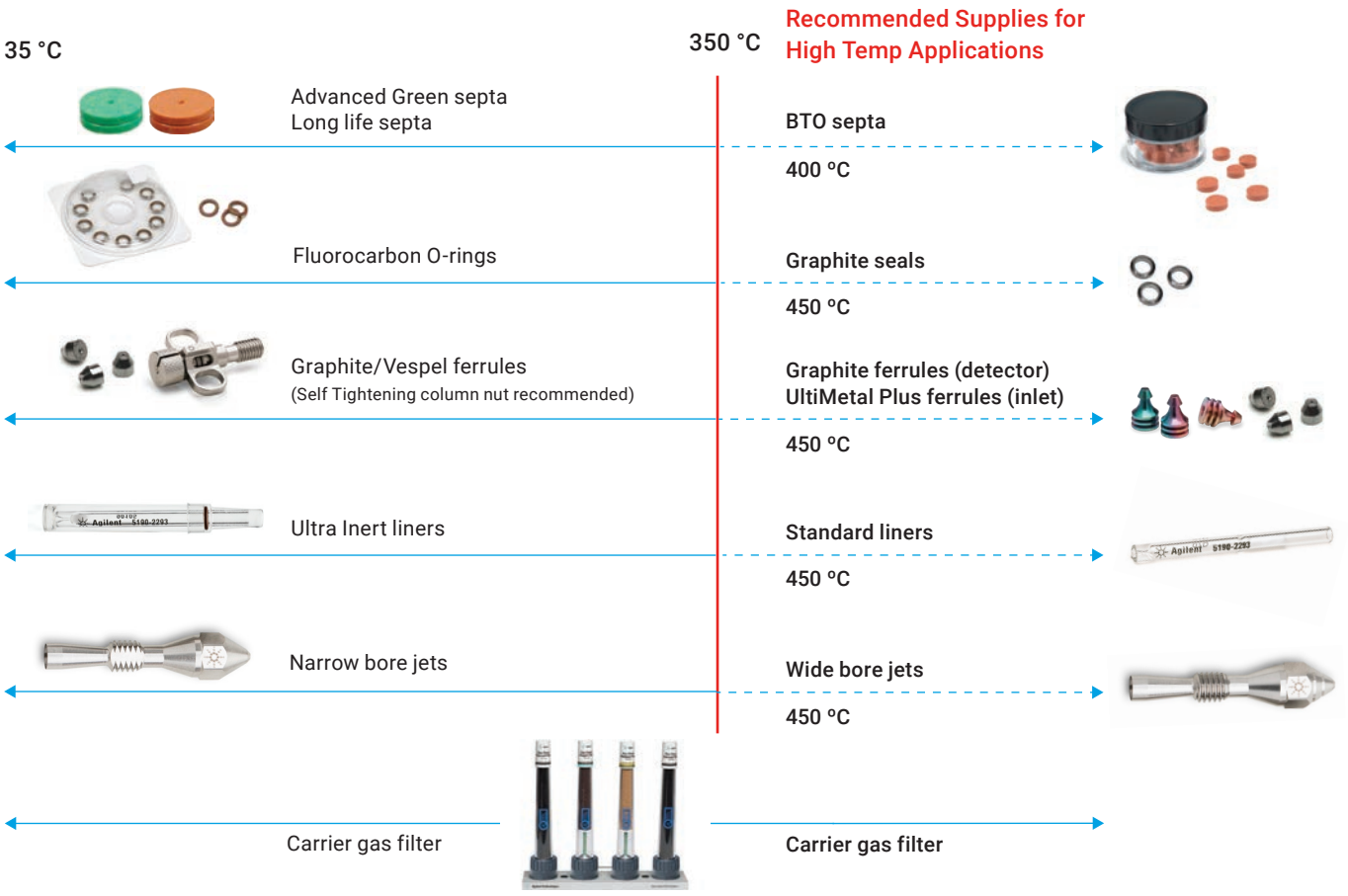
To learn more, visit **www.agilent.com/chem/inert**

Higher Temperatures Demand Quality Consumables

In high-temperature GC analysis, it is important to reduce any possible source of leaks into the GC system. That's because oxygen damage can be rapid at high temperatures, resulting in massive bleed and faster column degradation.

You can reduce the presence of oxygen in the carrier gas—and minimize outgassing and leaks—using the proper high-temperature GC consumables.

Choosing the right supplies for your high-temperature analysis



Product spotlight: Agilent gas leak detector

Gas leaks can reduce column lifetime, especially with high-temperature applications. The Agilent gas leak detector makes it easy to quickly identify leaks in your system, so you can minimize expensive downtime. **Take a closer look**.

Ordering information

High-temperature fused silica GC columns

Description	Part Number
DB-1ht	
15 m x 0.25 mm, 0.1 µm, 7 in.	122-1111
15 m x 0.25 mm, 0.1 µm, 5 in.	122-1111E
30 m x 0.25 mm, 0.1 µm, 7 in.	122-1131
15 m x 0.25 mm, 0.1 µm, 5975 LTM Toroid	222-1111LTM
30 m x 0.25 mm, 0.1 µm, 5975 LTM Toroid	222-1131LTM
2 m x 0.25 mm, 0.1 µm, QuickProbe	G3903-61006
5 m x 0.32 mm, 0.25 µm, 7890/6890 LTM module	123-1102LTM
15 m x 0.32 mm, 0.1 µm, 7 in.	123-1111
15 m x 0.32 mm, 0.1 µm, 7890/6890 LTM module	123-1111LTM
30 m x 0.32 mm, 0.1 µm, 7 in.	123-1131
30 m x 0.32 mm, 0.1 µm, 5 in.	123-1131E
30 m x 0.53 mm, 0.17 µm, 7 in.	125-1131
DB-5ht	
20 m x 0.18 mm, 0.18 µm, 7 in.	121-5722
15 m x 0.25 mm, 0.1 µm, 7 in.	122-5711
15 m x 0.25 mm, 0.1 µm, 5 in.	122-5711E
30 m x 0.25 mm, 0.1 µm, 7 in.	122-5731
30 m x 0.25 mm, 0.25 µm, 7 in.	122-5732
30 m x 0.25 mm, 0.1 µm, 7890/6890 LTM module	122-5731LTM
30 m x 0.25 mm, 0.1 µm, 5975 LTM Toroid	222-5731LTM
15 m x 0.25 mm, 0.1 µm, w/ Smart Key for 8890 GC	122-5711-KEY
10 m x 0.32 mm, 0.1 µm, 7 in.	123-5701
10 m x 0.32 mm, 0.1 µm, 7890/6890 LTM module	123-5701LTM
15 m x 0.32 mm, 0.1 µm, 7 in.	123-5711
15 m x 0.32 mm, 0.1 µm, 5 in.	123-5711E
30 m x 0.32 mm, 0.1 µm, 7 in.	123-5731
30 m x 0.32 mm, 0.1 µm, 5 in.	123-5731E
5 m x 0.32 mm, 0.1 µm, Intuvo	123-57J1-INT
VF-5ht	
15 m x 0.25 mm, 0.1 µm, 7 in.	CP9045
30 m x 0.25 mm, 0.1 µm, 7 in.	CP9046
30 m x 0.25 mm, 0.1 µm, 5 in.	CP9092I5
10 m x 0.32 mm, 0.1 µm, 7 in.	CP9044
15 m x 0.32 mm, 0.1 µm, 7 in.	CP9047
30 m x 0.32 mm, 0.1 µm, 7 in.	CP9048
CP-Simulated Distillation	
10 m x 0.32 mm, 0.1 µm, 7 in.	CP7521
5 m x 0.53 mm, 0.17 µm, 7 in.	CP7522
5 m x 0.53 mm, 0.88 µm	CP7523
10 m x 0.53 mm, 0.1 µm, 7 in.	CP7541

Description	Part Number
DB-17ht	
5 m x 0.25 mm, 0.15 µm, 7 in.	122-1801
15 m x 0.25 mm, 0.15 µm, 7 in.	122-1811
30 m x 0.25 mm, 0.15 µm, 7 in.	122-1831
30 m x 0.25 mm, 0.15 µm, 7890/6890 LTM module	122-1831LTM
15 m x 0.32 mm, 0.15 µm, 7 in.	123-1811
30 m x 0.32 mm, 0.15 µm, 7 in.	123-1831
30 m x 0.32 mm, 0.15 µm, 5 in.	123-1831E
60 m x 0.32 mm, 0.15 µm, 7 in.	123-1861
Select Mineral oil	
15 m x 0.32 mm, 0.1 µm, 7 in.	CP7491
15 m x 0.32 mm, 0.1 µm, Intuvo	CP7491-INT
15 m x 0.32 mm, 0.1 µm, 7 in., 3/pk	CP749103
15 m x 0.32 mm, 0.1 µm, 7 in., 6/pk	CP749106
Select Biodiesel	
10 m x 0.32 mm, 0.1 µm, 7 in.	CP9077
15 m x 0.32 mm, 0.1 µm, 7 in.	CP9079
30 m x 0.32 mm, 0.25 µm, 7 in.	CP9080
30 m x 0.32 mm, 3 µm, 7 in.	CP9083
CP-TAP CB for triglycerides	
25 m x 0.25 mm, 0.1 µm, 7 in.	CP7483
25 m x 0.25 mm, 0.1 µm, Intuvo	CP7483-INT

High-temperature stainless steel GC columns

Description	Part Number
VF-5ht	
15 m x 0.25 mm, 0.1 µm, 7 in.	CP9090
30 m x 0.2 mm, 0.1 µm, 7 in.	CP9092
CP-TAP CB for triglycerides	
25 m x 0.25 mm, 0.1 µm, 7 in.	CP7463
Select Biodiesel	
10 m x 0.32 mm, 0.1 µm, 7 in.	CP9076
15 m x 0.32 mm, 0.1 µm, 7 in.	CP9078
DB-HT Simulated Distillation	
5 m x 0.53 mm, 0.15 µm, 7 in.	145-1001
5 m x 0.53 mm, 0.1 µm, 7 in.	145-1009

High-temperature GC consumables and accessories

Description	Part Number
BTO septa	
Inlet septa, bleed and temperature optimized (BTO), non-stick, 11 mm, 50/pk	5183-4757
Inlet septa, bleed and temperature optimized (BTO), non-stick, 5 mm, through-hole, 50/pk	5183-4758
Inlet septa, bleed and temperature optimized (BTO), non-stick, 11 mm, 100/pk	5183-4757-100
Inlet septa, bleed and temperature optimized (BTO), non-stick, 11 mm, 400/pk	5190-3157
UltiMetal Plus Flexible Metal ferrules	
Flexible Metal ferrule, UltiMetal Plus, 0.4 mm id, for 0.1 to 0.25 mm id fused silica tubing, 10/pk	G3188-27501
Flexible Metal ferrule, UltiMetal Plus, 0.5 mm id, for 0.32 mm fused silica tubing, 10/pk	G3188-27502
Flexible Metal ferrule, UltiMetal Plus, 0.8 mm id, for 0.53 mm id fused silica tubing, 10/pk	G3188-27503
Flexible Metal ferrule, UltiMetal Plus, without hole, to plug capillary flow technology fittings, 10/pk	G3188-27504
Flexible Metal ferrule, UltiMetal Plus, for 0.25 and 0.32 mm id UltiMetal column tubing, 10/pk	G3188-27505
Flexible Metal ferrule, UltiMetal Plus, for 0.53 mm id UltiMetal column tubing, 10/pk	G3188-27506
Graphite ferrules	
Ferrule, 0.4 mm id, graphite, 0.05 to 0.25 mm column, 10/pk	500-2114
Ferrule, 0.8 mm id, graphite, 0.45 to 0.53 mm column, 10/pk	500-2118
Ferrule, graphite, 1 mm id, for 0.53 mm column, 10/pk	5080-8773
Ferrule, graphite, short, 0.5 mm id, for 0.1 to 0.32 mm columns, 10/pk	5080-8853
Inlet seals	
Inlet liner, O-ring, graphite, 6.35 mm id, 9.63 mm od, 10/pk	5180-4168
Inlet liner, O-ring, graphite for splitless liner, 6.52 mm id, 9.63 mm od, 10/pk	5180-4173
Inlet liner, O-ring, FPM for high temperature PTV, 10/pk	5188-5311
Liners	
Inlet liner, PTV, sintered glass, deactivated, 112 µL	5190-1426
Inlet liner, PTV, high temperature, 3.4 mm id, 668 µL, for G3506A	5188-5356
Inlet liner, PTV, high temperature, quartz, 3.4 mm id, 713 µL, for G3506A	5188-5313
Inlet liner, PTV, multi baffle, deactivated, 150 µL	5183-2037
Inlet liner, PTV, single baffle, glass wool, deactivated, 180 µL	5183-2038
Inlet liner, PTV, single baffle, deactivated, 180 µL	5183-2036
Splitless, single taper, deactivated, dimpled, 200 µL	5190-2296
Splitless, straight, deactivated, quartz, 250 µL, 5/pk	5183-4703
Splitless, straight, deactivated, quartz, 250 µL, 25/pk	5183-4704
Splitless, double taper, deactivated, 800 µL, 4 mm, 5/pk	5183-4705
Splitless, double taper, deactivated, 800 µL, 4 mm, 25/pk	5183-4706
Splitless, double taper, deactivated, 800 µL, 4 mm, 100/pk	5190-2272
Splitless, single taper, deactivated, 900 µL, 4 mm, 5/pk	5183-4695
Splitless, single taper, deactivated, 900 µL, 4 mm, 25/pk	5183-4696
Splitless, straight, 900 µL, 4 mm, 5/pk	210-3003-5

Gas filters

Description	Part Number
Gas Clean filter: Intuvo kit	CP17995
Gas Clean filter: 7890 kit	CP17988
Gas Clean filter: 8890/8860 kit (includes Gas Clean sensor)	CP179880
Replacement Gas Clean carrier gas kit	CP17973

Self Tightening column nuts

Description	Part Number
Self Tightening column nut, inlet/detector	G3440-81011
Self Tightening column nut, MSD	G3440-81013

Gas leak detectors

Description	Part Number
Replacement sample probe filter, for Agilent G3388 gas leak detector	G3388-80001
Replacement reference port filter, for Agilent G3388 gas leak detector	G3388-80002
Electronic gas leak detector, handheld	G3388B

Cool on-column (COC) inlets

View part numbers and descriptions

Programmable temperature vaporizing (PTV) inlets

View part numbers and descriptions

Agilent CrossLab services. From insight to outcome.

CrossLab is an Agilent capability that integrates services and consumables to support workflow success and important outcomes like improved productivity and operational efficiency. Through CrossLab, Agilent strives to provide insight in every interaction to help you achieve your goals. CrossLab offers method optimization, flexible service plans, and training for all skill levels. We have many other products and services to help you manage your instruments and your lab for best performance.

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Published in the USA, January 22, 2020
5994-1384EN
DE.4196527778

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