

# Residual Solvent Analysis of Pharmaceutical Products

USP <467> and ICH Q3C (R5) consumable workflow ordering guide



# Be Confident That Residual Solvents Will Not Affect the Safety, Stability, or Effectiveness of Your Products

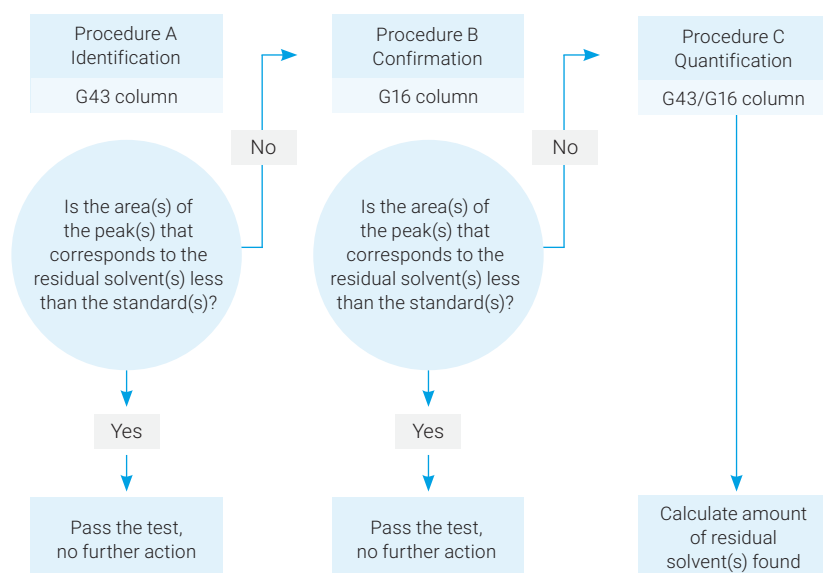
The manufacturing process for active pharmaceutical ingredients (APIs) may contribute to residual solvents remaining in the final product. Producers need to monitor and control the levels of residual solvents for several reasons—including safety, effect on crystalline form, solubility, bio-availability, and stability. Residual solvents can be classified\* as follows:

- Class 1 solvents are considered hazardous, and should be avoided during manufacturing.
- Class 2 solvents are considered less severely toxic, and should be limited.
- Class 3 solvents pose less risk to human health than Class 1 or Class 2 solvents.

United States Pharmacopeia (USP) Method <467> is the method used worldwide for quality control, and closely follows ICH Q3C guidelines. The method is composed of three analytical procedures for identification and quantification.

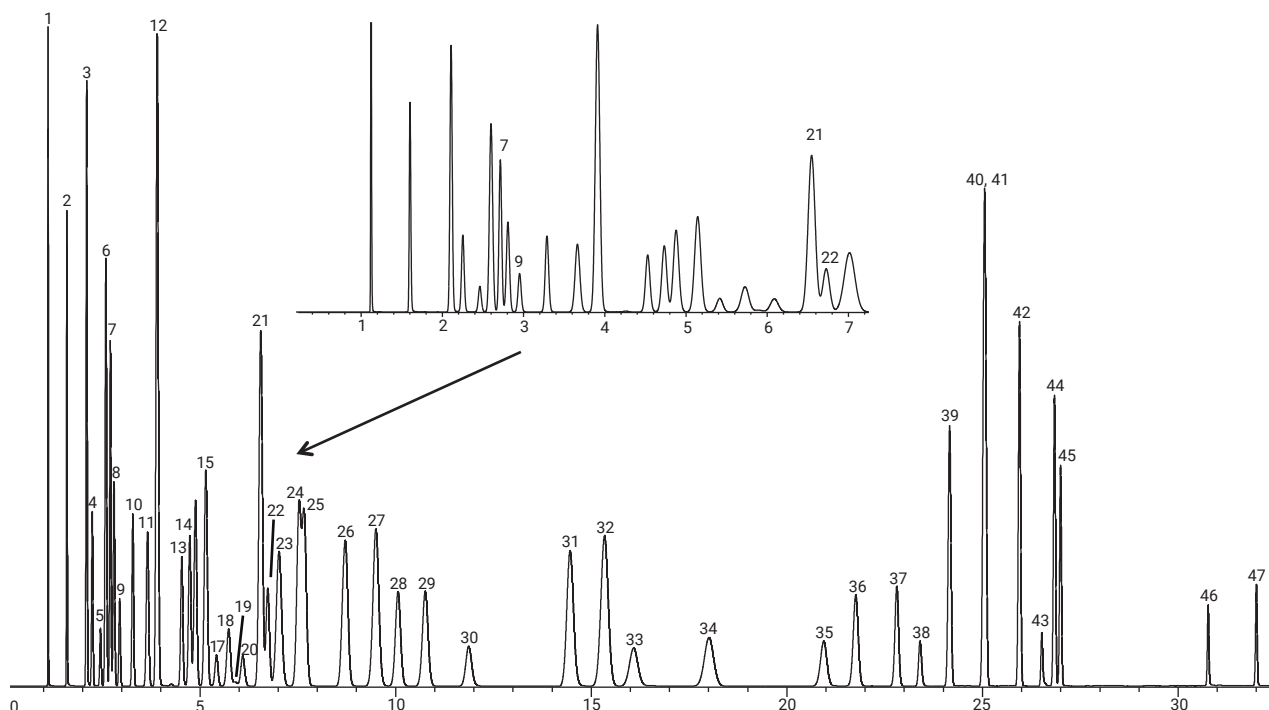
- Procedure A: Identification and limit testing. Uses a G43 phase (624-type column).
- Procedure B: Confirms whether or not an identified solvent is above the regulated limits. Uses a G16 phase (WAX-type column).
- Procedure C: Quantitative test using a G43 phase or G16 phase, depending on which produced fewer coelutions.

\*Q3C—Tables and List Guidance for Industry, Rev 3, U.S. Department of Health and Human Services, CDER and CBER, FDA, June 2017.



USP <467> analytical flowchart for residual solvent analysis.

Elution of 46 USP <467> OVI solvents on a DB-Select 624 UI column (30 m x 0.53 mm id, 3.0 µm, part number 125-0334UI)



USP <467> requires columns to provide a resolution greater than 1.0 between acetonitrile and dichloromethane. The DB-Select 624 UI, 30 m megabore column has a resolution of 3.1 (see inset peaks 7 and 9). Benzene and 1,2-dichloroethane have a resolution of 1.1 (see inset peaks 21 and 22).

**Conditions**

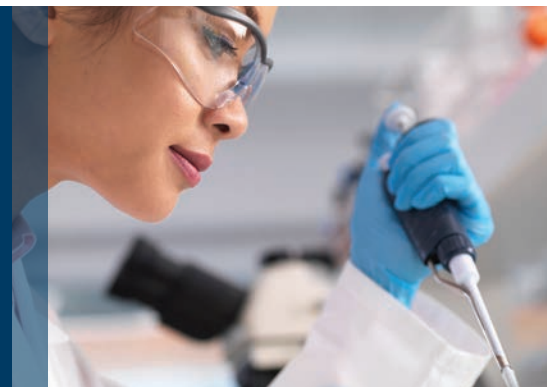
Oven: 40 °C (20 min), 10 °C/min, 170 °C (0 min)  
 Carrier gas: Helium 44 cm/s (approx. 6 mL/min) set at 40 °C, EPC-constant flow  
 Inlet: Split, 5:1 at 250 °C (total flow approx 40 mL/min, and 4.5 psi)  
 Detector: FID at 240 °C, H<sub>2</sub> @ 30 mL/min, air @ 400 mL/min, N<sub>2</sub> makeup @ 35 mL/min (constant column + makeup)  
 Detector signal: 20 Hz  
 Column serial number: USC9260355

1.120 Methane (1)*	5.180 Formic acid	14.665 Methyl isobutyl ketone (aka, 4-Methyl-2-pentanone, MIBK)
1.603 Methanol (2)	5.223 Tetrahydrofuran (THF)	15.330 Toluene (32)
2.092 n-Pentane	5.408 Chloroform (17)	16.126 3-Methyl-1-butanol (33)
2.111 Ethanol (3)	5.721 1,1,1-Trichloroethane (18)	18.017 Isobutyl acetate (34)
2.256 Diethyl ether (4)	5.889 Cyclohexane (19)	20.985 1-Pentanol (35)
2.458 1,1-Dichloroethylene (5)	6.079 Carbon tetrachloride (20)	21.776 Methyl-butyl-ketone (MBK) (36)
2.472 Acetone	6.471 2-Methoxyethanol	22.822 n-Butyl acetate (37)
2.597 2-Propanol (6)	6.540 2-Methylpropanol	23.430 N,N-Dimethylformamide (38)
2.635 Ethyl formate	6.560 Benzene (21)	24.162 Chlorobenzene (39)
2.713 Acetonitrile (7)	6.719 1,2-Dichloroethane (22)	25.024 m-Xylene (40)
2.807 Methyl acetate (8)	6.982 Isopropyl acetate	25.024 p-Xylene (41)
2.955 Dichloromethane (9)	7.015 Isooctane (2,2,4-Trimethylpentane) (23)	25.950 o-Xylene (42)
3.285 trans-1,2-Dichloroethylene (10)	7.539 3-Methyl-2-butanone (24)	26.526 Dimethyl sulfoxide (43)
3.285 Methyl-t-butyl ether (MTBE)	7.652 n-Heptane (25)	26.839 Cumene (44)
3.662 n-Hexane (11)	7.770 Acetic acid	26.872 N,N-Dimethylacetamide
3.917 1-Propanol (12)	8.624 Trichloroethylene (26)	27.020 Anisole (45)
3.930 Isopropyl ether (DIPE)	8.675 1-Butanol	30.775 N-Methyl pyrrolidone (46)
4.534 Nitromethane (13)	9.490 Methycyclohexane (27)	30.807 Formimide
4.730 cis-1,2-Dichloroethylene (14)	10.066 1,4-Dioxane (28)	32.005 Tetralin (47)
4.733 2-Butanone	10.767 Propyl acetate (29)	
4.877 Ethyl acetate (15)	11.922 2-Ethoxyethanol (30)	
5.163 2-Butanol (16)	14.518 Pyridine (31)	

\*Numbers in italics are the peak ID numbers for the chromatogram.

# USP <467> Procedure A

High repeatability for identification and limit testing



Procedure A is the first step in the identification process. It is performed on a G43 phase (624-type column) to determine whether or not residual solvents are present at detectable levels.

## Single-column GC/FID analysis of residual solvents

In this example, Agilent J&W DB-Select 624 UI columns delivered excellent resolution of the residual solvent peaks. The Agilent 7697A headspace sampler was also a key factor in achieving the lower limits of concentration for these tests. Its inert sample path, thermal zone stability, and flexible EPC-controlled vial sampling all contribute to reliable system performance.

### Conditions

Column:	Agilent J&W DB-Select 624 UI for <467>, 30 m x 0.32 mm, 1.8 µm (p/n 123-0334UI)
Carrier:	Helium, 2.2 mL/min constant flow at 40 °C
Oven:	40 °C (20 min), then 10 °C/min to 240 °C (5 min)
Inlet:	MMI, 140 °C, 1 µL split 5:1
Sample vol:	1.0 mL loop
FID:	250 °C, H <sub>2</sub> @ 30 mL/min, air @ 400 mL/min, N <sub>2</sub> constant col + makeup = 30 mL/min

### Flow path supplies

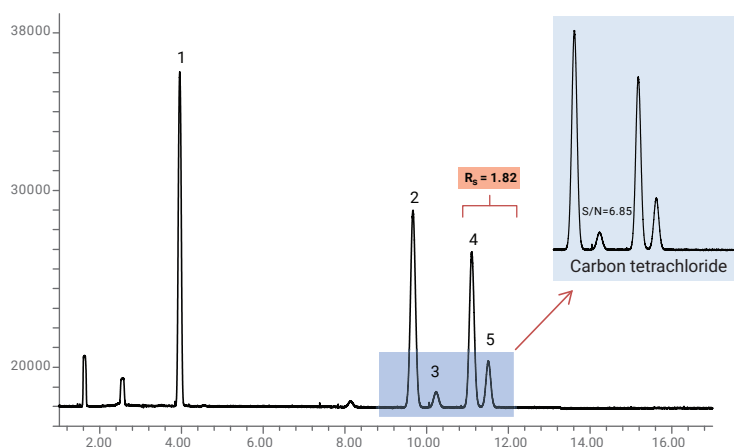
Vials:	20 mL flat bottom crimp cap headspace vials (100 pk, p/n 5190-2288)
Vial caps:	Headspace crimp cap/high performance septa (100 pk, 5190-3987)
Crimper:	Electronic crimper for 20 mm caps (p/n 5191-5615)
Transfer line:	0.53 mm deactivated fused silica (5 m, p/n 160-2535-5)
Fitting:	1/6 to 1/32 inch reducing fitting (p/n 0100-2594)
Septum:	Non-stick, bleed, and temperature optimized (50 pk, p/n 5183-4757)
Inlet liner:	1 mm straight single taper Ultra Inert liner (p/n 5190-4047)
Gold seal:	Gold-plated inlet seal with washer (10/pk, p/n 5190-2209)
Ferrules:	0.5 mm id short 85/15 Vespel/graphite (10 pk, p/n 5062-3514)
Magnifier:	20x magnifier loop (p/n 430-1020)

### Standards

Class 1:	USP <467> class 1 residual solvents (p/n USPM-467J-1)
Class 2A:	USP <467> class 2 residual solvents A (p/n USPM-467K-1)
Class 2B:	USP class 2 residual solvents B (p/n USPM-467L-1) USP class 2 residual solvents B, low (p/n USPM-467N-1) USP <467> class 2B, low (p/n 5190-0513)
Class 2C:	USP <467> class 2 residual solvents C (p/n USPM-467M-1)
USP <467> calibration standards:	USPM-467A-1, USPM-467C-1, USPM-467D-1

These chromatograms represent all three solvent classes tested using Procedure A. Excellent peak shape was achieved by combining Agilent J&W DB-Select 624 UI columns with the Agilent 7697A headspace sampler.

### Class 1

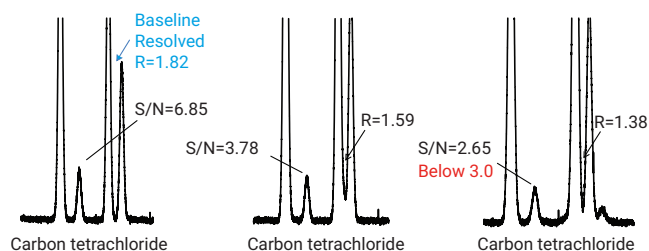


- 1,1-Dichloroethene
- 1,1,1-Trichloroethane
- Carbon tetrachloride
- Benzene
- 1,2-Dichloroethane

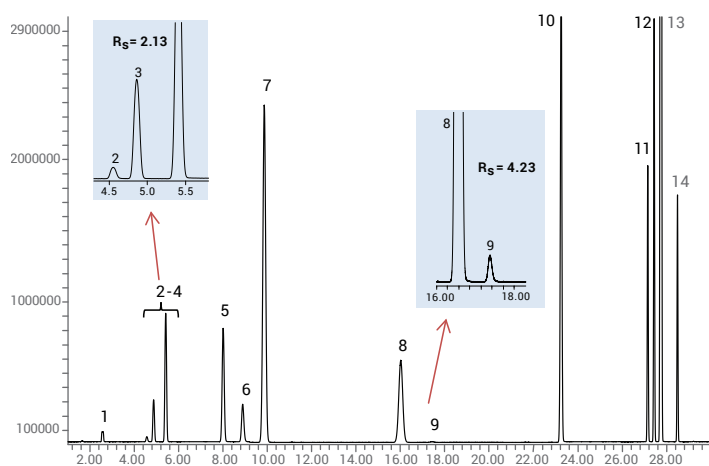
DB-Select 624 UI <467>

Vendor X G43

Vendor Y G43



### Class 2A

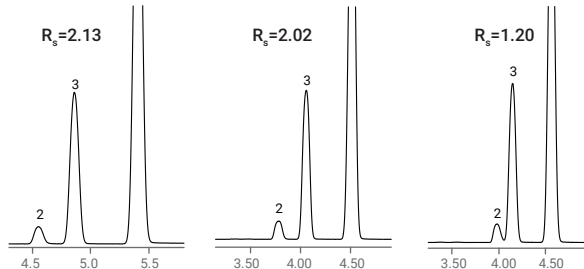


- |                                     |                      |                        |
|-------------------------------------|----------------------|------------------------|
| 1. Methanol                         | 6. Tetrahydrofuran   | 11. Chlorobenzene      |
| 2. Acetonitrile                     | 7. Cyclohexane       | 12. Ethylbenzene       |
| 3. Dichloromethane                  | 8. Methylcyclohexane | 13. <i>m-p</i> -Xylene |
| 4. <i>trans</i> -1,2-Dichloroethene | 9. 1,4-Dioxane       | 14. <i>o</i> -Xylene   |
| 5. <i>cis</i> -1,2-Dichloroethene   | 10. Toluene          |                        |

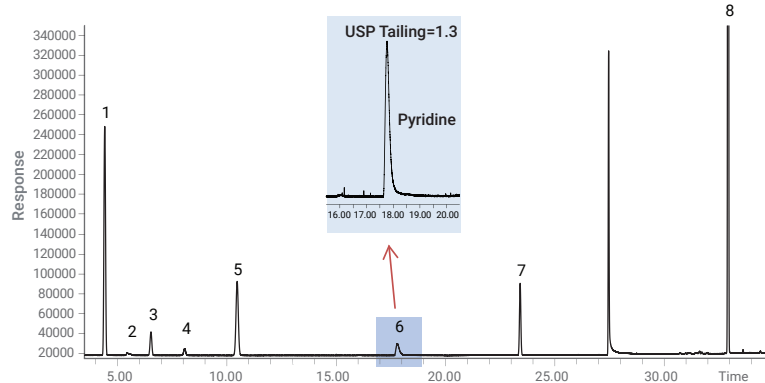
DB-Select 624 UI <467>

Vendor X G43

Vendor Y G43



### Class 2B

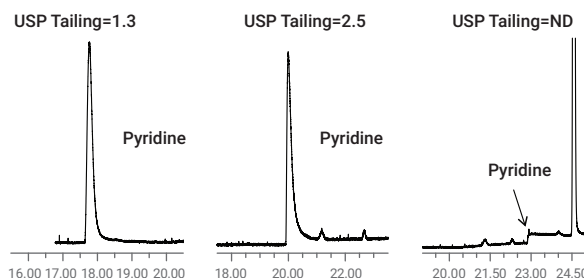


- |                 |                        |               |
|-----------------|------------------------|---------------|
| 1. Hexane       | 4. 1,2-Dimethoxyethane | 7. 2-Hexanone |
| 2. Nitromethane | 5. Trichloroethylene   | 8. Tetralin   |
| 3. Chloroform   | 6. Pyridine            |               |

DB-Select 624 UI <467>

Vendor X G43

Vendor Y G43



Class 1 (top), class 2A (middle), and class 2B (bottom) solvents at USP <467> limit concentrations.

For more information, refer to application note 5991-0616

# USP <467> Procedure B

Excellent chromatographic performance for confirmatory testing



Once a residual solvent is identified and determined to be above the daily exposure limit, Procedure B is performed to confirm analyte identity.

## Single-column GC/FID analysis of residual solvents

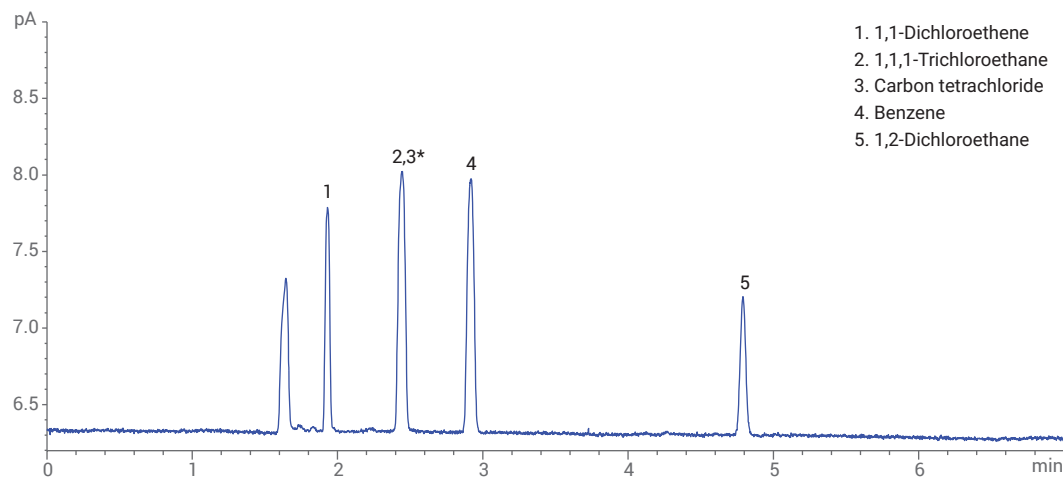
Here, USP <467> Procedure B was used to confirm the peak identification of Procedure A. An Agilent J&W DB-WAX UI GC column was used as a confirmation column.

### Conditions

Column:	Agilent J&W DB-WAX UI, 30 m × 0.32 mm, 0.25 µm (p/n 123-7032UI)	FID:	250 °C
Liner:	Agilent liner, splitless, straight, deactivated, quartz (p/n 5181-8818) Equivalent: Agilent Ultra Inert liner, splitless, straight, 1 mm id (p/n 5190-4047)	Headspace:	Agilent 7697A headspace sampler
Inlet:	Split/splitless, 140 °C, split ratio 5:1	Oven temperature:	80 °C
Oven:	50 °C (hold 20 min) to 165 °C at 6 °C/min (hold 20 min)	Loop temperature:	80 °C
		Transfer line temperature:	100 °C
		Equilibration time:	45 min
		Sample loop:	1 mL

The Agilent J&W DB-WAX UI GC column demonstrated good resolution, peak shape, sensitivity, and repeatability for the three classes of residual solvents at method-specified limits.

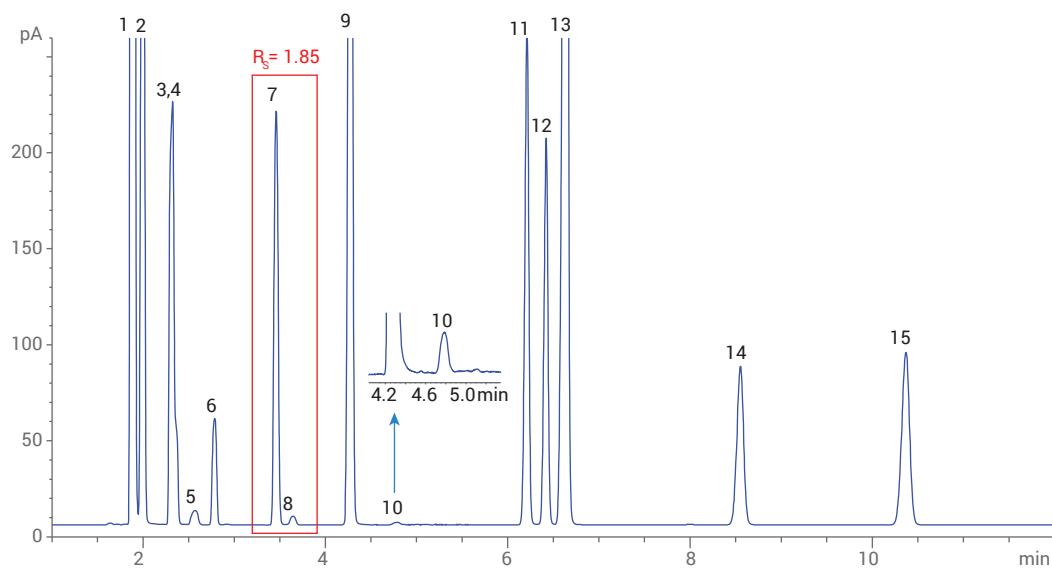
### Class 1



Class 1 standard solution resolved on an Agilent J&W DB-WAX Ultra Inert GC column.

\*Carbon tetrachloride coelutes with 1,1,1-Trichloroethane with the G16 column but is separated from all peaks in the class 1 standard with the G43 column.

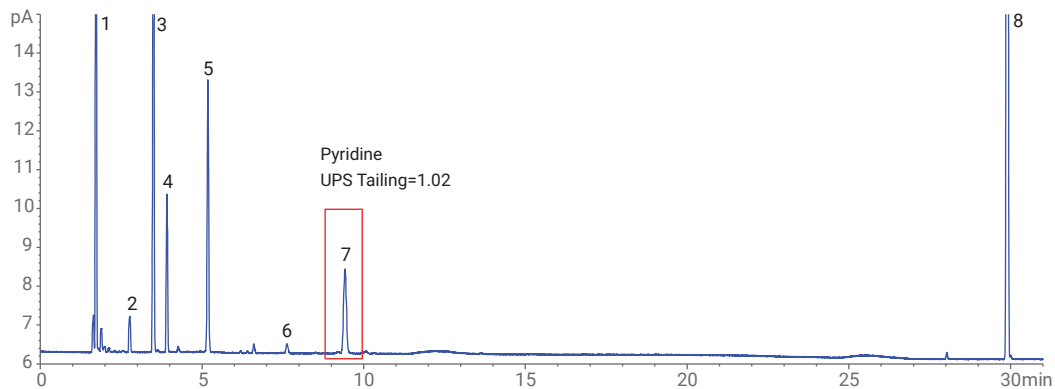
### Class 2A



1. Cyclohexane
2. Methylcyclohexane
3. *trans*-1,2-Dichloroethene
4. Tetrahydrofuran
5. Methanol
6. Dichloromethane
7. *cis*-1,2-Dichloroethene
8. Acetonitrile
9. Toluene
10. 1,4-Dioxane
11. Ethylbenzene
12. *p*-Xylene
13. *m*-Xylene
14. *o*-Xylene
15. Chlorobenzene

Class 2A standard solution resolved on an Agilent J&W DB-WAX Ultra Inert 30 m × 0.32 mm, 0.25 μm GC column.

### Class 2B



1. Hexane
2. 1,2-Dimethoxyethane
3. Trichloroethylene
4. Chloroform
5. 2-Hexanone
6. Nitromethane
7. Pyridine
8. Tetralin

Class 2B standard solution resolved on an Agilent J&W DB-WAX Ultra Inert 30 m × 0.32 mm, 0.25 μm GC column.

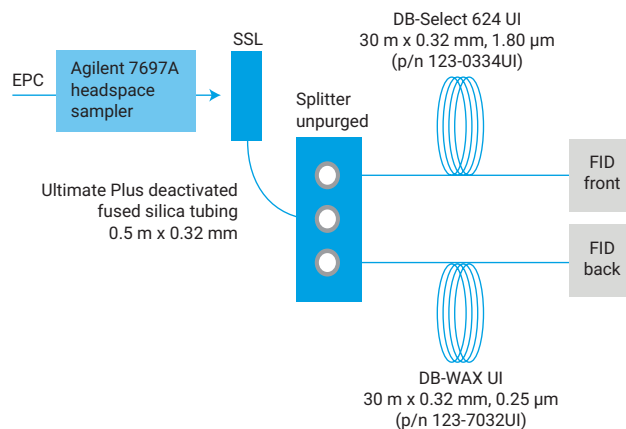
## Dual-column GC/FID analysis of residual solvents

With the dual-channel GC/FID configuration, static headspace analysis performed at 85 °C for 40 minutes improved repeatability and reduced analysis time and cycle time. A DB-WAX UI GC column was used as a confirmation column in this system. USP <467> procedures A and B can be accomplished in one run with the dual-channel configuration.

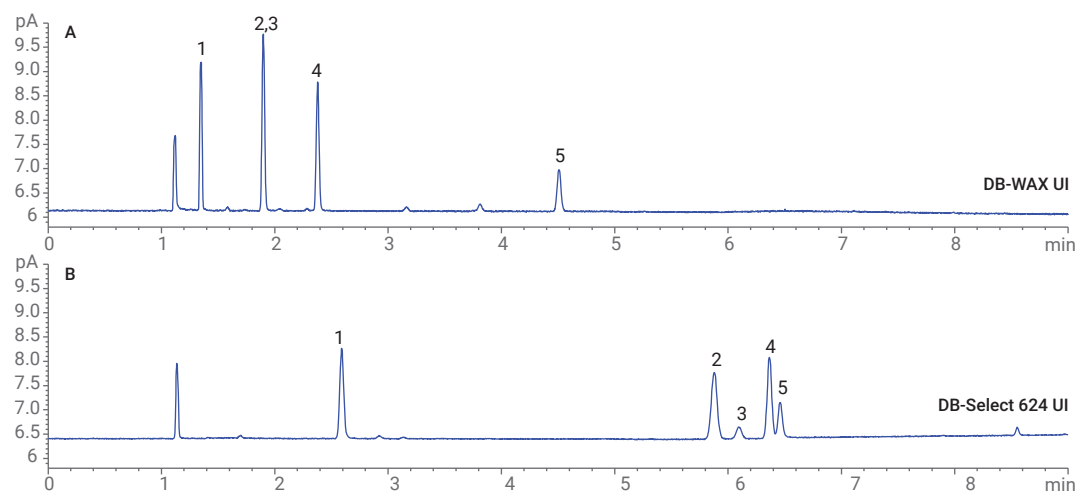
### Conditions

Column 1:	Agilent J&W DB-WAX UI, 30 m × 0.32 mm, 0.25 µm (p/n 123-7032UI)
Column 2:	Agilent J&W DB-Select 624 UI, 30 m × 0.32 mm, 1.8 µm (p/n 123-0334UI)
Liner:	Agilent liner, splitless, straight, deactivated, quartz (p/n 5181-8818) Equivalent: Agilent Ultra Inert liner, splitless, straight, 1 mm id (p/n 5190-4047)
Tubing:	Agilent Ultimate Plus deactivated fused silica tubing, 0.5 m × 0.32 mm (p/n CP803205)
Carrier gas:	Helium, constant flow mode, 15 psi
Inlet:	Split/splitless, 140 °C, split ratio 2.5:1
Oven:	40 °C (hold 5 min) to 240 °C at 18 °C/min (hold 2 min)
FID (both channels):	250 °C
Headspace:	Agilent 7697A headspace sampler
Oven temperature:	85 °C
Loop temperature:	85 °C
Transfer line temperature:	100 °C
Equilibration time:	40 min
Sample loop:	1 mL

### Dual-channel GC/FID system



### Class 1

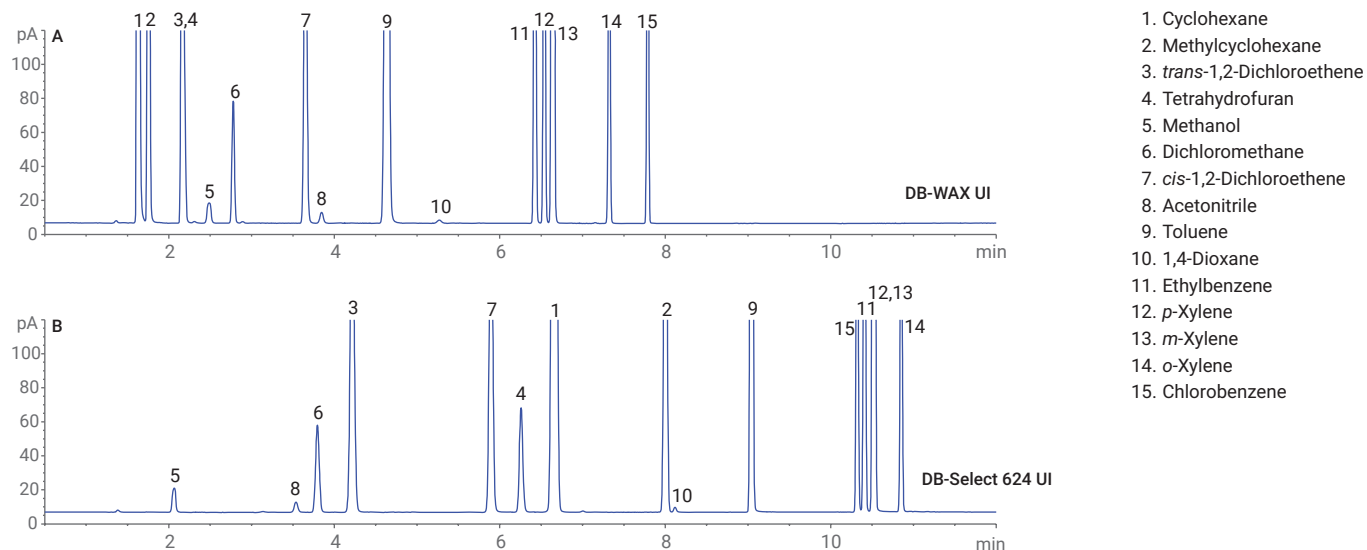


Class 1 standard solution analyzed using an Agilent J&W DB-WAX UI and an Agilent DB-Select 624 UI GC column.



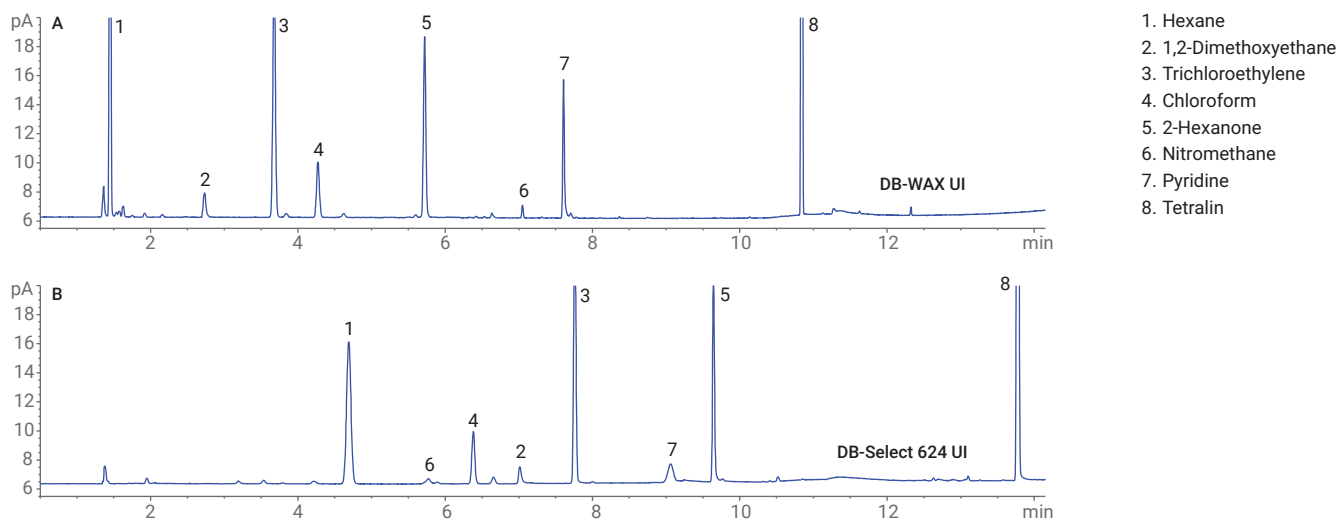
The high inertness of the DB-WAX UI column provided excellent peak shape for residual solvents. For pyridine—a particularly challenging compound—USP tailing was 1.06.

### Class 2A



Class 2A standard solution analyzed using an Agilent J&W DB-WAX UI and an Agilent DB-Select 624 UI GC column.

### Class 2B



Dual-channel GC/FID chromatograms of class 2B standard solution using an Agilent J&W DB-WAX UI and an Agilent DB-Select 624 UI GC column.

For more information, refer to application note [5991-7531](#)

# USP <467> Procedure Summary

Proven resolution, peak shape, and sensitivity

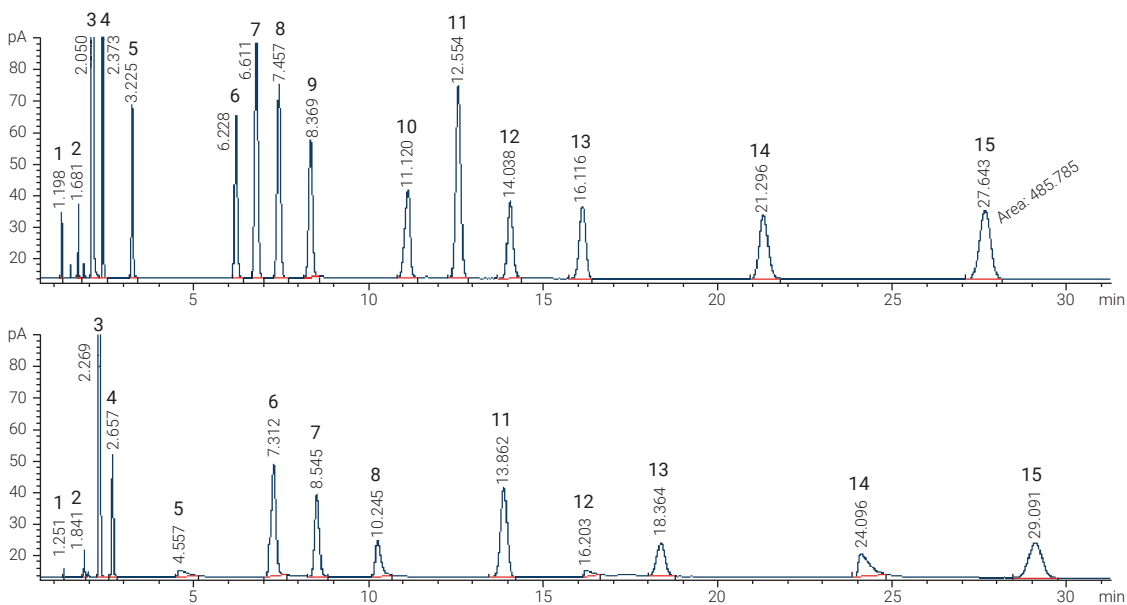


Agilent J&W DB-Select 624 UI columns showed excellent performance for residual solvent analysis according to USP <467> Procedure A. Repeatability was generally better than 2.5% RSD for Class 1, Class 2A, and Class 2B solvents.

Once a residual solvent was identified above the permitted daily exposure (PDE) limit, Procedure B was performed to confirm analyte identity. The Agilent J&W DB-WAX UI GC column was successfully used as a confirmation column, because it yields an alternate selectivity compared to that of a G43 column.

## Comparison: Agilent versus the competition

These chromatograms compare an Agilent DB-Select 624 UI (30 m x 0.53 mm x 3.0  $\mu$ m) with a column from Brand Z (30 m x 0.53 mm x 3.0  $\mu$ m).



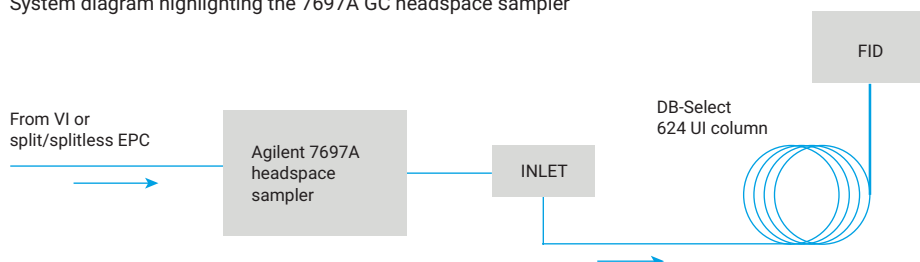
1. Methane
2. Methanol
3. Ethanol
4. 1-Propanol
5. Acetic acid
6. Pyridine
7. Octane
8. 1-Pentanol
9. 1,2-Propanediol
10. n-Butyric acid
11. m-Xylene
12. 4-Methylpyridine
13. Bromoform
14. Dimethyl methylphosphonate
15. Decane

## First-class precision, reliability, and ease of use: Agilent 7697A GC headspace sampler

With best-in-class technology and powerful software, the Agilent 7697A headspace sampler is packed with the latest productivity-boosting features.

- Unique sampling design allows you to use hydrogen as a carrier gas, delivering optimal chromatography and helping to future-proof your lab.
- Comprehensive software goes beyond sample handling to guide you through tasks, such as method development and resource conservation.
- Method optimization tools facilitate headspace method development.
- Electronic pneumatic control, vial leak checking, and barometric pressure compensation ensure consistent results.

System diagram highlighting the 7697A GC headspace sampler



## Agilent GC and GC/MSD portfolio

### Routine analysis



### Rapid high throughput



### Unknown analysis



Agilent has a range of GC and GC/MSD systems capable of delivering USP/ICH compliance based on your laboratory's need. [Read more about using the Agilent 8890 GC/FID/5977B MSD system.](#)

# Residual Solvent Analyzers

Rapid high-throughput USP <467>  
residual solvent detection



Based on the Agilent Intuvo 9000 GC system, Agilent Residual Solvent Analyzers are factory pretested and preconfigured to deliver results, *fast*, while saving precious startup time. What's more, their analytical precision exceeds USP method requirements for the three classes of residual solvents.

## Rapid high-throughput residual solvent analysis with the Intuvo 9000 GC and 8697 headspace sampler

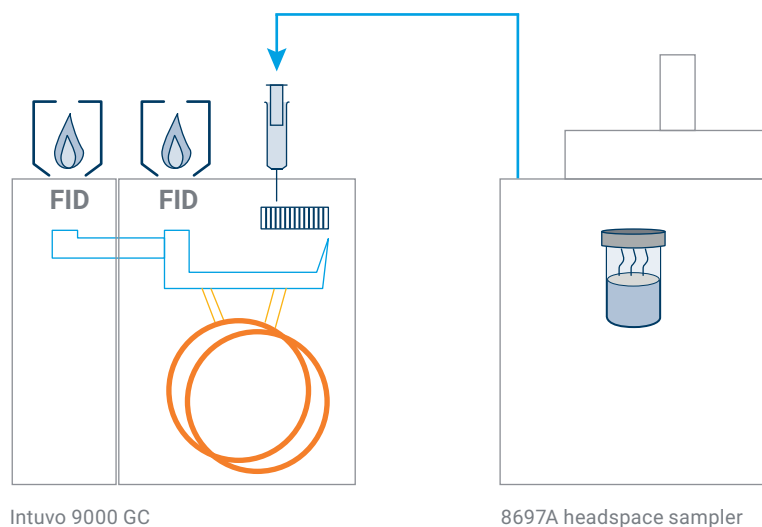
- Preconfigured to meet system suitability requirements for USP <467>, including column, consumables, calibration/checkout samples, and analytical method.
- Chemically tested to ensure optimal analysis of class 1 and class 2A/B solvents.
- Precise temperature and sampling control routines. The Agilent 8697A headspace sampler maximizes throughput and minimizes operator error.
- Headspace thermal zone stability of  $\pm 0.1$  °C, inert flow path, and capillary flow technology provide excellent RSD for class 1 and 2A/B solvents—while minimizing carryover.
- Begin system calibration and validation immediately following installation.



## Easily quantitate OVI content with dual-FID residual solvent analyzers

Dual-FID analyzers are ideal for identifying organic contaminants in active ingredients, formulations, and additives. The dual-FID configuration uses dissimilar columns for added confirmation within a single injection.

In addition, an inert sample flow path and thermal zone stability—combined with the automation capabilities of the Agilent 8697A headspace sampler—provide unsurpassed accuracy and repeatability.



### Intuvo residual solvent analyzers reflect innovative technology and a stringent quality control process

Systems include:

#### Factory

- System assembly, performance check, and leak testing
- Application, configuration, and Agilent J&W Ultra Inert columns
- Factory chemical performance verification with application-specific chemical checkout mix

#### Delivery

- DVD with method parameters and checkout data files for easy out-of-the-box operation
- Instrument and method operational manuals
- Information to help you reorder consumables easily

#### Installation

- Onsite installation by factory-certified support engineer
- Duplicate factory checkout with application-specific class 2A checkout sample
- Optional application startup assistance

For more information, read application note [Residual Solvents Analysis Using an Agilent Intuvo 9000 GC with 8697 Headspace sampler](#).

# Agilent-engineered GC supplies deliver what your pharmaceutical applications demand

## Make productivity happen with the Agilent ADM Flow Meter

The ADM Flow Meter measures volumetric gas flow, and is a valuable tool for troubleshooting detector problems.

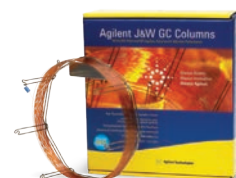
Visit [www.agilent.com/chem/admflowmeter](http://www.agilent.com/chem/admflowmeter)



## Protect the purity of your gas with the Agilent Gas Clean filter

Inserting a Gas Clean filter system in the gas line immediately before the instrument inlet greatly reduces the level of contaminants and impurities, improving trace analysis.

Visit [www.agilent.com/chem/gasclean](http://www.agilent.com/chem/gasclean)



## Easy selection and ordering information

This guide provides recommendations for Agilent products for USP<467> residual solvent analysis, so you can find what you're looking for quickly. To add items to your **Favorite Products** list at the Agilent online store, simply click the **MyList** links in each header below. Then, enter the quantities for the products you need. Your list will remain under **Favorite Products** for your use with future orders.

If this is your first-time using **Favorites Products**, you will be asked to enter your email address for account verification.

If you have an existing Agilent account, you will be able to log in. If you don't have a registered Agilent account, you will need to register for one. This feature is valid only in regions that are e-commerce enabled. All items can also be ordered through your regular sales and distributor channels.

View [MyList](#) of all consumables required for USP<467> residual solvent analysis using 7890/8890 systems.

View [MyList](#) of all consumables required for USP<467> residual solvent analysis using the Intuvo 9000 system

Description	Part Number
<a href="#">MyList of GC columns and tubing for 7890/8890 GC systems</a>	
Agilent J&W DB-WAX UI, 30 m × 0.32 mm, 0.25 µm	<a href="#">123-7032UI</a>
Agilent J&W DB-Select 624 UI for <467>, 30 m × 0.32 mm, 1.8 µm	<a href="#">123-0334UI</a>
Agilent Ultimate Plus deactivated fused silica tubing, 0.5 m × 0.32 mm	<a href="#">CP803205</a>
<a href="#">MyList of GC columns for the Intuvo 9000 GC system</a>	
J&W DB-Select 624 Ultra Inert Intuvo GC column module, 30 m, 0.32 mm, 1.80 µm	<a href="#">123-0334UI-INT</a>
J&W DB-WAX Ultra Inert Intuvo GC column module, 30 m, 0.32 mm, 0.25 µm	<a href="#">123-7032UI-INT</a>
<a href="#">MyList of GC supplies for the Intuvo 9000 GC system</a>	
Jumper chip, Intuvo, split/splitless inlet	<a href="#">G4587-60575</a>
Gasket, Intuvo, polyimide, 5/pk	<a href="#">5190-9072</a>

Description	Part Number
Flow chip, Intuvo, inlet splitter chip	<a href="#">G4588-60601</a>
Flow chip, Intuvo, D1	<a href="#">G4581-60032</a>
<a href="#">MyList of GC inlet supplies</a>	
Agilent liner, splitless, straight, deactivated, quartz	<a href="#">5181-8818</a>
1 mm straight single taper Ultra Inert liner (Equivalent)	<a href="#">5190-4047</a>
Gold-plated inlet seal with washer, 10/pk*	<a href="#">5190-2209</a>
Gold-plated inlet seal with washer, Ultra Inert, 10/pk*	<a href="#">5190-6145</a>
Gold-plated inlet seal with washer, Ultra Inert, 50/pk*	<a href="#">5190-6149</a>
Non-stick, bleed and temperature optimized, 11mm, 50/pk	<a href="#">5183-4757</a>
Non-stick, Bleed and Temperature Optimized, 11mm, 100/pk	<a href="#">5183-4757-100</a>
Column nut, collared, self-tightening, inlet/detector	<a href="#">G3440-81011</a>
20x magnifier loupe	<a href="#">430-1020</a>

\*Supplies for 7890/8890 GC system only



Description	Part Number
<a href="#">MyList of FID supplies</a>	
FID jet, universal fit, 0.29mm (0.011 inch) id, capillary	<a href="#">5200-0176</a>
FID jet, universal fit, 0.47mm (0.018 inch) id	<a href="#">5200-0177</a>
<a href="#">MyList of pneumatic and transfer line parts</a>	
1mL sample loop	<a href="#">G4556-80106</a>
Sample probe, inert	<a href="#">G4556-63825</a>
0.53 mm deactivated fused silica, 5 m	<a href="#">160-2535-5</a>
1/6 to 1/32 inch reducing fitting	<a href="#">0100-2594</a>
0.5 mm id short 85/15 Vespel/graphite. 10/pk	<a href="#">5062-3514</a>
9mm HS septa for HS transfer line. Transfer line use only. Please do not use in the GC inlet.	<a href="#">5183-4801</a>
<a href="#">MyList of standards</a>	
USP 467 Class 2B, low	<a href="#">5190-0513</a>
USP 467 calibration standard	<a href="#">USPM-467C-1</a>
USP 467 calibration standard	<a href="#">USPM-467A-1</a>
USP 467 calibration standard	<a href="#">USPM-467D-1</a>
USP 467 class 1 residual solvents	<a href="#">USPM-467J-1</a>
USP 467 class 2 residual solvents A	<a href="#">USPM-467K-1</a>
USP 467 class 2 residual solvents B	<a href="#">USPM-467L-1</a>
USP 467 class 2 residual solvents B, low	<a href="#">USPM-467N-1</a>

Description	Part Number
USP 467 class 2 residual solvents C	<a href="#">USPM-467M-1</a>
USP<467> class 2: 4-Methyl-2-pentanone (MIBK), 5,000 ug/ml in methanol	<a href="#">EPA-1043-1</a>
USP<467> class 2: 4-Methyl-2-pentanone (MIBK), 100 ug/ml in methanol	<a href="#">NV-220-1</a>
<a href="#">MyList of headspace vials and caps</a>	
Headspace vial, crimp, clear, write-on spot, flat bottom, 20 mL, 23 x 75 mm, 100/pk	<a href="#">5190-2288</a>
Cap, crimp, headspace, aluminum, PTFE/silicone septa, 20 mm, 100/pk <sup>1</sup>	<a href="#">5183-4477</a>
Headspace crimp cap 20mm, /high performance septa, 100/pk <sup>2</sup>	<a href="#">5190-3987</a>
<a href="#"><sup>1</sup>MyList of Crimper, decapper for aluminum caps 5183-4477</a>	
A-line E-crimper, for 20 mm caps	<a href="#">5191-5615</a>
A-line E-decapper, for 20 mm caps	<a href="#">5191-5613</a>
<a href="#"><sup>2</sup>MyList of Crimper, decapper for high performance caps 5190-3987</a>	
A-line HP E-crimper, with power supply, no jaws	<a href="#">5191-5617</a>
Crimper jaw set, 20 mm	<a href="#">5190-4064</a>
Decapper jaw set, 20 mm	<a href="#">5190-4065</a>
Replacement lithium ion battery, for crimper	<a href="#">5190-3192</a>

Visit [www.agilent.com/chem/standards](http://www.agilent.com/chem/standards) to view Agilent's comprehensive portfolio of residual solvent individual standards and mixes.

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