Reference Standards

Overcome the Frustrations of Residual Solvent Gases Testing

with Restek's Exceptionally Reliable Standards

RESTEK Pure Chromatography www.restek.com

Overcome the Frustrations of Residual Solvent Gases Testing with Restek's Residual Solvent Gases Standards

Our Restek Team has gone above and beyond to produce the best quality residual solvent gases standards across the cannabis testing industry. We've taken measures to overcome common pain points in testing, ensured consistent lot-to-lot and ampul-to-ampul reproducibility, and created supportive resources for best practices in handling. Our four-component residual solvent gases standard mix contains *n*-propane, isobutane, *n*-butane, and neopentane at concentrations of 5000 µg/mL. We also offer singles of each analyte at 5000 µg/mL.

- Our proprietary manufacturing process was optimized to ensure standards are accurate, reproducible, and stable.
- High analyte concentrations allow for flexible calibration curves.
- Second independent lots available to ensure you can meet your requirements without needing to source another supplier.

Common Challenges in Residual Solvent Gases Testing

Difficulties with accuracy, reproducibility, and stability are well-known frustrations in labs analyzing for residual solvent gases across the cannabis industry. Because of the volatility of residual solvents gases, well-thought-out methodologies utilizing proper care and handling of the standards is crucial to ensure reliable calibration curves. To make sure you have all the tools to feel confident in handling your standards, we published a convenient **Volatile Standards Handling Guide** that covers the most important aspects of handling residual solvents gases, from ensuring analytes are in the solution prior to opening the ampul to recommendations for the best tools in constructing calibration solutions.

While handling is certainly important, starting with reliable standards you can trust is perhaps even more critical. Each step in our production process, from solvent choice to ampul design to quality testing, is safeguarded to ensure standards are optimized for accuracy, stability, and reproducibility. We've taken measures to ensure that our residual solvent gases standards are optimized for performance and stability so that you can avoid common frustrations experienced with these standards and have confidence in your analysis every time.

Our Residual Solvent Gases Standards Are Optimized to Meet All of Your Testing Needs

Proprietary Manufacturing and Tailored Formations

Manufacturing reliable standards starts with creating specific and tailored formulations that have been subjected to rigorous stability and performance studies. Each of our neat materials is assayed by multiple techniques prior to formulation in order to assign an accurate purity value. After purity of neat materials is confirmed, our scientists develop optimized formulations, which are then subjected to rigorous studies to confirm integrity.

A particularly important consideration in the formulation of residual solvents gases standards is solvent choice. To support these extremely volatile, nonpolar hydrocarbons, choosing a solvent that strikes a balance between maximizing solubility interactions while not interfering with the analytes of interest is crucial. 1,2,4-trimethylbenzene was selected as the most optimal solvent, producing exceptionally stable and reproducible standards. Beyond solvent choice, we have tailored each of the steps in our manufacturing processes to ensure the integrity of the standards are preserved in each subsequent step.

Second Independent Lots Ready for Shipment

Your calibration verifications are important, and we are aware that it can be both frustrating and time-consuming to find second source standards that you can trust to meet your requirements. To eliminate the need to source a second standard, we are ready to provide a second independent lot at the time of your order, so there's no waiting or hassle in finding a second lot for verification. Our independent lots are prepared by two different chemists using separate NIST-calibrated balances and are assayed post-ampulation to ensure lot-to-lot consistency.

Optimized for Consistency and Easier Handling

To help eliminate the frustrations of poor lot-to-lot and ampul-to-ampul reproducibility frequently reported in residual solvent gases standards, we have taken measures to address concerns both in handling and the integrity of the standards themselves. Our optimized design is specifically tailored to reduce volatility issues, support easier handling, and ensure you are set up for success in generating your calibration solutions.

High Analyte Concentration for Added Flexibility in Constructing Calibrations

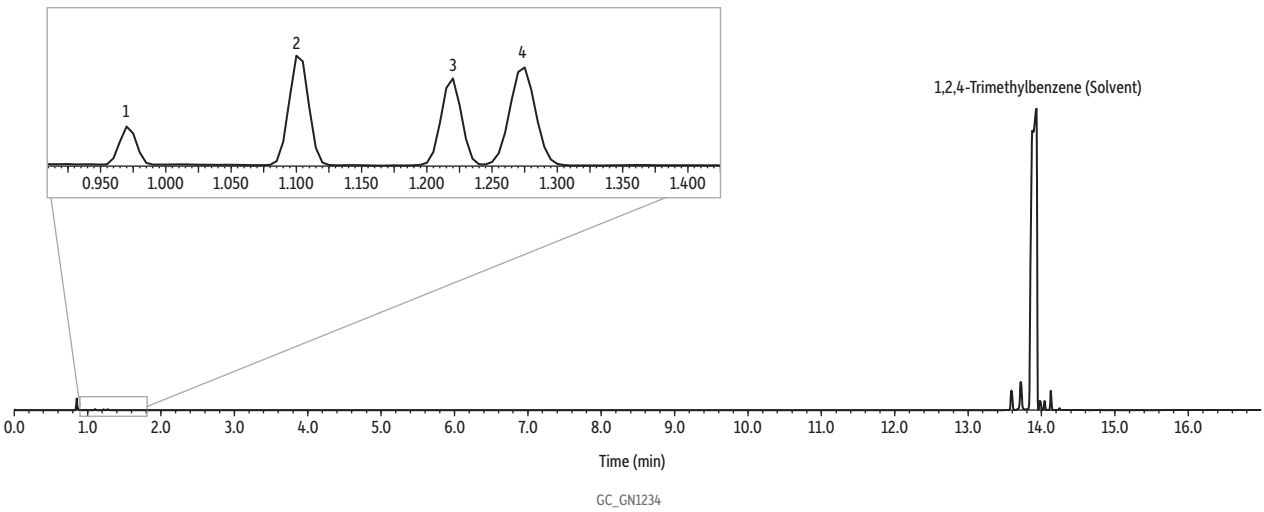
The action limits for residual solvent cannabis testing vary significantly from state-to-state, and, indeed, some action limits are set at 5000 ppm. To provide the most flexibility in constructing your calibration curves, we chose a concentration at 5000 ppm for all four target analytes. Starting with a higher analyte concentration gives you the freedom to construct your curves according to your specific requirements and methodologies.

Excellent Chromatographic Performance and Reproducibility

Chromatographic Performance

To assess chromatographic performance, our residual solvents gases standard (cat# 36024) was prepared at a concentration of 125 µg/mL in 1,2,4-trimethylbenzene. Gas-tight syringes were used in constructing standard solutions to control any evaporative loss of the standard. To perform testing 50 µL of the working standard solution was added to a 20 mL headspace vial, then tested on the Rxi-624Sil MS column by HS-Syringe-GC-MS. Excellent chromatographic separations and peak shape were achieved for all four compounds. For the full method conditions and chromatographic results of this analysis, see Figure 1 on the next page.

Figure 1: Our Residual Solvent Gases Standard achieved exceptional chromatographic performance.



GC_GN1234

Peaks	t_R (min)	Conc. (µg/mL)
1. *n*-Propane	0.970	125
2. Isobutane	1.100	125
3. *n*-Butane	1.220	125
4. Neopentane	1.275	125

Column	Rxi-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Standard/Sample	Residual Solvent Gases Standard (cat.# 36024)
Diluent:	1,2,4-Trimethylbenzene
Conc.:	125 µg/mL
Injection	
Inj. Vol.:	250 µL headspace-syringe split (split ratio 10:1)
Liner:	Topaz, straight/SPME inlet liner, 1.8 mm x 5.0 x 95 (cat.# 23279)
Inj. Temp.:	280 °C
Headspace-Syringe	
Instrument:	AOC-6000 Plus
Syringe Temp.:	150 °C
Sample Temp.:	80 °C
Sample Equil. Time:	45 min
Inj. Speed:	25 mL/min
Inj. Dwell:	0.05
Inj. Temp.:	280 °C
Oven	
Oven Temp.:	30 °C (hold 6 min) to 85 °C at 15 °C/min (hold 2 min) to 250 °C at 35 °C/min (hold 1 min)
Carrier Gas	He, constant flow
Flow Rate:	2 mL/min
Detector	**QP2020 NX MS**
Scan Program:	

Group	Start Time (min)	Scan Range (amu)	Scan Rate (scans/sec)
1	0	35-350	1111

Transfer Line Temp.:	250 °C
Analyzer Type:	Quadrupole
Source Temp.:	200 °C
Solvent Delay Time:	0 min
Tune Type:	PFTBA
Ionization Mode:	EI
Instrument	Shimadzu GC 2030
Sample Preparation	A Residual Solvents Gases (cat# 36024) working standard was prepared at 125 µg/mL. 50 µL of that working solution was added to a 20 mL headspace vial, then tested using HS-Syringe-GC-MS.
Notes	Conditions were optimized for an expanded list of residual solvents, similar to GC_GN1198. This chromatogram was generated with our residual solvent gases standard mix (cat #36024). We also offer single solutions of each analyte. Please see the catalog numbers below for reference.

Cat.#	Description
36020	Propane Standard
36021	Isobutane Standard
36022	Butane Standard
36023	Neopentane Standard

Reproducibility

Reproducibility is a crucial component in analyzing for residual solvent gases, so we made it our top priority to ensure our standards were consistent both lot-to-lot and ampul-to-ampul. We optimized our manufacturing process and took measures to ensure these volatile compounds were properly safeguarded at each step in our production process. Rigorous testing was performed to ensure a consistent product, so you can have the assurance you need in performing your analyses.

To demonstrate reproducibility for our standards, we tested three randomly-selected ampuls each from four separate lots. Reproducibility was then calculated both within and between lots for each of the target analytes. To evaluate reproducibility within lots, we calculated the %RSDs for each of the three ampuls across a single lot for each of the targeted compounds (results reported in Table I). Exceptionally low %RSDs were achieved within lots, with an overall %RSD of less than 4% across all lots and all analytes.

To measure the reproducibility of our manufacturing process across lots, we calculated the % difference between each of the four lots, then took the average of these % difference values. Table II below reports the average as well as the range of % difference values. With these outstanding results in reproducibility, both within and between lots, you can have confidence that our residual solvent gases standards will consistently perform at the level you need analysis after analysis.

Table I: Reproducibility within Lots for Restek's Residual Solvent Gases Standards

	Response % RSD Across Ampuls in Each Lot (n=3)			
Target Analyte	Lot 1	Lot 2	Lot 3	Lot 4
n-Propane	3.1%	3.7%	1.7%	0.5%
Isobutane	3.3%	3.4%	1.1%	0.5%
n-Butane	3.5%	3.3%	0.9%	0.5%
Neopentane	3.2%	3.3%	0.6%	0.7%

Table II: Reproducibility between Lots for Restek's Residual Solvent Gases Standards

Target Analyte	Average Response % Difference Across Four Lots
n-Propane	6.3% (Range = 2.5% – 11.5%)
Isobutane	1.6% (Range = 0.3% - 3.2%)
n-Butane	1.7% (Range = 0.2% - 3.4%)
Neopentane	1.4% (Range = 0.4% - 2.6%)

How Do Our Residual Solvent Gases Standards Compare?

Because we know how important reproducibility is in analyzing for residual solvent gases, we performed testing on two different competitor standards to provide transparency in how our standards compare to the current standards on the market. Additional compounds were present in some of these competitor solutions, but our focus was specifically on the residual solvent gases: *n*-propane, isobutane, *n*-butane, and neopentane.

Three ampuls each from two separate lots were evaluated for each of the two competitors. The %RSDs calculated within lots for Competitor A are reported in Table III, with an overall %RSD of less than 10%. The % difference between lots for Competitor A ranged from 28% to 50% and are reported in Table IV.

Table III: Competitor A* Reproducibility within Lots

	Response %RSD Across Ampuls in Each Lot (n=3)	
Target Analyte	Lot 1	Lot 2
n-Propane	8.9%	4.2%
Isobutane	9.2%	4.8%
n-Butane	9.1%	4.8%
Neopentane	9.5%	5.5%

Table IV: Competitor A* Reproducibility between Lots

Target Analyte	Response % Difference Across Two Lots
n-Propane	31.8%
Isobutane	32.1%
n-Butane	50.1%
Neopentane	28.4%

**Formulated with N,N-dimethylacetamide solvent.*

The results for Competitor B are reported in Table V and Table VI. Please note that the standard from Competitor B did not contain isobutane and neopentane, so these compounds were not evaluated. The overall %RSD within lots for Competitor B was less than 7%, and the % difference between lots for the two measured compounds (*n*-propane and *n*-butane) was 34.0% and 28.4%, respectively.

Table V: Competitor B† Reproducibility within Lots

	Response %RSD Across Ampuls in Each Lot (n=3)	
Target Analyte	Lot 1	Lot 2
n-Propane	3.7%	5.8%
Isobutane	NA	NA
n-Butane	1.4%	6.2%
Neopentane	NA	NA

Table VI: Competitor B† Reproducibility between Lots

Target Analyte	Response % Difference Across Two Lots
n-Propane	34.0%
Isobutane	NA
n-Butane	28.4%
Neopentane	NA

†Formulated with triacetin solvent.

A comparison of the data from our standards to these two competitors reveals a clear Restek advantage for reproducibility both from lot-to-lot and ampul-to-ampul. Particularly in evaluating the differences from lot to lot, our standards offer exceptional consistency and far outperforms these two competitor standards. Backed by this data, the proven integrity of our standards, and our optimized production process, you can have assurance that our standards will deliver the reproducibility you need in your residual solvent gases testing.

Have Confidence in Your Residual Solvent Gases Analysis with Our Exceptionally Reliable Standards

Our Restek Team takes pride in helping to provide solutions to the everyday challenges of scientists across the globe. With data showing superior chromatographic performance and reproducibility and a highly controlled manufacturing process, we are confident in our residual solvent gases standards. These highly consistent standards offer a solution to cannabis laboratories struggling with reproducibility in their calibration solutions. Start your analysis with confidence knowing that you are set up for success with our dependable residual solvent gases standards.

For specific care and handling instruction for your Residual Solvent Gases Standards, see our Volatile Standards Handling Guide at **www.restek.com/volatilestandardhandling**

Residual Solvent Gases Standards

- Designed for cannabis labs testing residual solvents gases at different threshold limits by headspace GC.
- Our proprietary manufacturing process was optimized to ensure standards are accurate, reproducible, and stable.
- High analyte concentrations allow for flexible calibration curves.
- Second independent lots available to ensure you can meet your requirements without needing to source another supplier.
- Verified composition and stability.

Residual Solvent Gases Mix

Contains each following compounds at a concentration of 5000 µg/mL:

n-Butane (C4) (106-97-8)
2,2-Dimethylpropoane (Neopentane) (463-82-1)
2-Methylpropane (Isobutane) ()75-28-5)
n-Propane (C3) (74-98-6)

Concentration in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp	Volume	Cat.#
5000 µg/mL in 1,2,4-Trimethylbenzene	Yes	6 months	60 months	Ambient	0 °C or colder	2.0 mL	36024

Residual Solvent Gases Singles

Product	Concentration in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp	Volume	Cat.#
Propane Standard	5000 µg/mL in 1,2,4-Trimethylbenzene	Yes	6 months	60 months	Ambient	0 °C or colder	2.0 mL	36020
2-Methylpropane (Isobutane) Standard	5000 µg/mL in 1,2,4-Trimethylbenzene	Yes	6 months	60 months	Ambient	0 °C or colder	2.0 mL	36021
n-Butane Standard	5000 µg/mL in 1,2,4-Trimethylbenzene	Yes	6 months	60 months	Ambient	0 °C or colder	2.0 mL	36022
2,2-Dimethylpropane (Neopentane) Standard	5000 µg/mL in 1,2,4-Trimethylbenzene	Yes	6 months	60 months	Ambient	0 °C or colder	2.0 mL	36023

Rxi-624Sil MS Columns (fused silica)

midpolarity Crossbond phase

- Low-bleed, high-thermal stability column—maximum temperatures up to 300–320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—G43 phase highly selective for volatile organics, terpenes, and residual solvents, great choice for USP<467>.
- Temperature Range: -20 °C to 320 °C.

Product Name	df (Film Thickness)	Internal Diameter (ID)	Length	Cat.#.
Rxi-624Sil MS GC Capillary Column	1.0 µm	0.18 mm	20 m	13865

Topaz, Straight/SPME Inlet Liner

Topaz GC inlet liners feature revolutionary technology and inertness to deliver you the next level of True Blue Performance:

- Deactivation—unbelievably low breakdown for accurate and precise low-level GC analyses.
- Reproducibility—unbeatable manufacturing controls and QC testing for superior reliability across compound classes.
- Productivity—unparalleled cleanliness for maximized GC uptime and lab throughput.
- 100% Satisfaction—if a liner doesn't perform to your expectations, we will replace it or credit your account.

Patented

Product Name	Material	Volume	Cat.#
Topaz, Straight/SPME Inlet Liner, 1.8 mm x 6.5 x 78.5, for Agilent GCs, Premium Deactivation, 5-pk.	Borosilicate Glass	0.246 mL	23280

Headspace Vials

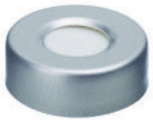
Product Name	Color	Modification	Size	Type	Units	Volume	Cat.#
Headspace Crimp-Top Vials, 20 mm	Clear	Rounded Bottom	23 x 75 mm	20 mm Crimp-Top	100-pk.	20 mL	21162
Headspace Crimp-Top Vials, 20 mm	Clear	Rounded Bottom	23 x 75 mm	20 mm Crimp-Top	1000-pk.	20 mL	21163
Headspace Screw-Thread Vials, 18 mm	Clear	Rounded Bottom	22 x 75 mm	18-425 Screw-Thread	100-pk.	20 mL	23082
Headspace Screw-Thread Vials, 18 mm	Clear	Rounded Bottom	22 x 75 mm	18-425 Screw-Thread	1000-pk.	20 mL	23083

Screw-Thread Headspace Caps

Product Name	Cap Size	Septa Material	Thickness	Units	Cat.#
Magnetic Screw-Thread Headspace Caps, 18 mm	18-425	Red PTFE/Silicone	1.9 mm	100-pk.	23092
Magnetic Screw-Thread Headspace Caps, 18 mm	18-425	PTFE/Red Chlorobutyl	1.9 mm	100-pk.	23094

Crimp-Top Headspace Caps (Magnetic)

Product Name	Material	Septa Material	Units	Cat.#
Magnetic Crimp-Top Caps with PTFE/Silicone Septa, 20 mm w/ 8 mm Hole, Gold, Preassembled	steel	PTFE/Silicone	100-pk.	22831
Magnetic Crimp-Top Caps with PTFE/Butyl Septa, 20 mm w/8 mm Hole, Gold, Preassembled	steel	PTFE/Butyl	100-pk.	22835



Crimp-Top Headspace Caps (Not Magnetic)

Product Name	Material	Septa Material	Units	Cat.#
Aluminum Crimp-Top Seals with PTFE/Gray Butyl Rubber Septa, Silver, Preassembled, 20 mm	Aluminum	PTFE/Gray Butyl Rubber	100-pk.	21761
Aluminum Crimp-Top Seals with PTFE/Silicone Septa, Silver, Preassembled, 20 mm	Aluminum	PTFE/Silicone	100-pk.	21763

Gas-Tight Syringes

- Suitable for gases or liquids.
- High accuracy of dispensed volumes.
- Interchangeable barrels, plungers, and tips extend performance and increase cost-effectiveness.

Product Name	Needle Gauge	Needle Length	Needle Point Style	Needle Termination	Volume	Cat.#/ ea.
Syringe, SGE, PTFE Tip, Gas-Tight	25	50 mm	2	F	500 µL	24742
Syringe, Hamilton 1750, PTFE Tip, Gas-Tight	22	51 mm	2	LTN	500 µL	24571
Syringe, SGE, PTFE Tip, Gas-Tight	25	50 mm	2	F	25 µL	24727
Syringe, Hamilton 1702, PTFE Tip, Gas-Tight	22	51 mm	2	N	25 µL	24559
Syringe, SGE, PTFE Tip, Gas-Tight	25	50 mm	2	F	100 µL	24734
Syringe, Hamilton 1710, PTFE Tip, Gas-Tight	22	51 mm	2	N	100 µL	24563

Mininert Precision Sampling Valve

Mininert valves are very convenient for repetitive sampling and limit content exposure to the silicon septum. Models are available for screw-cap and crimp-top vials. The crimp-top valve for 13 mm ID glassware slides into the neck of the vial. Turn the threaded flange to secure a tight fit.

Product Name	Cap Size	Type	Units	Catalog No.
Mininert Precision Sampling Valve, 20 mm,	20-400	Screw-Thread	12-pk.	24903

Accessories for Mininert Precision Sampling Valves

Product Name	Units	Cat.#
Replacement Septa for Mininert Precision Sampling Valves	50-pk.	24906
Septum Insertion Tool for Mininert Precision Sampling Valves	ea.	24907

Polypropylene Vial Storage Rack for 6, 10, or 20 mL Headspace Vials

Product Name	Size	Units	Cat.#
Polypropylene Vial Storage Rack for 6, 10, or 20 mL Headspace Vials, ea.	36 vial capacity	ea.	22643
Polypropylene Vial Storage Rack for 6, 10, or 20 mL Headspace Vials, 5-pk.	36 vial capacity	5-pk.	22644

Restek Electronic Leak Detector

- Detects a broad range of gases and indicates leak severity with both an LED display and audible tone.
- No more waiting for a full charge—can be operated during charging or used up to 12 hours between charges.
- Charging kit includes both universal AC power adaptor and USB charging cable, so you can charge anywhere, anytime.
- Pinpoint very small gas leaks quickly and accurately before they cause damage and downtime.
- Compact, handheld unit is easy to operate and convenient to use anywhere you need to check for leaks.

Description	Units	Cat.#
Restek Electronic Leak Detector includes carrying case, universal AC power adaptor [U.S., UK, Europe, Australia, Japan], 6-ft USB charging cable	ea.	28500

RESTEK
Pure Chromatography

Questions? Contact us or your local Restek representative (www.restek.com/contact-us).

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