



Restek GC

Rtx-BAC Plus 1 and Rtx-BAC Plus 2 Columns

Advanced Technology for Fast, Reliable Measurement of Alcohol in Blood

- Optimized column selectivities guarantee resolution of ethanol, internal standards, and frequently encountered interferences.
- Robust and reproducible column chemistry ensures longer column lifetime and accurate, consistent results.
- 2-minute analysis time increases lab productivity.



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Pure Chromatography

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Rtx-BAC Plus 1 and Rtx-BAC Plus 2 Columns

Advanced Technology for Fast, Reliable Measurement of Alcohol in Blood

Getting accurate, reliable results quickly is critical for labs analyzing blood alcohol concentration (BAC). Rtx-BAC Plus 1 and Rtx-BAC Plus 2 columns provide definitive data in a fast, 2-minute analysis, so you can be certain of your results and maximize sample throughput.

Blood alcohol content is often determined using headspace injection and dual column GC-FID analysis. While this is a relatively straightforward procedure, column choice plays a major role in data quality and reliability. In order to produce accurate results, the primary and confirmation columns must fully separate target analytes from all interferences and produce symmetrical peaks. Due to deficiencies in selectivity and inertness, coelution and tailing peaks are observed on competitor columns, which make confident reporting of target alcohols difficult.

Best Overall Performance

Rtx-BAC Plus 1 and Rtx-BAC Plus 2 columns have optimized column selectivities, which result in optimized resolution of all target compounds, as well as the retention time and elution order changes necessary for confirmation. These new columns outperform other blood alcohol column pairs and ensure baseline separation of all critical compounds, including ethanol, methanol, acetone, *tert*-butanol (IS), acetaldehyde, isopropanol, and 1-propanol (IS), in less than 2 minutes (Figure 1). The separation of *tert*-butanol is especially notable as it has recently been adopted as an internal standard for BAC headspace analysis, but coelutes with acetone on some columns.

In addition to being fully separated, target compounds exhibit excellent peak symmetry on Rtx-BAC Plus columns, allowing more accurate integration. In contrast, alcohol peaks on competitor columns display tailing, which can make integration difficult. As shown in Table I and Figure 1, the Rtx-BAC Plus columns produce the best peak shape for ethanol among the columns tested.

Quality Counts

Every Rtx-BAC Plus 1 and Plus 2 column is conditioned at maximum isothermal temperature and quality tested with the analytes shown in Figure 1 to ensure reliable separations of all target compounds. Quality specifications for retention and efficiency ensure consistent column-to-column performance, and tightly controlled manufacturing results in robust columns with long lifetimes. The maximum temperature of these 100% chemically bonded columns is 260 °C.

Compared to other columns, Rtx-BAC Plus 1 and Rtx-BAC Plus 2 columns offer the best overall performance for blood alcohol analysis. These columns provide fully separated, highly symmetrical peaks in a fast 2-minute analysis, allowing analysts to determine blood alcohol concentration quickly and report results with certainty.

Table I: Rtx-BAC Plus 1 and Rtx-BAC Plus 2 columns exhibit both baseline resolution of critical compounds and excellent peak shape compared to other blood alcohol columns available.

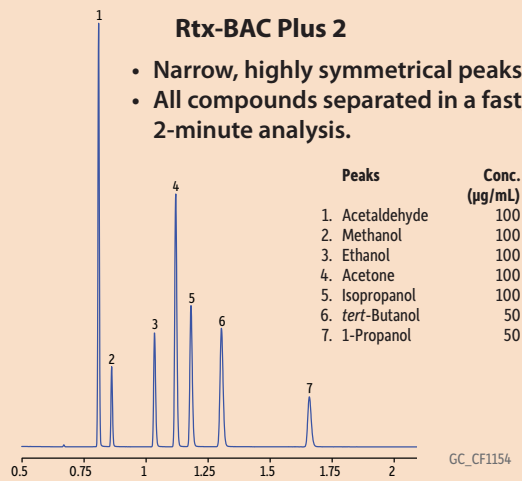
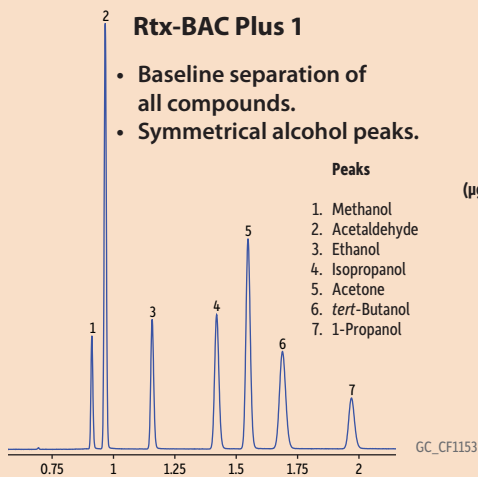
Column	Resolution (Methanol/Acetaldehyde)	Resolution (Acetone/ <i>tert</i> -Butanol)	USP Tailing Factor (Ethanol)
Rtx-BAC Plus 1	-	3.5	1.287
DB-ALC1	-	0.2	1.470
ZB BAC 1	-	3.4	1.852
Rtx-BAC Plus 2	4.4	-	1.089
DB-ALC2	4.6	-	1.445
ZB BAC 2	2.8	-	2.085

Figure 1: Rtx-BAC Plus columns provide the best overall performance for determining blood alcohol concentration. Highly symmetrical, baseline-separated peaks provide fast and definitive results for all target compounds.

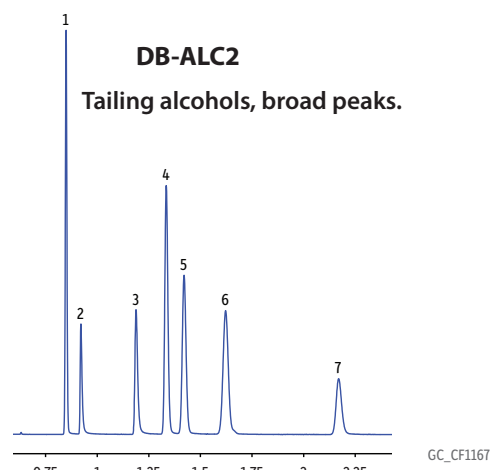
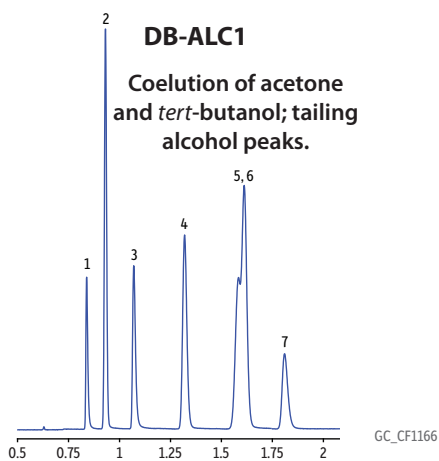
Primary Analysis

Confirmational Analysis

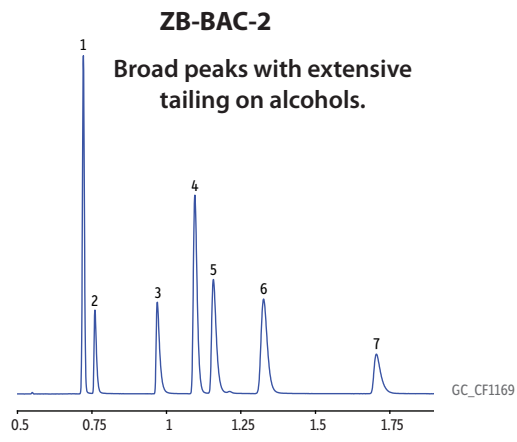
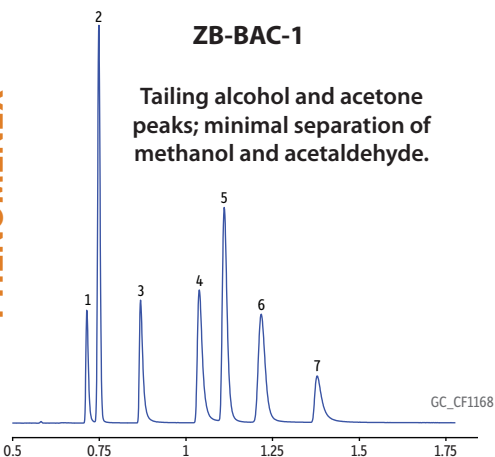
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PHENOMENEX



Columns: Rtx-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 µm (cat.# 18004); Rtx-BAC Plus 2, 30 m, 0.32 mm ID, 0.6 µm (cat.# 18006); DB-ALC2 and ZB-BAC2, 30 m, 0.32 mm ID, 1.2 µm; DB-ALC1 and ZB-BAC1, 30 m, 0.32 mm ID, 1.2 µm; Sample: 50 µL each of BAC resolution control standard n-P (cat.# 36010) and BAC resolution control standard t-B (cat.# 36011) diluted in 900 µL water in a 20 mL headspace vial; Injection: Headspace-loop split (split ratio 50:1); Liner: 1 mm ID straight inlet liner (cat.# 20972); Headspace-Loop: Inj. Port Temp.: 200 °C; Instrument: Tekmar HT3; Transfer Line Temp.: 125 °C; Valve Oven Temp.: 125 °C; Standby Flow Rate: 50 mL/min; Sample Temp.: 60 °C; Sample Equil. Time: 5 min; Vial Pressure: 30 psi; Loop Pressure: 20 psi; Loop Fill Time: 1 min; Oven: 40 °C (hold 3 min); Carrier Gas He, constant flow; Linear Velocity: 80 cm/sec @ 40 °C; Detector FID @ 240 °C; Make-up Gas: Nitrogen, 30 mL/min; Instrument Agilent/HP6890 GC; Acknowledgement: Headspace concentrator courtesy of Teledyne Tekmar, Mason, OH.

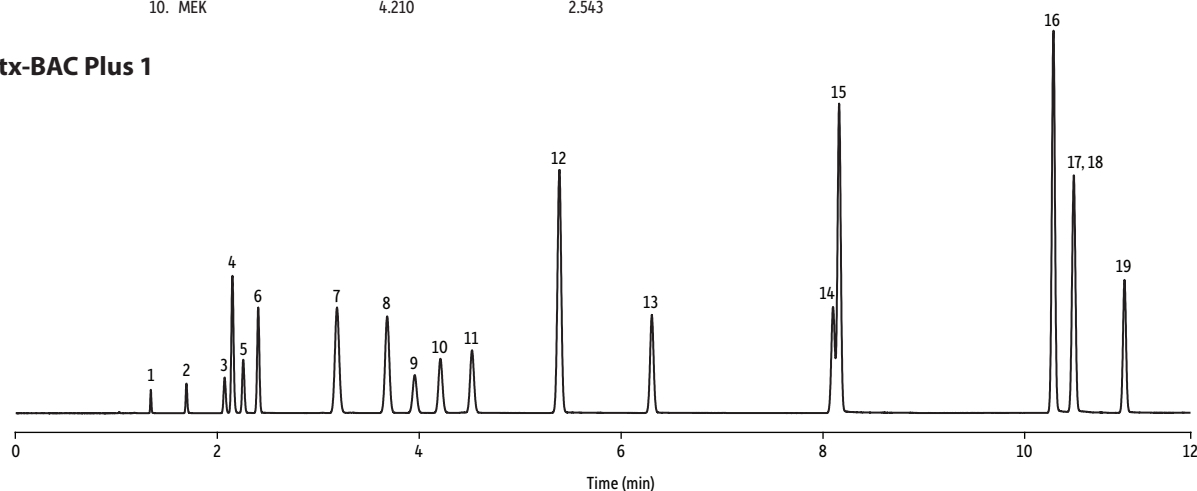
Other Applications

Rtx-BAC Plus columns can be used for other low temperature applications for volatile organic compounds, due to their unique selectivity, retention, and inertness. For example, in the analysis of abused inhalants in Figure 2, most compounds are resolved between the columns with several elution order changes for confirmation. In addition, excellent peak shapes are observed. As shown in Figures 3 and 4, Rtx-BAC Plus columns can also be used for single column applications, such as glycols or gamma-butyrolactone (GBL), which is a derivatized form of gamma-hydroxybutyrate (GHB). The low-bleed character of these columns also makes them useful for mass spectrometry applications.

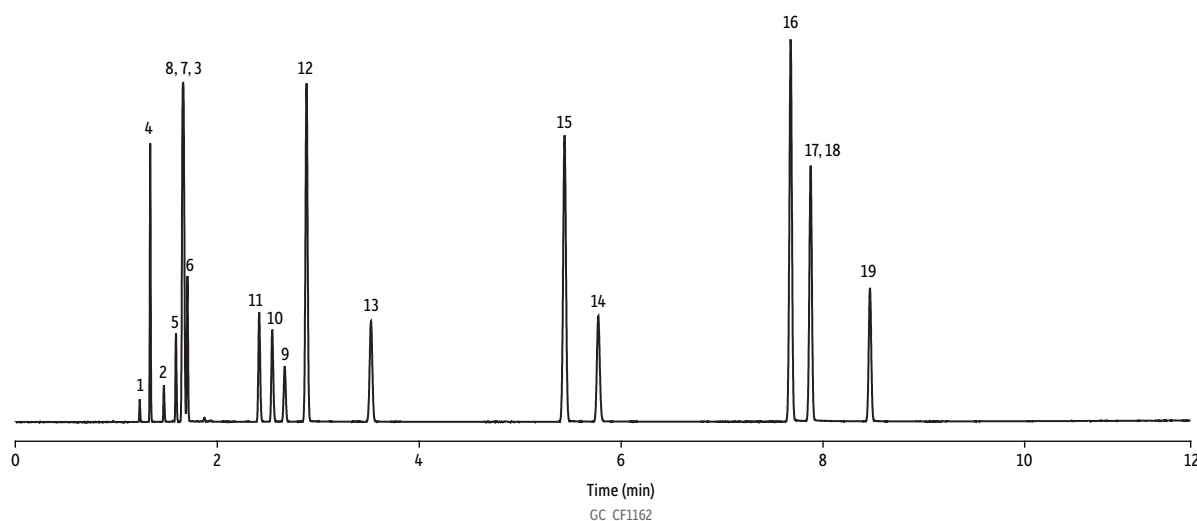
Figure 2: Dual column analysis of abused inhalants.

Peaks	Rtx-BAC Plus 1 RT (min)	Rtx-BAC Plus 2 RT (min)	Peaks	Rtx-BAC Plus 1 RT (min)	Rtx-BAC Plus 2 RT (min)
1. Methanol	1.340	1.230	11. Ethyl acetate	4.54	2.414
2. Ethanol	1.694	1.470	12. Benzene	5.390	2.883
3. Isopropanol	2.072	1.660	13. Trichloroethylene	6.306	3.522
4. Diethyl ether	2.149	1.334	14. MIBK	8.101	5.775
5. Acetone	2.256	1.589	15. Toluene	8.162	5.440
6. Methylene chloride	2.405	1.703	16. Ethylbenzene	10.286	7.681
7. MTBE	3.185	1.660	17. <i>m</i> -Xylene	10.487	7.879
8. Hexane	3.683	1.660	18. <i>p</i> -Xylene	10.487	7.879
9. Chloroform	3.956	2.667	19. <i>o</i> -Xylene	10.990	8.467
10. MEK	4.210	2.543			

Rtx-BAC Plus 1

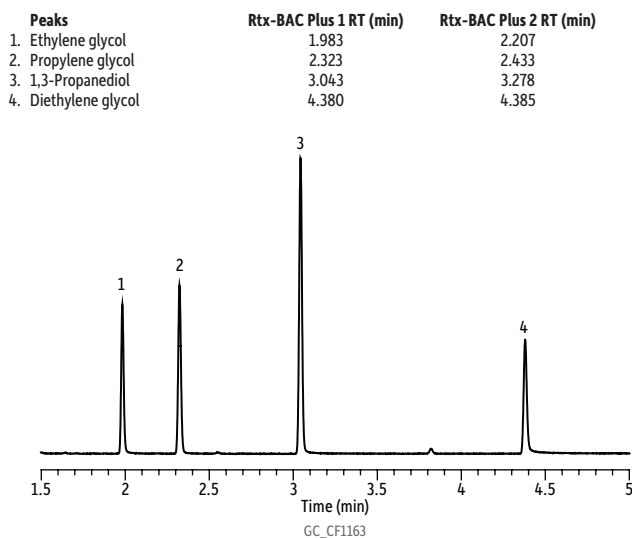


Rtx-BAC Plus 2



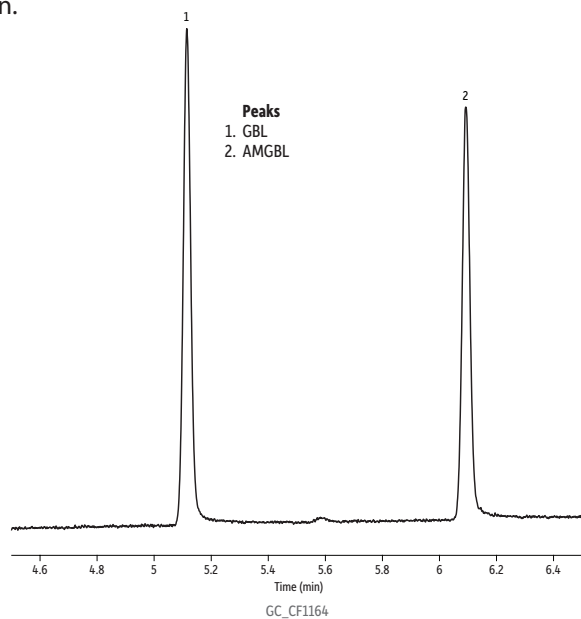
Columns: Rtx-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 μ m (cat.# 18004) and Rtx-BAC Plus 2, 30 m, 0.32 mm ID, 0.6 μ m (cat.# 18006) using Rxi guard column, 5 m, 0.32 mm ID (cat.# 10039) with Universal "Y" Press-Tight connector (cat.# 20405-261); Sample: 50 μ g/mL each inhalant in water; Injection: headspace-loop split (split ratio 50:1); Liner: 1 mm straight inlet liner (cat.# 20972); Headspace-Loop: Inj. Port Temp.: 220 $^{\circ}$ C; Instrument: Tekmar HT3; Inj. Time: 3 min; Transfer Line Temp.: 125 $^{\circ}$ C; Valve Oven Temp.: 125 $^{\circ}$ C; Sample Temp.: 70 $^{\circ}$ C; Sample Equil. Time: 5 min; Vial Pressure: 30 psi; Pressurize Time: 2 min; Loop Pressure: 20 psi; Loop Fill Time: 1 min; Oven Temp: 40 $^{\circ}$ C (hold 4 min) to 120 $^{\circ}$ C at 10 $^{\circ}$ C/min (hold 0 min); Carrier Gas: He, constant flow; Linear Velocity: 50 cm/sec; Detector: FID @ 240 $^{\circ}$ C; Make-up Gas: N₂, 30 mL/min; Instrument: Agilent/HP6890 GC; Notes The Rtx-BAC Plus 1 and Plus 2 columns were connected to the injection port using a ~12 inch section of guard column between the injection port and the Universal "Y" Press-Tight connector. Headspace concentrator courtesy of Teledyne Tekmar, Mason, OH.

Figure 3: Separation of glycols on the Rtx-BAC Plus 1 column.

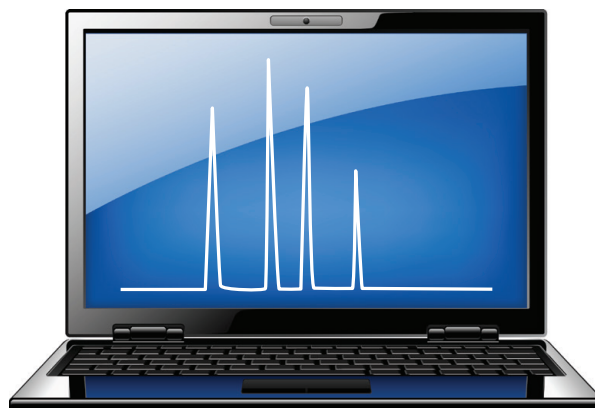


Columns: Rtx-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 μ m (cat.# 18004); Sample: 200 μ g/mL each glycol in methanol:water (40:60); Injection: 1 μ L split (split ratio 20:1); Liner: Restek Premium 4 mm straight inlet liner w/wool (cat.# 23300.1); Inj. Temp.: 260 $^{\circ}$ C; Oven Temp: 60 $^{\circ}$ C (hold 0 min) to 240 $^{\circ}$ C at 20 $^{\circ}$ C/min (hold 5 min); Carrier Gas: He, constant flow; Linear Velocity: 70 cm/sec; Detector: FID @ 240 $^{\circ}$ C; Make-up Gas: N₂, 30 mL/min; Instrument: Agilent/HP6890 GC; Notes: Injections were performed manually with a Merlin Microshot injector (cat.# 22229).

Figure 4: Gamma-butyrolactone (GBL) and internal standard alpha-methylene-gamma-butyrolactone (AMGBL) on an Rtx-BAC Plus 1 column.



Columns: Rtx-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 μ m (cat.# 18004); Sample: Gamma-butyrolactone (GBL) (cat.# 34077) and alpha-methylene-gamma-butyrolactone (AMGBL) (cat.# 34079); Injection: Headspace-loop split (split ratio 10:1); Liner: 1 mm ID straight inlet liner (cat.# 20972); Headspace-Loop: Inj. Port Temp.: 200 $^{\circ}$ C; Instrument: Tekmar HT3; Inj. Time: 1 min; Transfer Line Temp.: 125 $^{\circ}$ C; Valve Oven Temp.: 125 $^{\circ}$ C; Sample Temp.: 100 $^{\circ}$ C; Sample Equil. Time: 10 min; Vial Pressure: 30 psi; Pressurize Time: 2 min; Loop Pressure: 20 psi; Loop Fill Time: 1 min; Oven: 80 $^{\circ}$ C (hold 0 min) to 180 $^{\circ}$ C at 10 $^{\circ}$ /min (hold 0 min); Carrier Gas He, constant flow; Linear Velocity: 48 cm/sec; Detector FID @ 240 $^{\circ}$ C; Make-up Gas: Nitrogen, 30 mL/min; Instrument Agilent/HP6890 GC; Notes: Sample was prepared by injecting 1 μ L of each standard into a capped headspace vial. The mass of each compound inside the headspace vial was 1 μ g. Headspace concentrator courtesy of Teledyne Tekmar, Mason, OH.



Looking for other applications?

- Search our chromatogram library by compound name, synonym, CAS# or keyword at www.restek.com/chromatograms
- Learn the latest and chat with other chemists in our technical blog at blog.restek.com



Columns and Standards for Blood Alcohol Testing

Rtx-BAC Plus 1/Rtx-BAC Plus 2 Columns

- Optimized column selectivities guarantee resolution of ethanol, internal standards, and frequently encountered interferences.
- Robust and reproducible column chemistry ensures longer column lifetime and consistent results.
- Stable to 260 °C.

Rtx-BAC Plus 1 Columns (fused silica)

Description	temp. limits	qty.	cat.#
Rtx-BAC PLUS 1.30 m, 0.32 mm ID, 1.80 µm	-20 to 240/260 °C	ea.	18004
Rtx-BAC PLUS 1.30 m, 0.53 mm ID, 3.00 µm	-20 to 240/260 °C	ea.	18005

Rtx-BAC Plus 2 Columns (fused silica)

Description	temp. limits	qty.	cat.#
Rtx-BAC PLUS 2.30 m, 0.32 mm ID, 0.6 µm	-20 to 240/260 °C	ea.	18006
Rtx-BAC PLUS 2.30 m, 0.53 mm ID, 1.0 µm	-20 to 240/260 °C	ea.	18007



Rxi Guard/Retention Gap Columns (fused silica)

- Extend column lifetime.
- Excellent inertness—obtain lower detection limits for active compounds.
- Sharper chromatographic peaks by utilizing retention gap technology.
- Maximum temperature: 360 °C.

Nominal ID	Nominal OD	5-Meter cat.#	5-Meter/6-pk. cat.#	10-Meter cat.#	10-Meter/6-pk. cat.#
0.25 mm	0.37 ± 0.04 mm	10029	10029-600	10059	10059-600
0.32 mm	0.45 ± 0.04 mm	10039	10039-600	10064	10064-600
0.53 mm	0.69 ± 0.05 mm	10054	10054-600	10073	10073-600



Blood Alcohol Resolution Control Standards

- Use to verify the retention time for each compound normally included in a blood alcohol test, and to verify that the compounds are resolved from and do not interfere with one another.
- Includes 1-propanol internal standard.
- Intended for qualitative use only.

Certified reference materials (CRMs) manufactured and QC-tested in ISO-accredited labs satisfy your ISO requirements.

BAC Resolution Control Standard n-P (6 components)

Acetaldehyde (75-07-0)	Methanol (67-56-1)
Acetone (67-64-1)	1-Propanol (<i>n</i> -Propanol) (71-23-8)
Ethanol (BAC) (64-17-5)	2-Propanol (Isopropanol) (67-63-0)
100 mg/dL each in water, 1 mL/ampul	
cat.# 36010 (ea.)	

No data pack available.

BAC Resolution Control Standard t-B (6 components)

Acetaldehyde (75-07-0)	Ethanol (BAC) (64-17-5)
Acetone (67-64-1)	Methanol (67-56-1)
<i>tert</i> -Butanol (TBA) (75-65-0)	2-Propanol (Isopropanol) (67-63-0)

100 mg/dL each in water, 1 mL/ampul

cat.# 36011 (ea.)

No data pack available.



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Chromatography Essentials

Topaz 1.0 mm ID Straight Inlet Liner for Agilent GCs equipped with split/splitless inlets



ID x OD x Length	qty.	cat.#
Straight, Premium Deactivation, Borosilicate Glass 1.0 mm x 6.3 mm x 78.5 mm	5-pk.	23333

* 100% SATISFACTION GUARANTEE: If your Topaz inlet liner does not perform to your expectations for any reason, simply contact Restek Technical Service or your local Restek representative and provide a sample chromatogram showing the problem. If our GC experts are not able to quickly and completely resolve the issue to your satisfaction, you will be given an account credit or replacement product (same cat.#) along with instructions for returning any unopened product. (Do not return product prior to receiving authorization.) For additional details about Restek's return policy, visit www.restek.com/warranty

Visit www.restek.com/liners for our full selection.

Restek Electronic Leak Detector

Don't let a small leak turn into a costly repair—protect your analytical column by using a Restek leak detector.

Leak Detector Specifications

Detectable Gases: Helium, nitrogen, argon, carbon dioxide, hydrogen
 Battery: Rechargeable lithium ion internal battery pack (12 hours normal operation)
 Operating Temperature Range: 32–120 °F (0–48 °C)
 Humidity Range: 0–97%
 Warranty: One year
 Certifications: CE, Ex, Japan
 Compliance: WEEE, RoHS, China RoHS 2

Limits of Detection

These gases can be detected with the Restek electronic leak detector at the following leak rates:
 Minimum Detectable Gas Limits and Indicating LED Color:
 Helium, 1.0×10^{-3} , red LED
 Hydrogen*, 1.0×10^{-5} , red LED
 Nitrogen, 1.4×10^{-3} , yellow LED
 Argon, 1.0×10^{-4} , yellow LED
 Carbon dioxide, 1.0×10^{-4} , yellow LED
 Gas detection limits measured in atm cc/sec.

Avoid using liquid leak detectors on a GC! Liquids can be drawn into the system and/or into the leak detector.

*Caution: The Restek electronic leak detector is designed to detect trace amounts of hydrogen in a noncombustible environment. It is NOT designed for determining leaks in a combustible environment. A combustible gas detector should be used for determining combustible gas leaks under any condition. When using it to detect hydrogen, the Restek electronic leak detector may only be used for determining trace amounts in a GC environment.

Restek Recommends: If you think that your Restek electronic leak detector needs service or repair, please contact Restek Customer Service before sending your unit in (cat.# 22655-R). Leak detector service/repair will include inspection and testing of the unit.

Universal “Y” Press-Tight Connectors

- Universal fit: use with 0.1–0.53 mm ID Restek columns (0.33–0.74 mm OD).
- Optional deactivated fused quartz helps eliminate activity for complete inertness along the GC flow path.
- Optional Siltek deactivation is ideal for organochlorine pesticides analysis.
- Split sample flow—perform dual-column confirmation analysis with a single injection.
- Split column flow to two detectors.



Description	ea.	3-pk.
Universal “Y” Press-Tight Connector	20405	20406
Universal “Y” Press-Tight Connector, Deactivated	20405-261	20406-261
Universal “Y” Press-Tight Connector, Siltek Deactivated	20485	20486



Description	qty.	cat.#
Leak Detector with Hard-Sided Carrying Case and Universal Charger Set (U.S., UK, European, Australian)	ea.	22655
Small Probe Adaptor for Leak Detector	ea.	22658
Dynamic Duo Combo Pack (Restek Leak Detector and ProFLOW 6000 Flowmeter)	kit	22654
Soft-Sided Storage Case for Leak Detector or ProFLOW 6000 Flowmeter	ea.	22657
Car Charger/Adaptor	ea.	22652
Universal AC Power Adaptor	ea.	22653

**Restek carries a full line
of headspace essentials**
including screw-thread headspace vials &
magnetic screw-thread caps!



Restek Has Added ISO 17034 and 17025 Accreditations



We Now Offer a Full Line of Certified Reference Materials!

Restek is proud to announce that our reference standard manufacturing and QA testing labs in Bellefonte, PA, have earned ISO 17034 and 17025 accreditations through A2LA. More than ever, you can rely on Restek for all of your reference standards, and now, you can also experience the advantages of our ISO accreditations:

- **Satisfy regulatory requirements** by sourcing CRMs from an accredited supplier.
- Benefit from the **exceptional product quality and customer service** needed to meet strict ISO 9001, 17034, and 17025 guidelines.
- Get the **same reliability and documentation with custom-formulated solutions** as you do with stock standards—both fall under Restek's accreditation.
- **Consolidate orders** by ordering primary- and secondary-source reference standards, GC and LC columns, sample prep supplies, and accessories from one vendor.

We invite you to visit www.restek.com/iso to learn more about our ISO quality credentials and view our certificates (including scopes of accreditation).

If you have any questions or would like more information, feel free to contact customer service at **814-353-1300, ext. 3**, or csreps@restek.com

Note: If your lab must use certified reference materials (CRMs), please be sure to tell your Restek representative when ordering so we can help you meet your regulatory requirements as we transition our inventory.

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

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