Increase Productivity With Restek's Faster GC Method for VOCs in Air

- **Analyze samples in about half the time** on Rxi®-5Sil MS (30 m x 0.32 mm ID, 1.00 µm) columns compared to typical 60 m column setups.
- **Reliably meet Method TO-15 performance requirements** and ensure accurate reporting at trace levels with inert SilcoCan® air sampling canisters.
- **Prevent contamination** with highly inert SilcoCan® canisters and a TO-Clean canister cleaning system.

Increase Productivity With Restek's Faster GC Method for VOCs in Air

Restek's new short column faster GC method produces accurate and reliable results in about half the time of typical analytical approaches.

Labs analyzing volatile organic compounds (VOCs), such as EPA method TO-15 analytes, typically employ 60 m GC columns, which require a relatively lengthy total cycle time for each sample. However, Restek has developed a faster short column GC method for analyzing VOCs in air samples. Using our 30 m column setup and procedure combined with highly inert SilcoCan® air sampling canisters, accurate results can be achieved and method requirements can be met in approximately half the time of conventional approaches, which results in increased lab productivity and profitability.

Many labs currently use EPA Method TO-15 to analyze VOCs in air. This performance-based guidance document specifies sampling and analytical procedures, but only requires that the chosen analytical setup to meet certain performance criteria. This allows analysts to optimize analytical methods as technology improves. Restek has developed a new faster GC method for analyzing VOCs in air samples that meets method performance criteria through the use of a more efficient, selective, and shorter Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm) and an inert SilcoCan® air sampling canister. This approach allows samples to be analyzed in less time (Table I) and with greater confidence.

The Rxi®-5Sil MS column (cat. # 13654) is more than adequate to quantify the standard suite of 65 components included in Method TO-15 (Figure 1). GC run times are just 16.5 minutes, approximately half that of a typical analysis on a 60 m column. The same coelutions observed on the 30 m column are also seen on the 60 m column, but because these compounds are not isobaric, they can be easily distinguished using MS detection, which is required for this method.

By meeting method criteria faster using a shorter Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm), labs can increase sensitivity, reduce consumables costs, and improve overall productivity.

Learn how Restek's faster GC solution can improve your productivity when analyzing TO-15 VOCs in air on the following pages or visit **www.restek.com/rapidTO-15** for our complete method evaluation!

Table I: Analyze more samples per day with Restek's faster GC approach based on an Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm).

Column Length	MDL (≤0.5 ppbv)	Replicate Precision (±25%)	Audit Accuracy (±30%)	Analysis Time (min)	Column Cooling Time (min)	Total Cycle Time (min)	Runs/Day
30 m	0.06 ppbv (scan mode) 35.9 pptv (SIM mode)	4.29%	-2.82%	16.5	5	21.5	67
60 m	Meets requirement	Meets requirement	Meets requirement	29.9	5	34.9	41

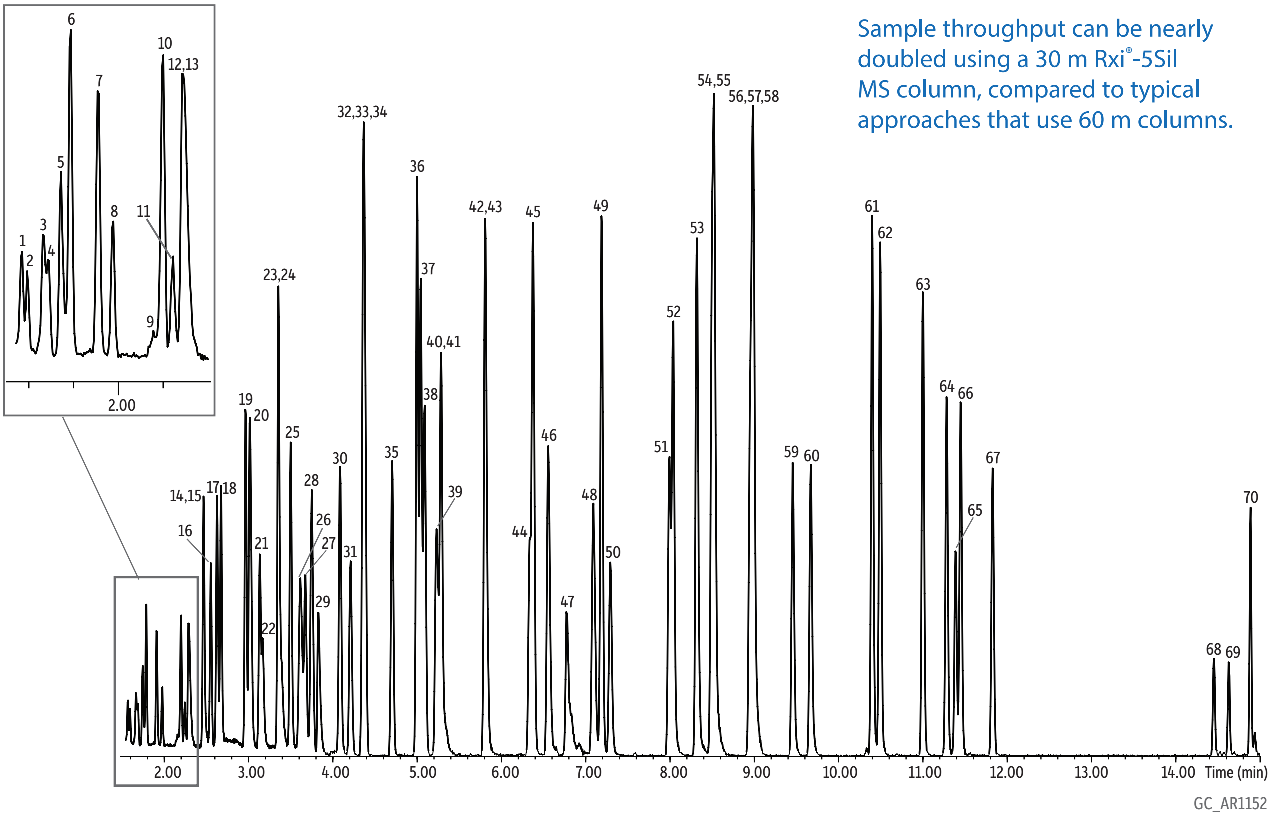
Tips for Success

Sample with highly inert SilcoCan® whole air sampling canisters. Our innovative deactivation prevents surface reactivity, ensuring accurate sampling of active polar and/or sulfur-containing compounds.

Use Restek's faster GC method to increase lab productivity. Compared to typical methods based on a 60 m column, Restek's approach uses an Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm) to meet Method TO-15 requirements in almost half the time. Get the full application note here: **restek.com/rapidTO-15**

Keep your canisters clean. Don't let contamination compromise your results. There's no better way to keep your whole air sampling canisters clean than with a TO-Clean canister cleaning system. This high capacity cleaning oven is fully automated, easy to use, and dramatically increases lab efficiency.

Figure 1: Analyze all 65 Method TO-15 VOCs in just 16.5 min on a 30 m x 0.32 mm ID, 1.00 µm Rxi®-5Sil MS column.



Peaks	tR (min)
1. Propylene	1.57
2. Dichlorodifluoromethane (Freon® 12)	1.60
3. Chloromethane	1.67
4. 1,2-Dichlorotetrafluoroethane (Freon® 114)	1.68
5. Vinyl chloride	1.74
6. 1,3-Butadiene	1.79
7. Bromomethane	1.91
8. Chloroethane	1.98
9. Ethanol	2.16
10. Trichlorofluoromethane (Freon® 11)	2.20
11. Acrolein	2.25
12. Acetone	2.29
13. Acetonitrile (contaminant)	2.29
14. 1,1-Dichloroethene	2.47
15. Isopropyl alcohol	2.49
16. 1,1,2-Trichlorotrifluoroethane (Freon® 113)	2.55
17. Methylene chloride	2.63
18. Carbon disulfide	2.68
19. *trans*-1,2-Dichloroethene	2.97
20. Methyl *tert*-butyl ether (MTBE)	3.02
21. 1,1-Dichloroethane	3.13
22. Vinyl acetate	3.17
23. 2-Butanone (MEK)*	3.36
24. Hexane*	3.36
25. *cis*-1,2-Dichloroethene	3.50
26. Ethyl acetate	3.62
27. Bromochloromethane (IS)	3.67
28. Chloroform	3.75
29. Tetrahydrofuran	3.83
30. 1,1,1-Trichloroethane	4.09
31. 1,2-Dichloroethane	4.21
32. Benzene	4.36
33. Carbon tetrachloride	4.37
34. Cyclohexane	4.39
35. 1,4-Difluorobenzene (IS)	4.70
36. Heptane	5.00
37. Trichloroethylene	5.04
38. 1,2-Dichloropropane	5.09
39. Methyl methacrylate	5.23
40. Bromodichloromethane	5.28
41. 1,4-Dioxane	5.32
42. 4-Methyl-2-pentanone (MIBK)	5.81
43. *cis*-1,3-Dichloropropene	5.81
44. *trans*-1,3-Dichloropropene	6.33
45. Toluene	6.37
46. 1,1,2-Trichloroethane	6.55
47. 2-Hexanone (MBK)	6.77
48. Dibromochloromethane	7.09
49. Tetrachloroethene	7.19
50. 1,2-Dibromoethane	7.29
51. Chlorobenzene-d5 (IS)	7.99
52. Chlorobenzene	8.04
53. Ethylbenzene	8.32
54. *m*-Xylene	8.52
55. *p*-Xylene	8.52
56. Styrene	8.95
57. *o*-Xylene	8.98
58. Bromoform	9.00
59. 1,1,2,2-Tetrachloroethane	9.46
60. 4-Bromofluorobenzene**	9.67
61. 4-Ethyltoluene	10.40
62. 1,3,5-Trimethylbenzene	10.49
63. 1,2,4-Trimethylbenzene	11.00
64. 1,3-Dichlorobenzene	11.28
65. Benzyl chloride	11.39
66. 1,4-Dichlorobenzene	11.45
67. 1,2-Dichlorobenzene	11.83
68. 1,2,4-Trichlorobenzene	14.46
69. Naphthalene	14.63
70. Hexachlorobutadiene	14.89

*Peaks 23 and 24 share ion m/z 43; **Tuning standard

Column: Rxi®-5Sil MS, 30 m, 0.32 mm ID, 1.00 µm (cat.# 13654), **Sample:** TO-15 65 component mix (cat.# 34436), TO-14A internal standard/tuning mix (cat.# 34408), Diluent: Nitrogen, Conc.: 10.0 ppbv 400 mL injection, **Injection:** Direct, **Oven**: Oven Temp.: 32 °C (hold 1 min) to 150 °C at 9 °C/min to 230 °C at 33 °C/min, **Carrier Gas:** He, constant flow, Flow Rate: 1.5 mL/min, Linear Velocity: 44 cm/sec @ 32 °C, **Detector:** MS, Mode: Scan, Scan Program: **Group 1**, **Start Time (min)** 0, **Scan Range (amu)** 35-250, **Scan Rate (scans/sec)** 3.32, Transfer Line Temp.: 230 °C, Analyzer Type: Quadrupole, Source Temp.: 230 °C, Quad Temp.: 150 °C, Electron Energy: 69.9 eV, Solvent Delay Time: 1.0 min, Tune Type: BFB, Ionization Mode: EI, **Preconcentrator:** Nutech 8900DS, **Trap 1 Settings:** Type/Sorbent : Glass beads, Cooling temp: -155 °C, Preheat temp: 5 °C, Preheat time: 0 sec, Desorb temp: 20 °C, Desorb flow: 5 mL/min, Desorb time: 360 sec, Bakeout temp: 200 °C, Flush flow: 120 mL/min, Flush time: 60 sec, Sweep flow: 120 mL/min, Sweep time: 60 sec, **Trap 2 Settings:** Type/Sorbent: Tenax®, Cooling temp: -35 °C, Desorb temp: 190 °C, Desorb time: 30 sec, Bakeout temp: 200 °C, Bakeout time: 10 sec, **Cryofocuser:** Cooling temp: -160 °C, Inject time: 140 sec, **Internal Standard:** Purge flow: 100 mL/min, Purge time: 6 sec, Vol.: 100 mL, ISTD flow: 100 mL/min, **Standard:** Size: 200 mL, Purge flow: 100 mL/min, Purge time: 6 sec, Sample flow: 100 mL/min, **Instrument:** HP6890 GC & 5973 MSD, **Acknowledgement**: Nutech

Set up for Success—How to Meet Method TO-15 Requirements While Reducing Analysis Time

In developing Restek's faster GC approach, a Nutech 8900DS preconcentrator from EST Analytical was paired with 6-L SilcoCan® air sampling canisters. The Nutech preconcentrator utilizes three cryogenically cooled traps to concentrate or focus target analytes (often referred to as "micro-scale purge-and-trap") for delivery to the GC-MS system. An Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm, cat.# 13654) was selected based on its ability to separate trace levels of the target compounds while reducing analysis time. Total cycle time was further reduced through the 8900DS sample overlap feature, which allows the next sample to be preconcentrating while the current sample is being analyzed.

For the method evaluation, samples were prepared by preconcentrating 400 mL of sample with 100 mL of TO-14A internal standard/tuning mix (cat. # 34408) prepared at 20 ppbv. All samples were analyzed against a 1.0–10.0 ppbv calibration curve. MDLs, precision, and accuracy were determined as noted below Table II. Visit **www.restek.com/rapidTO-15** for detailed descriptions of all calculations and procedures.

Results clearly demonstrate that criteria from section 11.1.1 of Method TO-15 were met (Table II). These requirements stipulate MDLs of ≤0.5 ppbv, replicate precision of ±25%, and audit accuracy ±30% for concentrations normally expected in contaminated ambient air (0.5 to 25 ppbv). For the faster GC method, average scan and SIM mode MDLs were 0.06 ppbv and 35.9 pptv, respectively; average replicate precision was 4.29% difference; and average audit accuracy for all 65 targeted TO-15 VOCs was -2.82%. Since the two-point replicate precision approach in Method TO-15 also includes sampling variation, the precision of the analytical system alone was evaluated using 7 replicate analyses of a 5.00 ppbv standard. An average %RSD of 6.86% was obtained, indicating the preconcentrator and GC-MS setup generated very reproducible results.

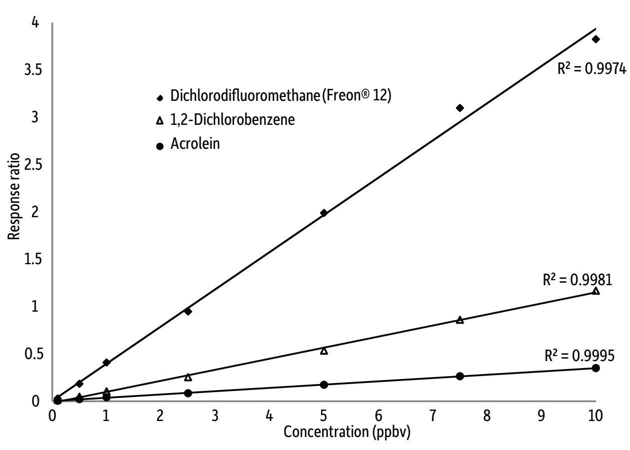
In addition, section 10.5.5 of Method TO-15 states that for the initial calibration the %RSD for the relative response factor (RRF) for each compound in the calibration table must be less than 30% with at most two exceptions up to a limit of 40%. Table II shows that this criterion was also met and, in addition, a broader-range linearity study (0.1 to 10 ppb) demonstrated that good linearity was achieved for compounds across a range of volatilities (Figure 2).

Restek's faster GC method for analyzing VOCs in air lets you improve sample throughput while increasing sensitivity and achieving method requirements. Since Method TO-15 performance criteria are easily met with shorter total cycle times, you can run more samples per day and have confidence in the data you report.

Taking a Closer Look—How Does a Shorter Column Increase Sensitivity?

For GC, the biggest barriers to good sensitivity are column activity and band broadening. If a column is not inert, response for active compounds can be reduced through adsorption and/or band broadening due to tailing. Broader peaks mean shorter peaks, which result in decreased signal-to-noise ratios and, therefore, decreased sensitivity. By using an inert Rxi®-5Sil MS column, adsorption and tailing are kept to a minimum. Band broadening can also occur due to the high mobility of gases. The longer a compound takes to elute from a column, the broader the peak will be, reducing sensitivity for later-eluting compounds, especially during lengthy analyses on long columns. This type of band broadening can be mitigated by reducing run times or increasing the GC oven ramp rate. Shorter columns naturally lend themselves to short run times as well as fast oven ramp rates because compounds are eluted more quickly from the column. By switching from a 60 m column to a 30 m column, analysis time is cut in half, oven ramp rate is doubled, and signal-to-noise values are increased, which ensures better sensitivity.

Figure 2: Confidently analyze a wide range of VOCs from lighter dichlorodifluoromethane to heavier 1,2-dichlorobenzene, as well as reactive polar VOCs such as acrolein.



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Generate accurate standards easily with Restek's jumbo syringe!

Table II: Method requirements were easily met for blank, MDL, precision, and accuracy criteria using Restek's faster GC approach with an Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm) and an inert SilcoCan® air sampling canister.

Analyte	Average Blank Concentration (pptv)[1]	Calibration (%RSD)[2]	Scan MDL (ppbv)[3]	SIM MDL (pptv)[4]	Replicate Precision (%Difference)[5]	Precision (%RSD)[6]	Audit Accuracy (%)[7]
Propylene	BDL	8.51	0.10	66.9	1.69	9.08	12.8
Dichlorodifluoromethane (Freon 12)	BDL	6.22	0.05	33.4	1.79	7.82	1.74
Chloromethane	BDL	7.63	0.02	38.8	0.89	6.59	1.29
1,2-Dichlorotetrafluoroethane (Freon 114)	BDL	18.9	0.08	65.3	3.33	7.71	-1.99
Vinyl chloride	BDL	5.60	0.05	37.6	0.15	7.12	-7.24
1,3-Butadiene	ND	6.44	0.15	34.0	3.25	5.12	-5.06
Bromomethane	ND	6.86	0.05	26.4	3.63	5.84	-4.86
Chloroethane	ND	10.5	0.06	78.0	3.30	6.07	-5.34
Ethanol	160	21.4	0.19	94.6	6.34	9.01	-4.06
Trichlorofluoromethane (Freon 11)	BDL	17.2	0.08	21.9	5.25	10.8	-0.63
Acrolein	BDL	9.96	0.09	31.0	1.04	6.70	-10.7
Acetone	BDL	10.8	0.14	45.1	6.60	5.55	1.20
Isopropyl alcohol	BDL	13.2	0.05	50.9	8.50	10.2	5.79
1,1-Dichloroethene	ND	14.5	0.03	23.4	3.53	6.07	-1.54
1,1,2-Trichlorotrifluoroethane (Freon 113)	BDL	25.0	0.09	23.5	4.45	5.84	7.99
Methylene chloride	BDL	12.7	0.05	56.3	4.75	5.68	2.11
Carbon disulfide	BDL	7.12	0.03	38.0	5.14	7.61	-1.89
trans-1,2-Dichloroethene	ND	8.14	0.05	39.9	4.89	6.46	0.37
Methyl *tert*-butyl ether (MTBE)	ND	5.17	0.03	42.8	3.41	6.53	-2.74
1,1-Dichloroethane	ND	18.4	0.03	25.2	4.23	6.36	-5.87
Vinyl acetate	ND	2.94	0.05	33.0	1.22	7.06	1.94
2-Butanone (MEK)	ND	7.47	0.06	39.9	6.07	7.34	0.89
Hexane	BDL	11.8	0.02	37.8	0.27	6.91	-6.81
cis-1,2-Dichloroethene	ND	4.88	0.02	21.7	3.22	5.67	-0.80
Ethyl acetate	ND	3.28	0.08	99.4	2.93	13.6	-4.63
Chloroform	ND	11.6	0.02	11.9	4.47	6.64	-1.51
Tetrahydrofuran	ND	7.97	0.08	41.6	0.12	9.72	6.01
1,1,1-Trichloroethane	BDL	22.6	0.04	15.4	3.28	6.22	-4.70
1,2-Dichloroethane	ND	5.67	0.04	15.7	3.67	5.34	2.94
Benzene	BDL	8.92	0.02	61.2	9.55	6.60	-1.17
Carbon tetrachloride	BDL	27.5	0.04	38.8	4.85	6.04	2.33
Cyclohexane	ND	29.8	0.05	40.7	4.00	5.61	-0.16
Heptane	ND	3.71	0.04	28.0	13.55	5.41	-2.46
Trichloroethylene	BDL	3.85	0.03	18.4	0.96	5.95	-0.09
1,2-Dichloropropane	ND	3.72	0.03	24.6	1.36	6.48	0.47
Methyl methacrylate	ND	18.6	0.14	20.7	3.53	7.75	-1.63
1,4-Dioxane	ND	11.5	0.08	19.6	0.13	7.10	0.90
Bromodichloromethane	ND	4.53	0.04	22.6	2.04	7.08	2.71
4-Methyl-2-pentanone (MIBK)	ND	2.46	0.08	24.3	6.87	6.24	1.90
cis-1,3-Dichloropropene	BDL	4.05	0.04	8.30	0.80	7.59	-0.86
trans-1,3-Dichloropropene	ND	2.44	0.05	20.4	8.30	5.86	0.79
Toluene	BDL	4.98	0.03	17.0	6.70	5.67	-3.04
1,1,2-Trichloroethane	BDL	4.30	0.05	14.3	0.58	5.73	-1.64
2-Hexanone (MBK)	ND	10.2	0.11	94.5	4.82	8.15	2.91
Dibromochloromethane	BDL	3.27	0.03	33.3	3.68	6.02	1.46
Tetrachloroethene	BDL	2.70	0.00	18.7	0.88	5.98	4.21
1,2-Dibromoethane	BDL	2.28	0.04	17.6	7.85	6.63	1.77
Chlorobenzene	ND	8.27	0.05	17.4	2.93	4.91	-3.37
Ethylbenzene	BDL	20.3	0.03	34.3	4.01	6.10	-12.3
m-Xylene	BDL	6.00	0.04	12.1	5.51	6.70	-14.3
p-Xylene	BDL	5.91	0.04	13.1	5.51	6.70	-14.3
Styrene	ND	1.60	0.05	29.2	3.34	6.89	-17.7
o-Xylene	ND	6.38	0.02	24.7	3.76	7.50	-13.9
Bromoform	BDL	3.09	0.05	12.1	5.88	6.34	-13.0
1,1,2,2-Tetrachloroethane	BDL	5.87	0.06	20.4	8.30	7.99	-9.79
4-Ethyltoluene	ND	3.01	0.05	59.1	7.03	7.63	-16.8
1,3,5-Trimethylbenzene	BDL	4.13	0.05	49.5	5.98	6.43	-17.1
1,2,4-Trimethylbenzene	ND	1.86	0.07	68.2	5.09	4.92	-14.1
1,3-Dichlorobenzene	ND	5.18	0.07	33.7	5.75	7.07	-11.8
Benzyl chloride	ND	23.2	0.05	44.2	4.58	7.42	-13.5
1,4-Dichlorobenzene	BDL	3.04	0.06	36.8	7.78	6.66	-11.8
1,2-Dichlorobenzene	BDL	6.26	0.07	36.4	6.92	7.72	-11.9
1,2,4-Trichlorobenzene	ND	15.9	0.24	39.0	7.39	6.42	11.0
Naphthalene	ND	17.7	0.15	70.3	3.37	6.82	15.1
Hexachlorobutadiene	ND	6.58	0.17	20.7	6.32	3.18	3.03

[1] Determined by SIM analysis of six SilcoCan® air monitoring canisters (cat.# 24142-650) filled with (50% RH) nitrogen to 30 psig and stored for 3 days.
[2] RRF from five-point calibration curve in scan mode.
[3] Calculated as the standard deviation of seven replicate analyses of a 0.20 ppbv standard and the Student's t test value for 99% confidence.
[4] Calculated as the standard deviation of seven replicate analyses of a 75.0 pptv standard and the Student's t test value for 99% confidence.
[5] Calculated as the absolute value of the difference between analyses of two canisters divided by their average value and expressed as a percentage.
[6] The average %RSD obtained from seven replicate analyses in scan and seven replicate analyses in SIM.
[7] Determined from a 10.0 ppbv audit standard.
BDL – Below detection limit
ND – Not detected

Pair our faster GC-MS analysis with rugged, inert SilcoCan® whole air sampling canisters and TO-Clean canister cleaning system to ensure contaminant-free samples.

Meet Clean Canister Requirements with SilcoCan® Whole Air Sampling Canisters and the TO-Clean Canister Cleaning System

Preventing sample contamination is a critical part of obtaining accurate results when analyzing VOCs in air samples. Section 8.4.1 of Method TO-15 addresses canister cleaning and certification. This section stipulates that any canister that has not tested clean (compared to direct analysis of humidified zero air of less than 0.2 ppbv of targeted VOCs) should not be used.

In addition to our short column GC-MS method, we used SilcoCan® whole air sampling canisters (cat. # 24141-650) fitted with Parker® diaphragm valves and gauges that were cleaned using a TO-Clean canister cleaning system (cat. # 22916). These sampling canisters were chosen because they are deactivated with Siltek® passivation treatment, which results in a highly inert surface that does not react with active compounds. All canisters were cleaned in a TO-Clean system using the procedure detailed in Table III. Blank samples were generated by pressurizing clean canisters with humidified (50% RH) nitrogen to 30 psig, storing them for 3 days at room temperature (to simulate sample handling/shipping times), and then analyzing them in selected ion monitoring (SIM) mode for cleanliness.

24282
Humidify reliably with Restek's humidification chamber.

Table III: Recommended canister cleaning procedure conducted at 100 °C with 50% RH nitrogen.

Cycle	Evacuation Vacuum (mTorr)	Pressurization Pressure (psig)
1	500 (Hold for 60 min)	30
2	500 (Hold for 60 min)	30
3	500 (Hold for 60 min)	30
Final	50	30 (Only for blanks)

The combination of the inert SilcoCan® whole air sampling canisters and the cleaning efficiency of the TO-Clean system produced clean blanks that met Method TO-15 criteria of less than 0.2 ppbv for all target analytes. With the exception of ethanol, which at 160 pptv still passes performance criteria, all 65 components were either not detected or were below detection limits. Good results were obtained even for active compounds (e.g., acrolein), polar compounds (e.g., isopropyl alcohol, methyl ethyl ketone), and heavier semivolatile compounds (e.g., *m*- and *p*- xylenes).

Restek's Faster GC Solution for Analyzing VOCs in Air—Meet Method Requirements While Increasing Sample Throughout

Labs testing VOCs in air can substantially increase productivity, while meeting Method TO-15 performance requirements, by adopting Restek's faster GC approach. As demonstrated here, the use of an Rxi®-5Sil MS column (30 m x 0.32 mm ID, 1.00 µm) paired with a highly inert SilcoCan® air sampling canister allows all requirements to be met in about half the time required by conventional 60 m setups. In addition, the shorter column increases sensitivity, which improves accuracy at trace levels. By combining the shorter column with SilcoCan® whole air sampling canisters and an easy-to-use, high efficiency TO-Clean canister cleaning systems, labs can improve productivity with confidence in data quality.

24285
Ensure accurate canister pressure and vacuum in the field and lab with Ashcroft® test gauges.

Review our complete method evaluation at www.restek.com/**rapidTO-15**

Recommended Products

Canisters are the gold standard for ambient VOC monitoring.

SilcoCan® Air Sampling Canisters

Ideal for low-level reactive sulfur (5-20 ppb), TO-14A, or TO-15 compounds

- High quality, metal-to-metal seal, 2/3-turn valve with stainless steel diaphragms.
- Sizes to support a wide range of sampling needs.
- 2-port or 3-port valve available; 3-port valve includes -30" Hg/60 psi vacuum/pressure gauge (other gauges available).
- Unsurpassed inertness, even for sulfur-containing or brominated compounds.
- For critical applications, order a Siltek®-treated valve—add suffix "-650" to the catalog number of the canister.

Dimensions/Weights of Air Canisters

Can Volume—	Dimensions: height x sphere diameter—		Weight	
1 liter—	8.5 x 5.25"	(21.6 x 13.3 cm)—	2.25 lbs	(1.02 kg)
3 liter—	11.5 x 7.25"	(29.2 x 18.4 cm)—	3.50 lbs	(1.59 kg)
6 liter—	12.5 x 9.25"	(31.8 x 23.5 cm)—	5.75 lbs	(2.61 kg)
15 liter—	17.0 x 12.25"	(43.2 x 31.1 cm)—	11.75 lbs	(5.33 kg)

Description	1 L Volume cat.#	3 L Volume cat.#	6 L Volume cat.#	15 L Volume cat.#
w/ Parker Diaphragm Valve, Siltek Treated, and Gauge*	24140-650	24141-650	24142-650	24143-650

Do not exceed canister maximum pressure of 40 psig.
*Range of standard gauge is -30" Hg to 60 psi.

TO-Clean Canister Cleaning System

High capacity, fully automated, easy-to-use canister cleaning oven dramatically increases lab efficiency.

- EPA Method TO-14A/15 compliant.
- Powerful pump can achieve 50 mTorr in 30 minutes for twelve 6 L canisters.
- Custom-built trays for different canister sizes.
- Humidifier provides humidified nitrogen to improve cleaning process.
- One-year limited warranty.
- Fully assembled and ready to use.

Description	qty.	cat.#
TO-Clean Oven, 120 V, 60 Hz	ea.	22916
TO-Clean Oven, 220/230 V, 50/60 Hz	ea.	22917

Shipping: FedEx Ground, unless otherwise requested. Costs vary depending on ship-to location.

Note: Ovens are built on demand; therefore, a ten-week lead time is required on all orders. A limited cancellation and return policy applies to TO-Clean ovens; contact Restek Customer Service for details.

CE

Specifications:
TO-Clean Oven
Dimensions: 44"H x 48"W x 27"D
Weight: 525 lb

Cart
Dimensions: 29"H x 48"W x 30"D
Weight: 486 lb

Dewar
Weight: 5 lb

Rxi®-5Sil MS Columns (fused silica)

(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

Description	temp. limits	qty.	cat.#
30 m, 0.32 mm ID, 1.00 µm	-60 to 320/350 °C	ea.	13654

Environmental Air Monitoring Gas Standards

Our high-quality air monitoring gas calibration standards are provided by Spectra/Linde and Scott/Air Liquide—meeting lab requirements for two separate sources of calibration standards. Each comes with a Certificate of Analysis and unique serial number.

TO-15 65 Component Mix (65 components)

Acetone
Acrolein
Benzene
Benzyl chloride*
Bromodichloromethane
Bromoform
Bromomethane
1,3-Butadiene
2-Butanone (MEK)
Carbon disulfide*
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
Cyclohexane
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
1,4-Dioxane
Ethanol*
Ethyl acetate
Ethyl benzene
Ethylene dibromide (1,2-dibromoethane)
4-Ethyltoluene
Trichlorofluoromethane (Freon 11)
Dichlorodifluoromethane (Freon 12)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
1,2-Dichlorotetrafluoroethane (Freon 114)
Heptane
Hexachloro-1,3-butadiene
Hexane
2-Hexanone (MBK)
4-Methyl-2-pentanone (MIBK)
Methylene chloride
Methyl *tert*-butyl ether (MTBE)
Methyl methacrylate
Naphthalene
2-Propanol
Propylene
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Tetrahydrofuran
Toluene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Vinyl acetate
Vinyl chloride
m-Xylene
o-Xylene
p-Xylene

1 ppm in nitrogen, 104 liters @ 1,800 psi
cat.# 34436 (ea.)

*Stability of this compound cannot be guaranteed.
No data pack available. Quantity discounts not available.

TO-14A Internal Standard/Tuning Mix (4 components)

Bromochloromethane
1-Bromo-4-fluorobenzene (4-Bromofluorobenzene)
Chlorobenzene-d5
1,4-Difluorobenzene

1 ppm in nitrogen, 104 liters @ 1,800 psi
cat.# 34408 (ea.)

No data pack available. Quantity discounts not available.

Gas standards are subject to hazardous materials shipping fees by most freight carriers. All calibration gas standards are nonreturnable due to DOT hazardous shipping requirements.

Lit. Cat.# EVBR1923-UNV