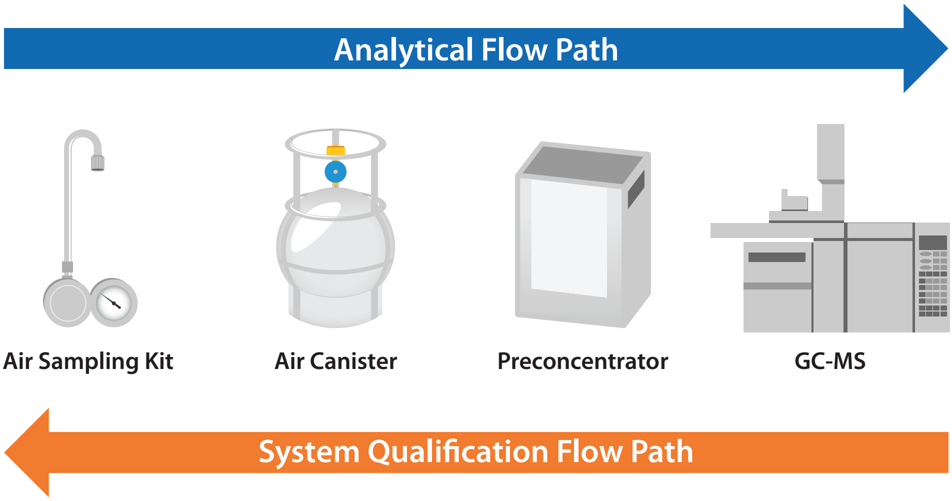
Method TO-15A Requirements and Best Practices for Sampling Devices, Canisters, and Analytical Systems

When collecting and analyzing whole air samples, it is critical to ensure that your entire system, from sample collection to sample introduction to GC instrumentation, is as clean and inert as possible. Method TO-15A [1] requirements (and those of similar methods, such as China's HJ759) define limits on blank interferences and standard recoveries and also provide important guidance on canister cleaning. While both electropolished and silicon-lined (i.e., "coated" or "treated") canisters are very inert, contaminants can cover the passivated surfaces and degrade performance over time. The consequences of poor system cleanliness include both negative bias (adsorption and breakdown) and positive bias (desorption and non-target interferences). These biases lower the accuracy of air monitoring methods and/or can reduce the acceptable storage time of samples in canisters.

When testing a multi-part system for cleanliness, it is helpful to break it down into components and test backwards from the normal sample flow. This may seem counter-intuitive at first, but because contamination can occur anywhere from the sampling device to the detector, reversing the sequence and eliminating one potential source at a time makes it easier to determine the root cause. Figure 1 shows a general sample flow path from collection to analysis (top arrow); to establish cleanliness, start with the GC-MS and move backward following the bottom arrow. Method TO-15A sections 9.3 through 9.5 follow this order and provide guidance for qualifying the analytical instrumentation, air canisters, and sampling devices. Method TO-15A requirements for qualification include both a blank test and a known standard challenge, which are used to detect positive and negative interferences.

In this article, we will walk through the Method TO-15A (revised Method TO-15) requirements, guidelines, and best practices that are designed to ensure your equipment is clean, inert, properly qualified, and able to produce accurate, reliable results. A detailed troubleshooting table is also provided at the end for quick reference.

Figure 1: For best results, system qualification should begin with the GC-MS and follow the reverse order of the analytical flow path.



Part 1: MS and Leak Checking

To begin the process of meeting Method TO-15A requirements for system qualification, we will start with section 9.3: Qualification of Analytical Instrumentation. We can break this down further by addressing the detector before considering the GC or preconcentrator. First, always check the MS tune on a regular basis; this practice will alert you to many issues that can interfere with accurate air sample analysis.

In particular, look for elevated ions related to nitrogen (m/z 28) or water (m/z 18) because these may indicate a leak in the system. The MSD transfer line nut is a common source of air leaks, so make sure it is fully tightened if elevated levels of m/z 28 or 18 are present (a 28:69 ratio of less than 5% is a good indication the GC-MS is leak tight). Be careful not to overtighten the fitting however, as this can break the GC column. The MS side plate and MS vacuum release knob are also potential sources of leaks, so check that they are fully sealed when the mass spec is pumped down. Leaks are not restricted just to the detector; any connection, often the preconcentrator and transfer lines, can potentially have air leaks. To prevent problems during analysis, use an electronic leak detector (cat.# 28500) to check all connections before starting to ensure a leak-free system.

Elevated amounts of background ions can indicate a dirty ion source or contamination in the GC or carrier gas. Difficulty meeting the tuning criteria is an additional clue that the ion source may be dirty and/or the filament needs to be replaced. Before performing maintenance to resolve these issues, see your instrument maintenance manual for instructions on how to properly vent and clean the MSD. PFTBA tuning solution, filaments, and commercially available GC-MS cleaning kits are readily available and are an essential part of proper instrument maintenance.

Part 2: GC, Carrier Gas, and Transfer Lines

After the detector, the GC and related components (carrier gas lines and transfer lines) are the next step in working through section 9.3 of Method TO-15A. Carrier gas contamination is the root cause of many issues in GC and can lead to qualification failures for air analysis. Compounds in the carrier gas or carrier gas lines can condense on the head of the GC column, especially if the GC is kept idle at lower temperatures. To determine whether contaminants are present in the GC and carrier gas, analyze a blank run with no injection from the preconcentrator. Note that the transfer line from the preconcentrator is normally tied into the GC inlet or connected directly on-column, so it is considered part of the GC system, unless it is disconnected to isolate individual components for troubleshooting.

If contaminants are present, they must be removed so that Method TO-15A requirements for cleanliness can be met. This can be accomplished by baking out the GC column and replacing the carrier gas line filters. To bake out the column, condition it at 20 °C above the final analysis temperature of the method for an hour. Do not exceed the column's maximum operating temperature. If this does not eliminate the contamination, then it is possible that the preconcentrator transfer line is contaminated. If possible, the transfer line temperature can be elevated to drive off contaminants, but make sure that downstream temperatures are not lower because this can trap the contaminants further in the system. Refer to your preconcentrator manual for appropriate temperature limits and further instructions for cleaning or replacing the transfer line.

Part 3: Preconcentrator, Autosampler, and "Zero" Air Source

After the GC-MS, the final part in the analytical system, as defined in section 9.3 of Method TO-15A, is the preconcentrator and autosampler. The first step in meeting Method TO-15 requirements here, before any blank checks are run, is to make sure the preconcentrator is leak free. If the control software does not have a leak check built in, then pressurizing the system and watching for a pressure drop or using an electronic leak detector are good alternatives.

To check the preconcentrator for cleanliness, first test the focusing trap by running a blank with no sample injection. If the blank fails, the trap may need to be baked out or replaced. Next, connect a clean zero air source, ideally a zero air generator, directly to the sample inlet and run it as you would with a sample canister. Note that while TO-15A states to use humidified zero air, it is best practice to first use dry air to verify its purity, and then add humidification to verify the water source is clean once you are satisfied that your air is clean.

Contamination in zero air can come from several potential sources. The first step in isolating the cause is to replace the gas filters or perform maintenance on the zero air generator. If this does not help, then the contamination may be built up in the gas lines and they may need to be replaced. If the lab environment has heavy solvent use, try to keep the gas lines away from areas of high solvent use to avoid diffusion into the gas lines. If neither maintenance nor replumbing fixes the issue, it may help to change gas sources (i.e., switching from an air compressor to UHP cylinders, or even just using a new air cylinder. If your lab is not using a zero air generator, installing one can greatly improve air quality [2].

Once the dry air source has been determined to be clean, the next step is testing your system with humidified air. Method TO-15A recommends humidification to 40-50% relative humidity (RH). If humidifying your air results in blank interferences, maintenance on your deionized (DI) or reverse osmosis (RO) water system may be required. If the water system is located in an area that uses volatile solvents, then it may be necessary to relocate the system, boil or sparge the water to remove volatile contamination, or find a new source of humidification water.

Part 4: Analytical System Known Standard Challenge

Once your entire analytical system has been demonstrated to be clean enough for blank analysis, the next step is performing a known standard challenge to test for sources of negative bias, such as cold spots or active sites. Method TO-15A section 9.3.2 recommends testing with known standards at 100-500 pptv (40-50% RH), with consideration given to the expected levels in your samples. Note that while canister cleanliness will not be formally covered until Part 5, you still need to be confident in the cleanliness of the canisters used here for preparing the known standard in order to get the initial results needed to certify your system and canisters. If possible, canisters that are new or have not been used for field sampling (i.e., have only been used for in-house standards) are highly recommended for initial calibration and internal standards. Allow the canisters containing the known standards to equilibrate for 24 hours as per TO-15A section 9.4.3, but use them within 48 hours to reduce the effects of any active sites that may be present.

If compounds show poor response or peaks are missing entirely, this is might be caused by active sites. Active sites are usually caused by the buildup of less volatile material, which can be cleaned out by baking out your preconcentrator at higher temperatures. Check your instrument manual for instructions on how to properly clean or replace potentially contaminated parts and lines.

Other possible causes of low responses include system leaks, cold spots, or problems with the focusing trap. Make sure to fully leak check all parts of the system, verify that all heated zones are set correctly and working properly, and that your trap is properly installed and conditioned.

If your preconcentrator has an autosampler, then the blank and known standard challenge test should be applied to all autosampler ports.

Part 5: Air Canisters

Cleaning

After the system has been shown to be clean, the next step in meeting Method TO-15A requirements is to prepare and test the air sampling canisters as described in section 9.4. Prior to testing, canisters should be cleaned using multiple cycles of evacuation and pressurization with clean, humidified air (as is recommended in TO-15A) or nitrogen. The use of humidified air is preferable for two reasons. First, the oxygen present in air can oxidize compounds that may have adhered to canister walls, breaking them down and helping remove them from the walls so they can be evacuated from the canister. Second, the water from humidification can hydrolyze compounds on canister walls, allowing them to be removed from the canister. TO-15A section 10.1.4 recommends five cycles of pressurization to ≤30 psig and evacuation to 28 in. Hg with a 1-minute hold time on each cycle. The final evacuation should be to ≤50 mTorr. The recommended temperatures for canister cleaning from Method TO-15A are presented in Table I; always consider the presence of components and use caution not to exceed maximum temperatures. See Restek's Frequently Asked Questions: Air Sampling [3] for more information on canister temperature and pressure limits.

Table I: Canister Cleaning and Maximum Temperatures.

	CANISTER CLEANING TEMPERATURE*		MAXIMUM TEMPERATURE	
Canister	**Air Purge Gas**	**Nitrogen Purge Gas**	**Air Purge Gas**	**Nitrogen Purge Gas**
SilcoCan (with gauge)	≤80 °C	≤100 °C	≤80 °C	≤120 °C
SilcoCan (without gauge)	≤80 °C	≤100 °C	≤80 °C	≤140 °C
TO-Can (with gauge)	≤100 °C	≤100 °C	≤120 °C	≤120 °C
TO-Can (without gauge)	≤100 °C	≤100 °C	≤120 °C	≤140 °C

*Never exceed maximum temperatures when cleaning equipment.

Post-Cleaning Testing

To test performance after cleaning, the canisters are first blank tested with 50% RH air. After filling, allow the canisters to equilibrate for 24 hours before analysis. Results should show no target analytes above 20 pptv in the canisters. In addition, the chromatogram should be evaluated for the presence of non-target compounds, as these may interfere with target compounds or be indications of possible active sites or compounds.

To verify the canisters are non-reactive, they also should undergo the known standard challenge, as described in section 9.4.3. Canisters that show low recoveries (70% or less of the nominal concentration) indicate the presence of active sites in the canister. High recoveries (130% or higher of the nominal concentration) indicate potential activity that is creating interferences for target compounds. Canisters that fail the zero air or known standard challenges should be cleaned again. If the recommended cleaning procedure is not sufficient to clean the canisters, check that your canister cleaning oven is reaching the desired temperature and humidity levels. The source of humid air used by the cleaning oven must be clean to avoid contamination of the canisters. The zero air and water sources validated in the previous steps would be suitable for use. Increasing the number of cleaning cycles may be needed to remove higher levels of contamination.

After cleaning, canisters can be stored under vacuum or pressurized with dry air or nitrogen (TO-15A section 10.1.4). Over time, compounds on canister walls may start to off-gas, so canisters that have been stored for some time should be given a quick pressurization/evacuation cycle with clean, humid air before being sent to the field.

Part 6: Sampling Devices

The final components of your system to be tested are the sampling devices, which are covered in section 9.5. To meet Method TO-15A requirements, sampling devices should undergo both a humid zero air challenge to verify cleanliness, as well as a known standard challenge to verify inertness. Samplers may be connected either directly to the analytical system or to a certified clean canister to be analyzed later. Passive air samplers, or other sampling devices, should be tested at the flow rates at which they will be used in the field. This means the incoming humid zero air and humid challenge standards must be supplied to the sampling device at near ambient pressure. This can be done using regulators (cat.# 21666 or 22452) and flow controllers to reduce the pressure of the incoming gas, or with a manifold using a vent to keep the sampling system at ambient pressure.

If air samplers do not pass the blank or known standard challenge, they may be cleaned by flushing with humidified air under low heat (maximum temperature of the assembled sampler is 94 °C) or by disassembling the unit and then sonicating with methanol or baking at higher temperatures. Be sure to check the manual of your specific sampling device to determine which parts should not be heated or exposed to methanol.

Summary

The process of meeting Method TO-15A requirements and qualifying your full analytical system as clean and inert enough for air analysis can be a long one, but by breaking it down into its component parts it can become a manageable task. By first verifying the cleanliness and inertness of your analytical system using the approach described here, you can have high confidence in the results for your canisters and sampling devices. The 20 pptv cleanliness requirement and known standard challenge for Method TO-15A may be difficult target for all compounds, but some deviations may be acceptable depending on customer or regulatory requirements. By establishing initial qualification and performing any ongoing qualifications required by Method TO-15A, Method TO-15, or other methods, the data generated by your air lab should be robust, reliable, and accurate.

TROUBLESHOOTING GUIDE

MS Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Elevated amounts of m/z 28 and 18	• Leak in MS system	• Check MSD transfer line nut, vacuum release knob/O-ring, and side plate for leaks • Check inlet or column connections for leaks
Instrument does not meet tuning criteria	• Dirty ion source	• Vent MSD and clean source • Replace worn filaments
Presence of ions not found in PFTBA tuning solution	• Dirty ion source • Low or empty PFTBA tuning solution • PFTBA valve not open • Contamination from GC or carrier gas.	• Vent MSD and clean source • Make sure tuning solution is full and valve is open • Troubleshoot GC system (see Part 2)

GC and Carrier Gas Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Presence of target compounds, non-target interferences, or poor baseline	• Contamination at head of GC column	• Bake out column • Replace column
	• Carrier gas contamination	• Replace carrier gas filters
	• Transfer line contamination	• Bake out, clean or replace transfer line

Preconcentrator/Autosampler Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Focusing trap blank with no sample injection shows target or non-target interferences	• Contaminated focusing trap	• Bake out or replace focusing trap
Blank with direct air connection shows target or non-target interferences	• Contaminated sample lines	• Clean or replace sample inlet lines
	• Contaminated fill gas source	• Perform maintenance on zero air generators • Replace gas filters • Try different gas source (i.e., air cylinder instead of compressor)
	• Contaminated ISTD	• Run without ISTD • Remake ISTD in clean canister
Blank with humid air shows target or non-target interferences	• Contaminated water source	• Perform maintenance on DI water system • Obtain water from new source, ideally isolated from areas of solvent use
Failure of known standard challenge	• Active sites in system caused by contaminants	• Bake out system • Replace or clean sources of active sites (column, transfer lines, autosampler lines, etc.)
	• Cold spots in system	• Make sure all heated zones in GC-MS and preconcentrator are set and working properly
	• Leak in system	• Leak check GC-MS and preconcentrator/autosampler

Air Canister Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Humid canister blank shows target or non-target interferences	• Contamination present in air canister	• Make sure canister cleaning oven is reaching desired temperature and humidity levels • Increase number of cleaning cycles • Replace canister
	• Contamination present in water source	• Perform maintenance on DI water system • Obtain water from new source, ideally isolated from areas of solvent use
	• Contaminated fill gas	• Perform maintenance on zero air generators • Replace gas filters • Try different gas source (i.e., air cylinder instead of compressor)
Failure of known standard challenge	• Active sites in canister	• Make sure canister cleaning oven is reaching desired temperature and humidity levels • Increase number of cleaning cycles • Replace canister

Sampling Device Troubleshooting

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Blanks show target or non-target interferences	• Contamination present in sampling device	• Flush assembled unit with humidified air while heating (maximum temperature of assembled unit is 94 °C) • Disassemble unit and sonicate with methanol (do not sonicate O-rings or orifice) • Bake disassembled unit at 100-150 °C (do not bake O-rings or gauges)
Failure of known standard challenge	• Active sites present in sampling device	• Flush assembled unit with humidified air while heating (maximum temperature of assembled unit is 94 °C) • Disassemble unit and sonicate with methanol (do not sonicate O-rings or orifice) • Bake disassembled unit at 100-150 °C (do not bake O-rings or gauges)

References

1. Method TO-15A Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography–Mass Spectrometry (GC-MS), U.S. Environmental Protection Agency, September 2019. https://www.epa.gov/sites/production/files/2019-12/documents/to-15a_vocs.pdf">https://www.epa.gov/sites/production/files/2019-12/documents/to-15a_vocs.pdf
2. J.S. Herrington, The new U.S. EPA Method TO-15A blog series—part 3: use clean air on a clean analytical system, Restek Corporation (2020) https://blog.restek.com/the-new-u-s-epa-method-to-15a-blog-series-part-3-use-clean-air-on-a-clean-analytical-system/
3. Frequently Asked Questions: Air Sampling, Restek Corporation, https://www.restek.com/Pages/faq_air

Canisters are the gold standard for ambient VOC monitoring.

SilcoCan Air Sampling Canisters with RAVE+ Valves

- Siltek-treated canister with optional Siltek-treated valve offers unsurpassed inertness, even for sulfur-containing or brominated compounds.
- High-quality, metal-to-metal seal, ⅔-turn valve with stainless-steel diaphragms prevents sample adsorption for more accurate results.
- Canisters and valves made of 304 and 316 stainless steel to withstand the rigors of field work.
- Both 2-port and 3-port valves are available; 3-port valve includes -30" Hg/60 psi vacuum/pressure gauge (other gauges available).
- Featuring the proven long life, leak-free performance, and effortless operation of RAVE+ valves.

Description	Modification	Volume	qty.	cat.#
SilcoCan Canister	2-Port RAVE+ Valve	1 L	ea.	27298
	2-Port, Siltek-Treated RAVE+ Valve	1 L	ea.	27299
	3-Port RAVE+ Valve with Gauge*	1 L	ea.	27300
	3-Port Siltek-Treated RAVE+ Valve with Gauge*	1 L	ea.	27301
	without Valve	1 L	ea.	22090
	2-Port RAVE+ Valve	3 L	ea.	27302
	2-Port, Siltek-Treated RAVE+ Valve	3 L	ea.	27303
	3-Port RAVE+ Valve with Gauge*	3 L	ea.	27304
	3-Port Siltek-Treated RAVE+ Valve with Gauge*	3 L	ea.	27305
	2-Port RAVE+ Valve	6 L	ea.	27306
	without Valve	3 L	ea.	22091
	2-Port, Siltek-Treated RAVE+ Valve	6 L	ea.	27307
	3-Port RAVE+ Valve with Gauge*	6 L	ea.	27308
	3-Port Siltek-Treated RAVE+ Valve with Gauge*	6 L	ea.	27309
	2-Port RAVE+ Valve	15 L	ea.	27310
	2-Port, Siltek-Treated RAVE+ Valve	15 L	ea.	27311
	without Valve	6 L	ea.	22092
	3-Port RAVE+ Valve with Gauge*	15 L	ea.	27312
	3-Port Siltek-Treated RAVE+ Valve with Gauge*	15 L	ea.	27313
	without Valve	15 L	ea.	22093

*Range of standard gauge is –30" Hg to 60 psi.
Do not exceed canister maximum pressure of 40 psig (2.75 bar).

TO-Can Air Sampling Canisters with RAVE+ Valves

- Proprietary electropolished surface maintains compound stability.
- High-quality, metal-to-metal seal, ⅔-turn valve with stainless-steel diaphragms prevents sample adsorption for more accurate results.
- Both 2-port and 3-port valves available; 3-port valve includes -30" Hg/60 psi vacuum/ pressure gauge (other gauges available).
- SUMMA canister equivalent.
- Featuring the proven long life, leak-free performance, and effortless operation of RAVE+ valves.

Description	Modification	Volume	qty.	cat.#
TO-Can Canister	without Valve	1 L	ea.	22094
	without Valve	3 L	ea.	22095
	without Valve	6 L	ea.	22096
	2-Port RAVE+ Valve	1 L	ea.	27314
	3-Port RAVE+ Valve with Gauge*	1 L	ea.	27315
	2-Port RAVE+ Valve	3 L	ea.	27316
	without Valve	15 L	ea.	22097
	3-Port RAVE+ Valve with Gauge*	3 L	ea.	27317
	2-Port RAVE+ Valve	6 L	ea.	27318
	3-Port RAVE+ Valve with Gauge*	6 L	ea.	27319
	2-Port RAVE+ Valve	15 L	ea.	27320
	3-Port RAVE+ Valve with Gauge*	15 L	ea.	27321

*Range of standard gauge is –30" Hg to 60 psi.
Do not exceed canister maximum pressure of 40 psig (2.75 bar).

Passive Air Sampling Kits—Integrated (Stainless Steel & Siltek Treated)

Superior Performance—an Excellent Restek Value.

- Provide accurate integrated sampling without a sampling pump.
- Siltek-treated components ensure accurate sampling of active components.
- Excellent for sampling times from 0.5 hour to 125 hours.

Canister Volume/Sampling Time							Siltek Treated	Stainless Steel
400 cc	1 Liter	3 Liter	6 Liter	15 Liter	Flow	Orifice Size	cat.#	cat.#
8 hour	24 hour	48 hour	125 hour	—	0.5–2 mL/min	0.0008"	24217	24216
2 hour	4 hour	12 hour	24 hour	60 hour	2–4 mL/min	0.0012"	24160	24165
1 hour	2 hour	6 hour	12 hour	30 hour	4–8 mL/min	0.0016"	24161	24166
—	1 hour	4 hour	8 hour	20 hour	8–15 mL/min	0.0020"	24162	24167
—	—	2 hour	3 hour	8 hour	15–30 mL/min	0.0030"	24163	24168
—	—	1 hour	1.5 hour	4 hour	30–80 mL/min	0.0060"	24164	24169
—	—	—	0.5 hour	1 hour	80–340 mL/min	0.0090"	22101	22100

1. Veriflo SC423XL flow controller
2. This flow controller is the heart of the sampling train. It is a high-quality device designed to maintain a constant mass flow as the pressure changes from –30" Hg to 7" Hg. (We recommend you stop sampling at or before 7" Hg of vacuum.) All wetted parts of the flow controller can be Siltek treated.
3. Stainless-steel vacuum gauge, 1/8" NPT
4. Fitted to the flow controller, the gauge monitors canister vacuum change during sampling.
5. 1/4" Siltek sample inlet
6. The 0.3 m x 1/4" tubing includes a stainless-steel nut on the inlet end to prevent water droplets from accumulating at the edge of the tubing where they could be pulled into the sampling train.
7. 2 µm frit filter and washer
8. Located prior to the critical orifice to prevent airborne particles from clogging the critical orifice. Replaceable. Available in stainless steel or Siltek treated for optimum inertness.
9. Interchangeable critical orifice
10. An interchangeable ruby critical orifice allows you to control the flow with very high precision.

Note: All fitting connections are 1/4" tube, except where noted.

Description	Flow Capacity	Material	Orifice Size	qty.	cat.#
Passive Air Sampling Kit	0.5–2 mL/min	Siltek Treated	0.0008"	kit	24217
	0.5–2 mL/min	Stainless Steel	0.0008"	kit	24216
	2–4 mL/min	Siltek Treated	0.0012"	kit	24160
	2–4 mL/min	Stainless Steel	0.0012"	kit	24165
	4–8 mL/min	Siltek Treated	0.0016"	kit	24161
	4–8 mL/min	Stainless Steel	0.0016"	kit	24166
	8–15 mL/min	Siltek Treated	0.0020"	kit	24162
	8–15 mL/min	Stainless Steel	0.0020"	kit	24167
	15–30 mL/min	Siltek Treated	0.0030"	kit	24163
	15–30 mL/min	Stainless Steel	0.0030"	kit	24168
	30–80 mL/min	Siltek Treated	0.0060"	kit	24164
	30–80 mL/min	Stainless Steel	0.0060"	kit	24169
	80–340 mL/min	Siltek Treated	0.0090"	kit	22101
	80–340 mL/min	Stainless Steel	0.0090"	kit	22100

*Vacuum/pressure gauge included in kit; air sampling canisters sold separately.

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
Ethylbenzene
Ethylene dibromide (1,2-dibromoethane)
4-Ethyltoluene
Trichlorofluoromethane (CFC-11)
Dichlorodifluoromethane (CFC-12)
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)
1,2-Dichlorotetrafluoroethane (CFC-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

Concentration	Conc. in Solvent	Certification	Product Grade	Shelf Life	qty.	cat.#
1 ppm	1 ppm in nitrogen, 104 liters @ 1,800 psig		Blend tolerance: ±10%; Analytical accuracy: ±5%	1 yr	ea.	34436
1 ppm	1 ppm in nitrogen, 110 liters @ 1,800 psig		Blend tolerance: ±10%; Analytical accuracy: ±5%	1 yr	ea.	26359
100 ppb	100 ppb in nitrogen, 110 liters @ 1,800 psig		Blend tolerance: ±20%; Analytical accuracy: ±10%	1 yr	ea.	26360

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

ordering notes

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.

Certificates of analysis for this product are provided electronically. To view and download your certificate, simply visit www.restek.com/documentation

Ultra-High Purity Chrome-Plated Brass Line Gas Regulator

- Oxidation-resistant, chrome plated.
- Use where you need to reduce the line pressure by 20 psig (138 kPa) or more.
- Same purity protection as high-pressure cylinder regulators.
- Rated to 3000 psig (20,684 kPa) maximum inlet pressure.

Custom gas regulators are also available. Request yours today.

Note: Inline regulators are not sold with end fittings. We recommend you order the appropriate NPT Male Connectors to connect the regulator to your gas line.

Fittings	Material	Outlet Gauge	Outlet Pressure	qty.	cat.#
$^{1}/_{4}$" female NPT ports	Chrome-Plated Brass	30", 0 to 100 psig (0–689 kPa)	0 to 50 psig (0–345 kPa)	ea.	21666
$^{1}/_{4}$" female NPT ports	Chrome-Plated Brass	30", 0 to 200 psig (0–1,379 kPa)	0 to 150 psig (0–1,034 kPa)	ea.	22452

21666

Inlet connections: $^{1}/_{4}$" FPT
Outlet assembly: $^{1}/_{4}$" FPT port

28500

Leak Detector Specifications
Detectable Gases: Helium, nitrogen, argon, carbon dioxide, hydrogen*
Battery: Rechargeable nickel-metal hydride (NiMH) internal battery pack (12 hours normal operation)
Ambient Temperature: 50–98.6 °F (10–37 °C)
Humidity Range: 0–97%
Warranty: One year
Certifications: CE (EU, Korea, Japan, Australia)
Compliance: WEEE, CEC, China RoHS 2
Indoor Use Only

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 x 10^{-5}, red LED
Hydrogen*, 1.0 x 10^{-5}, red LED
Nitrogen, 1.4 x 10^{-3}, yellow LED
Argon, 1.0 x 10^{-4}, yellow LED
Carbon dioxide, 1.0 x 10^{-4}, yellow LED
Gas detection limits measured in atm cc/sec.

Restek Electronic Leak Detector

New and improved! Prevent small leaks from causing big problems with a Restek 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.

Features & benefits include:

- Detects a broad range of gases.
- Audible tone and LED display indicate the severity of a leak.
- Can be operated during charging or used up to 12 hours between charges.
- Ergonomic, handheld design.
- Rugged side grips for added durability.
- Handy probe storage for cleanliness and convenience.
- Automatic shutoff.
- A convenient carrying and storage case.
- Easy-to-clean probe assembly.
- A universal AC power adaptor (U.S., UK, Europe, Australia, Japan).
- USB charging cable.

Backed by a one-year warranty, the Restek leak detector is the industry standard for performance and affordability in handheld leak detectors.

Restek's Competitive Advantage: Comparing Leak Detectors

	Restek Leak Detector	Agilent G3388B	GOW-MAC 21-070 (Mini)
Battery rating	12 hours normal operation	5 hours normal operation	8 hours normal operation
Battery type	NiMH	Lithium ion	Nickel cadmium
Leak indicator	Incremental visual (LEDs) Incremental audible	Incremental visual (LCD & LED) Step audible	Incremental visual (LEDs) Audible at maximum
Helium leak sensitivity	1 x 10^{-5} cc/sec	1 x 10^{-4} cc/sec (standard range) 1 x 10^{-5} cc/sec (high range)	1 x 10^{-5} cc/sec
Weight	252 grams	95 grams	476 grams
Handheld?	Yes	Yes	No

Description	Certification/Compliance	Includes	qty.	cat.#
Restek Electronic Leak Detector	CE (EU, Korea, Japan, Australia), WEEE, CEC, China RoHS 2	carrying case, universal AC power adaptor [U.S., UK, Europe, Australia, Japan], 6-ft USB charging cable	ea.	28500

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 should only be used 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.

If your Restek electronic leak detector needs service or repair, send a completed Health and Safety form and SRV-GC Accessories form to the email address listed at the top of each form. Failure to provide all required information may lead to significant processing delays. Once we have received both completed forms, we will provide authorization and instructions for returning your unit; do not send any equipment back to Restek prior to receiving authorization. Leak detector service (cat.# 22655-R or 28500-S) includes inspection, battery replacement (if necessary) and testing of the unit.

GC-MS Cleaning Kit

Poor sensitivity, loss of sensitivity at high masses, or high multiplier gain during an autotune are all indicators that your mass spectrometer source may need to be cleaned. Restek has assembled all of the necessary components for cleaning and polishing your ion source.

The Restek GC-MS Cleaning Kit (cat.#s 27194, 27195) Includes:

- Lint-free nylon gloves (small, 2 pair)
- Lint-free nylon gloves (large, 2 pair)
- Lint-free cotton cloth, 9 x 9 (10-pk.)
- Micro mesh 4 x 6 sheet (4-pk.)
- Aluminum oxide (1 kg jar)
- Cotton tip applicators
- Tweezers, large
- Tweezers, small
- Septum puller
- Rotary tool, battery operated (optional, 27194)
- Tool-kit bag

27194

Description	qty.	cat.#
Mass Spec Cleaning Kit with Rotary Tool	kit	27194
Mass Spec Cleaning Kit without Rotary Tool	kit	27195

High-Temperature EI Filament

for Agilent 5972, 5973, 5975, or 5977 GC-MS

- EI (electron ionization) filaments meet or exceed original manufacturer's performance.
- Every filament is subjected to QC tests, including heat, electrical current, and resistance.
- Samples from each filament manufacturing lot are installed in an MSD for *in situ* testing.

Description	Instrument	qty.	cat.#
High-Temperature EI Filament	for Agilent 5972, 5973, 5975, or 5977 GC-MS	ea.	23099

23099

PFTBA (MS Tuning Compound)

Perfluorotributylamine (PFTBA) (311-89-7)

Description	CAS #	Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	Data pack available?	qty.	cat.#
Perfluoro-tributylamine (PFTBA)	311-89-7	Neat, 1 mL/ampul	No	6 months	55 months	Ambient	0 °C or colder	No	ea.	30482

No data pack available.

RESTEK
Pure Chromatography

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

QUALITY ISO 9001 • 17025 • 17034

www.restek.com

Lit. Cat.# EVAR3483A-UNV