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Technical Bulletin

April 7, 2022

ANALYSIS OF 3M™ ETHYLENE OXIDE MONITOR 3550+/3551+ by GC/ECD

Desorption Solution with Internal Standard (DE)

Accurately add 10 uL 1-bromo-propanol into 900 mL toluene and 100 mL acetonitrile. This serves as the desorption solution with an added internal standard. The solution expires after 3 months. Other extraction solvents can be found in the NIOSH Manual of Analytical Methods or at the OSHA website. Labs who desire to use a different extraction solvent would need to determine their own DE values for each analyte on the appropriate monitor. A method for determining the DE is available (R.A. Dommer & R.G Melcher, (1978) AIHA Journal, 39:3, 240-246). To obtain an accurate value, it is good practice for individual labs to determine the DE at several (3-5) concentrations (µg of analyte per gram of media) that bracket the range of interest, and to determine the value at each concentration in triplicate. Some laboratories choose to re-determine DE values received from a 3rd party or to re-determine their own values from time-to-time.

STANDARD PREPARATION

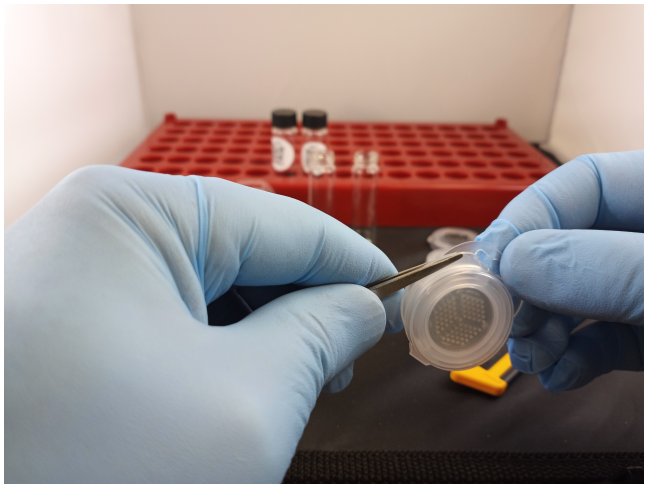
Stock Standard: Accurately weigh a Reference Standard of pure 2-bromoethanol into a measured volume of chromatography-grade desorption solvent (90% toluene: 10% CS2 with added internal standard) to make a Stock Standard Solution. Date the Stock Standard, store under refrigeration. Make fresh annually.

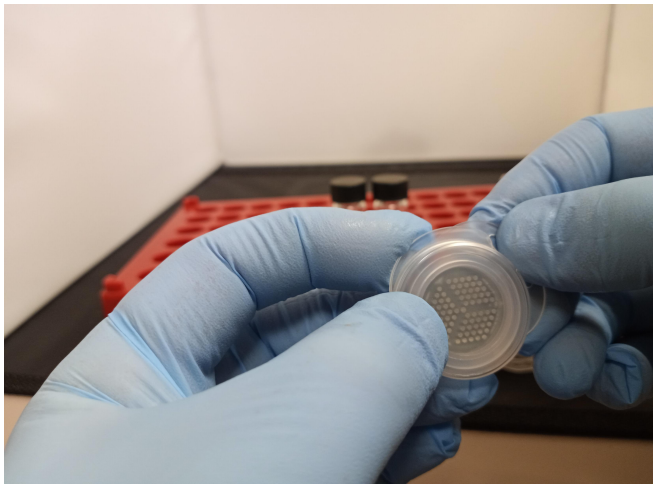
Working Standard: Prepare a working standard by adding a known amount of stock standard to a partially filled with DE 10 mL volumetric flask/ Fill to the 10 mL mark. Date Working Standards, store under refrigeration every six months.

Calibration Standards: Use the DE and working standard to make 3-5 Working Standards in the range 0.056-10 µg per ml of Desorption Solvent.

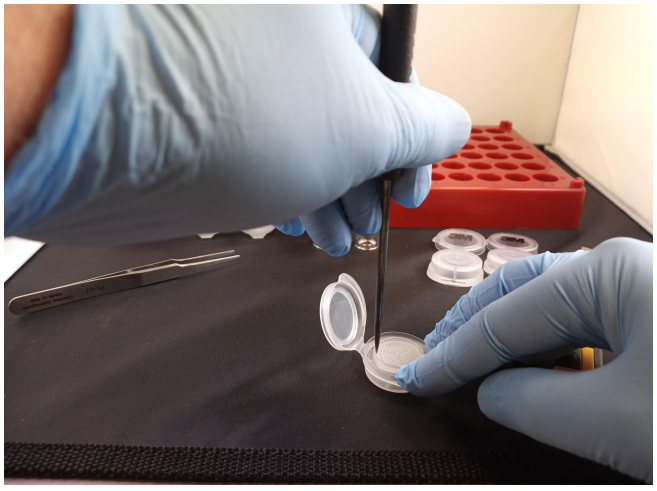
SAMPLE PREPARATION

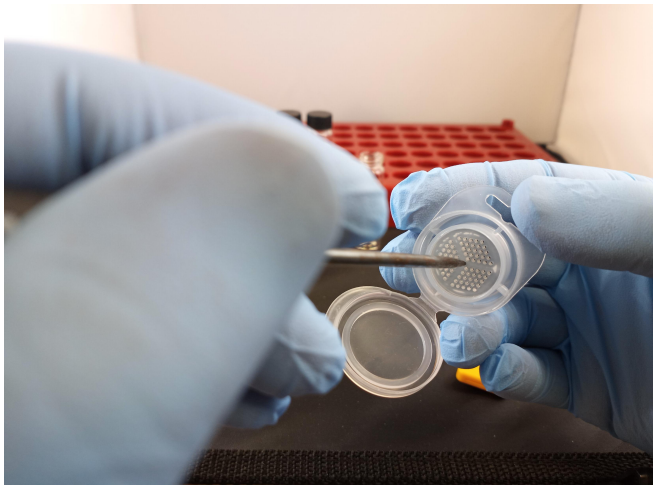
Remove each Monitor to be tested from the Return Pouch. To open the face of the Monitor either use something flat as a wedge to open it, or just open with your fingers.





Place Monitor on a hard solid surface. Do Not hold the badge in the palm of your hand.



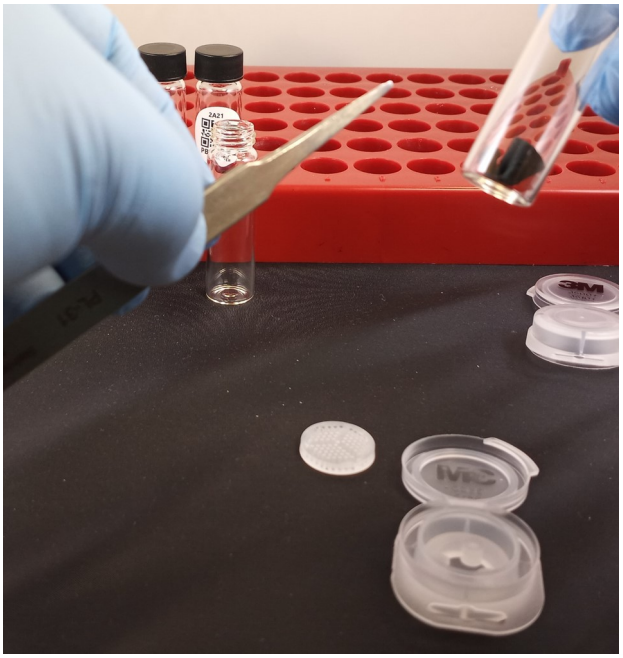


YES	NO

Using a lab pick (typ. McMaster-Carr 3842A42) as a tool, remove the plastic Sampling Grid from the clear plastic Sampler Body exposing the carbon wafer beneath. Place the tip of the pick either at the side or the middle. Push down hard and pry out the sampling grid.

If you do not have a pick, use a small sharp blade to make 2 incisions within 25 degrees for each other. Then pry the sampling grid out.

Using clean forceps, transfer the carbon wafer into a 7 ml glass vial (or similar) with inert gas tight closure cap.



Add ca. 50 mg sodium carbonate to the vial to neutralize excess HBr present on the wafer. (The sodium carbonate will not dissolve.) Pipet 2.0 ml of Internal Standard Solution and cap the vial with inert, gas-tight closure. Agitate the vial continuously for one hour using an orbital shaker or equivalent. Reserve for gas chromatographic analysis.

BLANKS

Most laboratory tests involve the analysis of an associated background blank, consisting of reagents or media that have not been exposed to the analyte tested. When typical blank values are detectable (attributed to analyzable substances acquired extrinsically), a blank test result is subtracted from the value obtained from each test to obtain a “blank corrected value”. It is good practice to initially analyze several monitors to determine whether blank values are detectable or significant relative to the laboratory’s reporting limit. If blank values are detectable and significant, it is good practice to measure and retain an average blank value for each manufactured lot of monitors analyzed and subtract that blank value from each measured sample. In some cases, an average blank value may be obtained from the media manufacturer.

At least once per analytical batch, remove a similar Monitor which has not been exposed. Process the unexposed "BLANK" Monitor exactly as the Sample Preparations (above) and subtract any Peak Area response at the retention time of interest from the value obtained from the Sample Preparation. Report any significant BLANK values to Quality Assurance group along with the Lot number of the Monitor analyzed.

QUALITY CONTROL SAMPLES

During each run, analyze check standards and determine whether Analyte Standard responses fall within the Calibration Parameters specified for that Analyte and stored in the Computer. Investigate and resolve any deviation or discrepancy of Standards from the known Calibration Parameters before reporting results.

CAPILLARY GAS CHROMATOGRAPHY(GC) ANALYSIS

Inject an aliquot of the Sample Preparation from each Monitor to be analyzed into a Gas Chromatography System using the following conditions.

GC Columns	Stabilwax (crossbond Carbowax polyethylene glycol)
Column Size	0.25 mm capillary x 30 m, 0.5 µm film thickness
Injection Mode	Split (typical 10:1)
Injector/Detector Temp	250°C/300°C
Detector	Electron Capture Detector
Column Temp	Hold 3 min 75°C; 20°C per min to 150°C; Hold 1 min
Injection Volume	1.0 microliter (nominal)

(*) Restek Corp, Bellefonte, Pennsylvania

Concomitantly, inject measured aliquots of a BLANK Preparation and three Standard Preparations in the range of interest (i.e. which bracket the concentrations of the Sample Preparations).

CALCULATION

Acquire the analytical data into a computer system in which chromatography data handling software has been installed. Using the software, compare the peak area ratio for analyte *vs* internal standard normalized for concentration from each Sample Preparation to the best-fit Calibration Curve obtained from BLANK and Standard Preparations and compute the Analyte Concentration in the Sample Preparation.

Calculate Exposure Level from Analyte Concentration as follows:

$$\text{EXPOSURE LEVEL (ppm)} = \frac{1000(C)(V)(R)(F)}{(DE)(M)(SR)(T)}$$

Where

- **C** = **Analyte (bromoethanol) Concentration (mcg/ml)**
- **F** = **Mass Ratio (EtO/Bromoethanol = 0.352)**
- **V** = **Volume of desorption solvent (ml)**
- **R** = **Molar Volume @ 25°C (24.45 l/mole)**
- **DE** = **De-Sorption Efficiency (fraction of extraction) for 2.0 ml DS**
- **M** = **Molecular Weight of Ethylene Oxide 44.05 g/mole)**
- **SR** = **Monitor Sampling Rate (ml/min)**
- **T** = **Sampling Time (min)**

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