Toxic Organic and Ozone Precursor Reference Standards

Introduction:

MATHESON leads the industry by providing stable, consistent, and accurate Toxic Organic and Ozone Precursor Reference Standards. The MATHESON integrated measurement process, VOC-free delivery system and NIST SRM traceability improve your time, cost, and accuracy associated with instrument calibration.

Component Stability:

In 1996, MATHESON conducted a series of tests to assist Japanese air monitoring efforts. The targeted compounds were 1,3-butadiene, acrylonitrile, and chlorodimethylether. These studies indicated the stability of TO-14 blends from major US manufacturers to be inconsistent and inaccurate when analyzing and comparing the heavy compounds in the tested blends. The experiments' successful completion led to the implementation of new blending and measurement techniques for VOC blends. This process successfully transferred to many other Toxic Organic Compound applications.

Multicomponent mixtures of Volatile Organic Compounds, particularly ones containing heavy hydrocarbon and aromatic compounds, are potentially unstable. MATHESON controls this instability by successfully integrating Microshield treated cylinders, qualified delivery systems, and *cis-trans* daily stability tests.

Microshield Cylinder Treatment

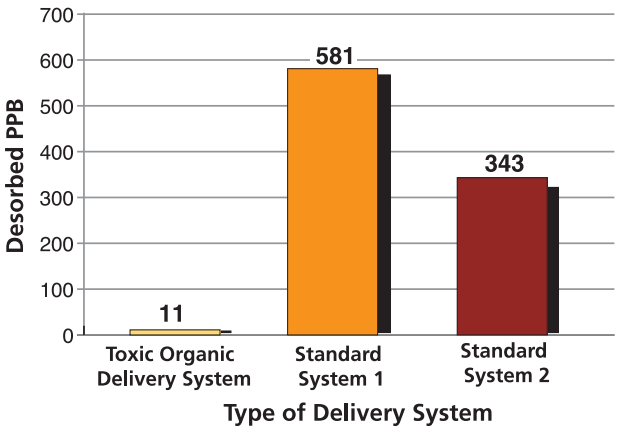
To improve stability and shelf life, MATHESON developed the revolutionary Microshield cylinder treatment. When manufacturing mixtures at the parts per million (ppm) and parts per billion (ppb) ranges, elimination of the active sites on the interior cylinder wall is mandatory.

Eliminating these active sites on the cylinder interior enables unique stability for the difficult components, such as benzyl chloride, and guarantees longer shelf life for our mixtures. For example, a MATHESON Toxi-MAT-14, 40-component mixture has a certified shelf life of 12 months.

Qualified Delivery System

When using a toxic organic standard, repeatable calibration measurements demand a qualified delivery system. A qualified delivery system includes all the components exposed to the gas stream before entering the detector. MATHESON tested several delivery systems commonly used in the TO marketplace. When evaluating the amount of the sample gas carryover adsorbed or desorbed by each type of system, desorption proved to be the biggest problem (Table 1). These desorbed compounds will provide inaccurate measurements of the components in the cylinder. Therefore, MATHESON developed the toxic organic delivery system to eliminate these effects of toxic organic desorption.

Table 1: Desorption of Compounds



cis-trans Ratio Test

MATHESON puts a high priority on proving the stability of its mixtures. Therefore, we developed a quick way to evaluate the stability of a TO mixture before running a daily standard. The *cis-trans* ratio test is a fast and accurate method to check mixture stability. First, check the response ratio of *cis*-1,3-dichloro-1-propene to its *trans* isomer. In an unstable mixture, the *trans* isomer will degrade before the *cis* isomer. If the value is not within the statistical variation inherent in your analytical system, your mixture is suspect. This works for two reasons. The mix manufacturer should be adding the same amount of each component to maintain a single concentration. The isomers' similar molecular weight and vapor pressure allow them to be nearly identical in any method of detection you may use.

Consistency and Accuracy:

MATHESON's "batch to batch" Toxic Organic and Ozone Precursor Mixtures are consistent and accurate. We ensure this by using state-of-the-art measuring and mixing techniques such as:

- High precision gravimetric and multi-gravimetric techniques providing the lowest direct weight additions
- Multi-range reference standards from our inventory
- NIST traceable weight certificates
- State-of-the-art GC instruments and testing methods

Table 2 depicts our commitment to providing consistent batch to batch mixtures, while Table 3 shows the inter-batch consistency ranges.

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Table 2: Intra-Batch vs. Inter-Batch ppm

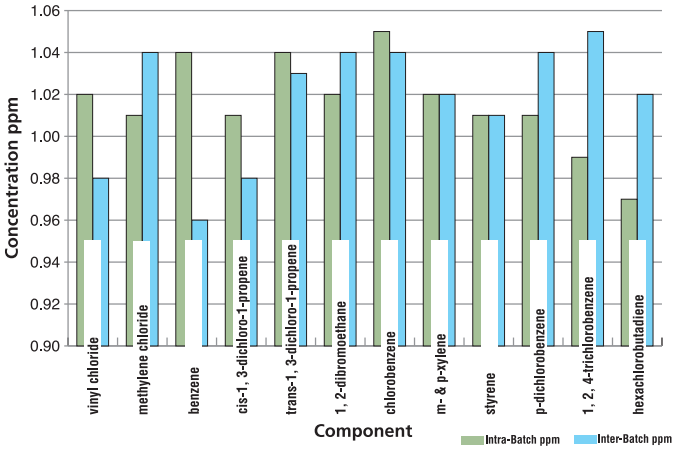

Table 2: Comparison of concentration of Intra-Batch (same lot) vs. Inter-Batch (different lots) mixtures. *Comparing the "Intra" vs. the "Inter" ppm concentration shows that regardless of which "lot number" the mixture is from; there is minimal concentration variation between MATHESON's mixtures. This is a result of MATHESON's expert measuring and mixing techniques.*

Table 3: TO Mixture Inter-Batch Consistency Range

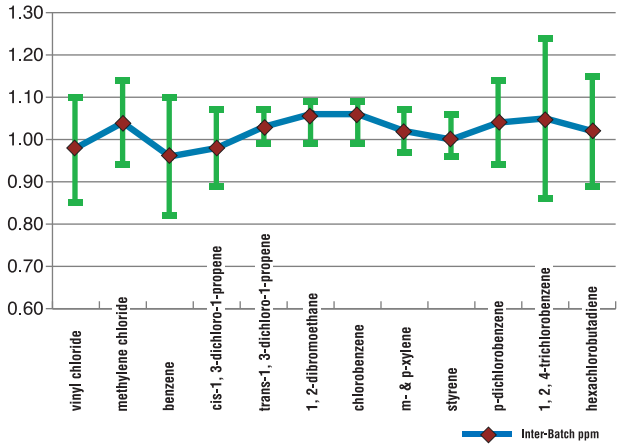

Table 3: Inter-Batch ppm Consistency Range *The points along the horizontal line represent the average measured concentration (ppm) compared to the target 1 ppm concentration of each component. The vertical Error Bars represent the upper and lower concentration ranges of certain components across different lot numbers.*

Flexibility:

MATHESON offers up to four cylinder sizes:

1l: 130 ft³ **3l: 26 ft³**
2l: 69 ft³ **6l: 3.64 ft³**

Concentrations are the standard 100 ppb and 1 ppm, plus custom concentrations that are customer defined. Minor components are available in our standard mixtures, plus we will custom blend any chemically compatible toxic organic components.

Examples of Standard Subsets:

Toxi-MAT-15: 18 TO-15 compounds
Aro-MAT: 14 TO-14 Aromatic compounds
Chloro-MAT: 19 Chlorocarbon compounds
Chromo-MAT-1: Tuning Mixture 4 components
- Bromochloromethane
- 4-Bromofluorobenzene
- Chlorobenzene-d5
- 1,4-Difluorobenzene

Chromo-MAT-2 BFB Tuning Standard for GCMS
- 4-Bromofluorobenzene

BTEX Air Monitoring Mixture
- Benzene
- Ethylbenzene
- Toluene
- m-Xylene
- o-Xylene
- p-Xylene

Microshield Cylinder Sizes

Size	Water Capacity lbs.	Pressure Rating	Cylinder Size	DOT Rating	Material of Construction
1l	64.9	2015	8 x 48	3AL2015	AL
2l	34.5	2015	7 x 33	3AL2015	AL
3l	13	2216	7 x 16	3AL2216	AL
6l	1.8	1800	3 x 9	3AL1800	AL

Delivery System

Description	Part Number
Toxic Organic Regulator	3571-180 (Cylinder 6l) 3571-350 (Cylinders 1l, 2l and 3l)
TOC Delivery Line	TBG-0503-XX
Carrying Case	CAS-0105-XX
VOC Kit*	KIT-0473-XX[1] KIT-0474-XX[2]

** Please order calibration standards separately.*
1-Includes regulator: 3571-180, TOC Delivery Line: TBG-0503-XX, and Carrying Case: CAS-0105-XX
2-Includes regulator: 3571-350, TOC Delivery Line: TBG-0503-XX, and Carrying Case: CAS-0105-XX

Toxi-MAT-14

40 Component Mixture for EPA Method TO-14A

List of Components

- Benzene
- Benzyl chloride
- Carbon tetrachloride
- Chlorobenzene
- Chloroform
- 1,2-Dibromoethane
- m-Dichlorobenzene
- o-Dichlorobenzene
- p-Dichlorobenzene
- Dichlorodifluoromethane (R-12)
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethylene
- cis-1,2-Dichloroethylene
- 1,2-Dichloropropane
- cis-1,3-Dichloropropene
- trans-1,3-Dichloropropene
- 1,2-Dichlorotetrafluoroethane (R-114)
- Ethyl chloride
- Ethylbenzene
- Hexachloro-1,3-butadiene
- Methyl bromide
- Methyl chloride
- Methylene chloride
- Styrene
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- Toluene
- 1,2,4-Trichlorobenzene
- 1,1,1-Trichloroethane (Methylchloroform)
- 1,1,2-Trichloroethane
- Trichloroethylene
- Trichlorofluoromethane (R-11)
- 1,1,2-Trichlorotrifluoroethane (R-113)
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Vinyl chloride
- m-Xylene
- o-Xylene
- p-Xylene

- **Balance VOC Free Nitrogen**

Sizes: 1l: 130 ft³, 2l: 69 ft³, 3l: 26 ft³, 6l: 3.64 ft³
Concentrations: 1 ppm, 100 ppb

Toxi-MAT-15 Calibration Standard

62 Minor Components

List of Components

- Acetone
- Benzene
- Benzyl chloride
- Bromoform
- Bromodichloromethane
- 1,3-Butadiene
- 2-Butanone (MEK)
- Carbon disulfide
- Carbon tetrachloride
- Chlorobenzene
- Chloroform
- Cyclohexane
- Dibromochloromethane
- 1,2-Dibromoethane (Ethylene dibromide)
- m-Dichlorobenzene (1,3)
- o-Dichlorobenzene (1,2)
- p-Dichlorobenzene (1,4)
- Dichlorodifluoromethane (Freon 12)
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethylene
- cis-1,2-Dichloroethylene
- trans-1,2-Dichloroethylene
- 1,2-Dichloropropane
- Cis-1,3-Dichloropropene
- Trans-1,3-Dichloropropene
- 1,2-Dichlorotetrafluoroethane (Freon 114)
- 1,4-Dioxane
- Ethanol
- Ethyl acetate
- Ethyl chloride (Chloroethane)
- Ethylbenzene
- 4-Ethyltoluene (p-ethyltoluene)
- Heptane
- Hexane
- 2-Hexanone (MBK)
- Hexachloro-1,3-Butadiene(Hexachlorobutadiene)
- 4-Methyl-2-Pentanone (MIBK)
- Methyl bromide (Bromomethane)
- Methyl chloride (Chloromethane)
- Methylene chloride
- MTBE
- 2-Propanol
- Propylene
- Styrene
- 1,1,2,2-Tetrachloroethane
- Tetra Chloroethylene
- Tetrahydrofuran
- Toluene
- 1,2,4-Trichlorobenzene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethylene
- Trichlorofluoromethane (Freon 11)
- 1,1,2-Trichlorotrifluoroethane (Freon 113)
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Vinyl acetate
- Vinyl chloride
- m-Xylene
- o-Xylene
- p-Xylene

- **Balance VOC Free Nitrogen**

Sizes: 1l: 130 ft³, 2l: 69 ft³, 3l: 26 ft³, 6l: 3.64 ft³
Concentrations: 1 ppm

Toxi-MAT-15 Subset Mixture for EPA Method TO-15

List of Components

- Acetonitrile
- Acrylonitrile
- Benzyl Chloride
- Bis(2-chloroethyl) ether
- Bis(chloromethyl) ether
- 1,3-Butadiene
- 3-Chloroprene
- Ethyl acrylate
- Ethyl bromide
- Hexane
- Methanol
- Methyl ethyl ketone (2-Butanone or MEK)
- Methyl isobutyl ketone (4-Methyl-2-Pentanone or MIBK)
- Methyl methacrylate
- 2,2,4-Trimethylpentane
- 2,3,4-Trimethylpentane
- Vinyl acetate
- Vinyl bromide

- **Balance VOC Free Nitrogen**

Sizes: 1I: 130 ft³, 2I: 69 ft³, 3I: 26 ft³, 6I: 3.64 ft³
Concentrations: 1 ppm

For more information on how MATHESON can provide you with stable, precision blended TO-14, 15, and Ozone Precursor Standards, please call us at 1-800-416-2505.

Equipment Technology Center
166 Keystone Drive
Montgomeryville, PA 18936
Tel: 800-416-2505 Fax: 215-619-0458
Email: info@mathesongas.com
www.mathesongas.com
Printed in USA TB363 R04/12

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