# ULTRARAE BUTADIENE-SPECIFIC MEASUREMENTS

1,3-Butadiene (BDE), with a low OSHA 8-hour PEL of 1.0 ppm, is used in large quantities in manufacturing polymers (rubber and plastics). In these processes, other solvents and organic vapors are often present (Styrene and acrylonitrile are used with butadiene to make ABS plastic and hexane or other compounds as a solvent). The exposure limit of butadiene is so low that its concentration alone usually defines the toxicity level of the vapors. Due to butadiene's carcinogenic nature, it is important to measure these low concentrations of butadiene (often ≤1 ppmv) in the presence of much higher concentrations (tens to hundreds of ppmv total) of other VOCs.

## SPECIFIC BUTADIENE MEASUREMENTS (OR METHYL BROMIDE OR VINYL CHLORIDE WITH A 10.6 EV LAMP)

RAE-Sep™ butadiene tubes scrub most organic vapors except butadiene and other short chain hydrocarbons. This is accomplished partly through a proprietary adsorption medium in the tubes. Further selectivity is afforded by using a 9.8 eV lamp, which responds strongly to butadiene but not at all to acrylonitrile and very weakly to common hydrocarbon solvents. Table 1 shows the response of the combined system to various challenge gases.

**Note:** This system is not designed for use where butenes may be present, such as in some in refinery processes.

## MEASUREMENT PROCEDURE

A separate tube is used for each measurement. The instrument is calibrated using a 5 ppm butadiene standard. When ready to measure, a clean RAE-Sep tube is opened, inserted into the UltraRAE and the start button pushed. A pump draws in the air sample at about 450cc/min. and the unit automatically fixes the display and logs the value after 75 seconds. The final value is an average of the concentration over the 75-second sampling period in the 600cc sample.

### Tube Capacity & Matrix Effects

There is virtually no effect of humidity on the capacity of RAE-Sep butadiene (polymer) tubes. Temperature affects the tube capacity and sampling time. The recommended measurement times at different temperatures are currently under evaluation. We suggest sampling times of 50 seconds at 40° C (104° F) and 100 seconds at 0° C (32° F).

### Linearity & Accuracy

Figure 1 shows the linearity of the butadiene response in the presence of 100 ppm n-hexane. The correlation coefficient ($r^2$) for the line is >0.99. This excellent linearity allows the use of a fast and simple single-point calibration. The resolution of the instrument is 0.1 ppm. The accuracy depends on the ambient conditions and amount of interferences. For standard butadiene vapors alone, the accuracy is ±0.2 ppm or ±15% of the reading, whichever is larger.

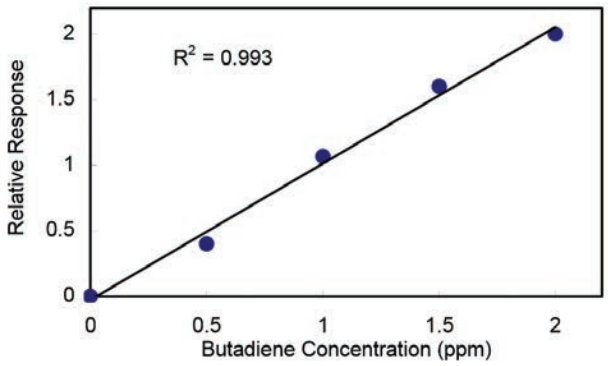


**Figure 1. Linearity of butadiene response added to 100 ppm of n-hexane in air.**

**Table 1. Response to potential butadiene interferences.**

| Compound | Concentration (ppmv)* | Apparent Butadiene Response |
|---|---|---|
| Acrylonitrile | 100 | 0.0 |
| Styrene | 100 | 0.0 |
| Ethylbenzene | 200 | 0.0 |
| Toluene | 100 | 0.2 |
| Toluene | 200 | 2 |
| Benzene | 10 | 0.3 |
| Benzene | 100 | 7 |
| Methane | 25,000** | 0.0 |
| Methyl Bromide | 5 | 3# |
| Propane | 1000 | 0.0 |
| Isobutane | 100 | 0.0 |
| Isobutylene | 50 | 40 |
| n-Hexane | 200 | 0.0 |
| Cyclohexane | 50 | 0.5 |
| Methyl salicylate | 100 | 0.1 |
| Vinyl Chloride## | 40 | 17 |
| 1,2-Dichloroethane | 40 | 0 |
| Vinylidene Chloride | 40 | 20 |
| Trichloroethylene | 40 | 0 |
| Perchloroethylene | 40 | 0 |

* Not necessarily the maximum allowable concentration.

** Methane above 1% by volume reduces the PID response but has no effect on tube capacity. Butane and higher hydrocarbons reduce tube capacity.

# Methyl bromide can be measured using a 10.6 eV lamp and a 60-second sampling time at room temperature. Adjust time at other temperatures proportionately.

## Vinyl chloride can be measured using a 10.6 eV lamp and a 30-second sampling time at room temperature. Adjust time at other temperatures proportionately. 1,2-DCA, TCA, TCE, and PCE do not interfere. 1,1-DCE gives about a 30% cross-sensitivity to the vinyl chloride measurement.