

COMPARISON OF SELECTED LOWER EXPLOSIVE LIMIT METERS USED BY USAF AND COMMERCIAL JET FUEL TANK ENTRY PERSONNEL. P. Jensen, S. Martin, NIOSH, Morgantown, WV; M. Sapko, C. Lazzara, K. Mura, NIOSH, Pittsburgh, PA; L. Smith, D. Fritts, B. Blazicko, J. Reichert, U.S. Air Force, Institute for Environment Safety and Occupational Health Risk Analysis, Brooks AFB, TX; J. Pleil, U.S. Environmental Protection Agency, Research Triangle Park, NC

Thousands of military personnel and tens of thousands of civilian workers perform tank entry procedures. OSHA regulations (§1910.146) require the internal atmosphere be tested with a calibrated direct-reading instrument for oxygen content, flammable gases and vapors, and potential toxic air contaminants before an employee enters the space. The U.S. Air Force and NIOSH previously identified the highest worker exposures during removal of fire suppressant foam from the fuel tanks of Hercules C-130H aircraft. In addition, the study noted that jet fuel vapor composition changed with time and ventilation.

In this study, lower explosive limit (LEL) meters were challenged with jet fuel vapor from fuel tanks of a C-130H and several commercially available LEL span gases. The three detection technologies were infrared, photoionization, and catalytic bead.

All meters were calibrated in accordance with manufacturer specifications and with manufacturer-supplied calibration gas. All meters were used as provided by the manufacturers except 0.25-inch (ID) Teflon®-lined Tygon® tubing was used in lieu of manufacturer-supplied tubing. A Foxboro TVA 1000B®, with flame-ionization detector (FID), was used to measure total hydrocarbon content of the jet fuel vapor.

Overall, the FID was most sensitive; the photoionization detectors and infrared detector were second. The catalytic beads appeared bifurcated - some were responsive and some were not to vapor compositions after ventilation. After ventilation, the jet fuel vapor composition changes from a C4-C8 dominated vapor to a C9-C12 dominated vapor.

Potentially explosive or unsafe environments might go undetected because the traditional catalytic bead sensors cannot ignite the complete vapor mixture. Thus, some LEL meters may significantly underestimate the explosive potential of jet fuel vapor after the light-end of jet fuel has been removed.

A second major finding of this study was that manufacturer-recommended calibration techniques do not appear to match instrument performance to jet fuel vapor.

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DEVELOPMENT AND VALIDATION OF A DIRECT-READ AIR MONITORING SYSTEM FOR PHOSPHINE. K. Chapman, K. Kirolos, G. Mihaylov, J. Helms, K&M Environmental, Inc., Virginia Beach, VA

The electronics industry has experienced tremendous growth in the past decade, which has led to an increased need for reliable, cost-effective means of monitoring hydride gases, particularly phosphine. A monitoring system consisting of a colorimetric badge and a color standard scale has been developed. The badge uses a sensor specific for the hydride gases. It is highly sensitive to phosphine and it is easy to use.

The user applies the business card-size badge to the breathing zone to begin personal exposure monitoring. The badge indicates the presence of phosphine by forming a gray exclamation mark in a white triangle. The exposure dose can be quantified by sliding the badge into the color comparator and matching the upper half of the exclamation mark with the color standards in the color wheel and reading the exposure dose. The system is capable of detecting 5 ppb/hr, and can quantify exposures from 5 ppb/hr to 1000 ppb/hr.

The badge was tested at humidities ranging from 10% to 85%, temperatures ranging from 10°C to 40°C, and face velocities ranging from 5 cm/sec to 168 cm/sec. To verify the selectivity, the badge was exposed to alcohols, aldehydes, aliphatic and aromatic solvents, chlorinated hydrocarbons, hydrochloric acid, chlorine, hydrogen sulfide, and sulfur dioxide. None of these substances reacted with the sensor. Arsine, stibine, and mercury formed color changes at different sensitivities.

Under ambient conditions, the system showed a mean coefficient of variation (MCV) of 15.4 and a mean bias of 0.27%.

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VALIDATION STUDY OF A PASSIVE ORGANIC VAPOR MONITOR (OVM) FOR ACRYLONITRILE. G. Mihaylov, K. Kirolos, K. Chapman, J. Helms, K&M Environmental, Inc., Virginia Beach, VA

Monitoring of acrylonitrile vapors in the workplace has been a challenge to industrial hygienists. The use of an air sampling pump and charcoal tube under harsh environmental conditions can be restrictive and impractical. The main objective of this study was to validate an OVM using a protocol based on the NIOSH Protocol for the Evaluation of Passive Monitors to provide the user with a fully validated method for monitoring acrylonitrile in the workplace. The protocol includes the determination of the sampling rate, desorption efficiency, reverse diffusion, and storage stability.

In this study, TraceAir OVM-1® and OVM-2® badges were used because of their high sampling rate (OVM-1) and their high capacity by means of a back-up section (OVM-2). All experiments were conducted in a dynamic generating system at a fixed relative humidity of 80% and temperature of 25°C. The system was calibrated with a gas chromatograph. The tested concentrations ranged from 0.1 ppm to 4 ppm. The exposure time ranged from 15 minutes (STEL) to 17 hours.

The results show a mean coefficient of variation (MCV) of ± 4.06 and a mean bias of 0.33%. DE studies showed an average of 80%. The sampling rate was determined to be 42.15 cc/min. Reverse diffusion data show biases within $\pm 6\%$ and the storage stability showed a bias of $\pm 4\%$ after one-month refrigeration. The OVM proved reliable for acrylonitrile monitoring in the workplace.

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ISOCYANATE ROUND ROBIN PROFICIENCY TEST PROGRAM FEATURING THE NEW DUAL FILTER METHOD (ISO-CHEKâ). J. Lesage, L. Richard, C. Ostiguy, IRSST, Montréal, Québec, Canada; E. Smyrloglou, Omega Specialty Instrument Co., Chelmsford, MA

A method for measuring separate vapor and aerosol fractions of diisocyanate monomers and oligomers has been published by the IRSST and is the subject of the ASTM D-5932 Standard and the proposed D-Z6452Z and D-Z6451Z standards. In

order to provide multiple laboratory quality assurance data in support of these ASTM standards, 12 laboratories in three countries were invited to participate in a round robin to evaluate spiked samples of vapor and aerosol of the four most common isocyanates: 2,4-toluene diisocyanate, 2,6-toluene diisocyanate, hexamethylene diisocyanate, and methylene di-p-phenyl diisocyanate.

The spiked samples were prepared at the IRSST using MAMA derivatives synthesized as part of the IRSST QC program. In the case of oligomers, the filters were spiked with pure generic oligomer containing both monomer and oligomer fractions and derivatized according to the field derivatizing protocol. These spiked samples were sent to all participants. Some participants chose not to analyze for oligomers.

Two levels of spikes around 0.25 TLV and 1 TLV for each monomer were chosen for the vapors and one for the aerosols around 40 µg for HDI and 70 µg for MDI. All vapor samples were pure monomer; aerosol samples included monomer and oligomers. Results were statistically evaluated according to the AIHA PAT program protocol. The true value was considered to be the mean of all participating laboratories, and the upper and lower limits were based on Z scores. The 12 laboratories have shown proficient data. Most of the tests were lower than 0.25 relative standard deviation (RSD).

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USE OF THE RESULTS OF THE PAT PROGRAM IN A QUALITY ASSURANCE CONTEXT. C. Dion, D. Drolet, P. Lariviere, IRSST, Montréal, Québec, Canada

The purpose of participating in an interlaboratory exchange program is to compare ourselves to other laboratories and to improve our analytical procedures. Statistical analysis of results from these interlaboratory programs must permit their integration to our quality assurance procedures.

Since round 132, AIHA has implemented the following modifications: the reference value is now calculated taking into account the results of all laboratories, and the relative standard deviation (RSD) limits of 4% and 20% are assigned if the real RSD is out of this range. These changes have had certain repercussions on our laboratory as well as on overall participants.

For asbestos, when results are compiled in function of the fiber type, we note that for chrysotile, the percentage of the outlier laboratories has increased from an average of 7.1% (rounds 126-131) to 15.7% (rounds 132-138). Difficulties in the counting of fine fibers of chrysotile can explain these results. The use of all results to set the reference value can force a negative bias that leads a proficient laboratory to have individual results higher than the reference value.

For metals, the RSDs have always been relatively low. The consequence of the 4% RSD attribution has been to lower the average percentage of outlier laboratories from 8.6% to 6.9%. In round 134, empirical RSDs were assigned for solvents without taking into account the concentration levels. For the less concentrated sample, 16.5% of the laboratories are outliers. This may be explained partly by using the same analytical method for simultaneous analysis of the three solvents.

These observations, associated with our participation in other QC programs for asbestos, led us to question ourselves on the use of results from only one program in evaluating our analytical methods.

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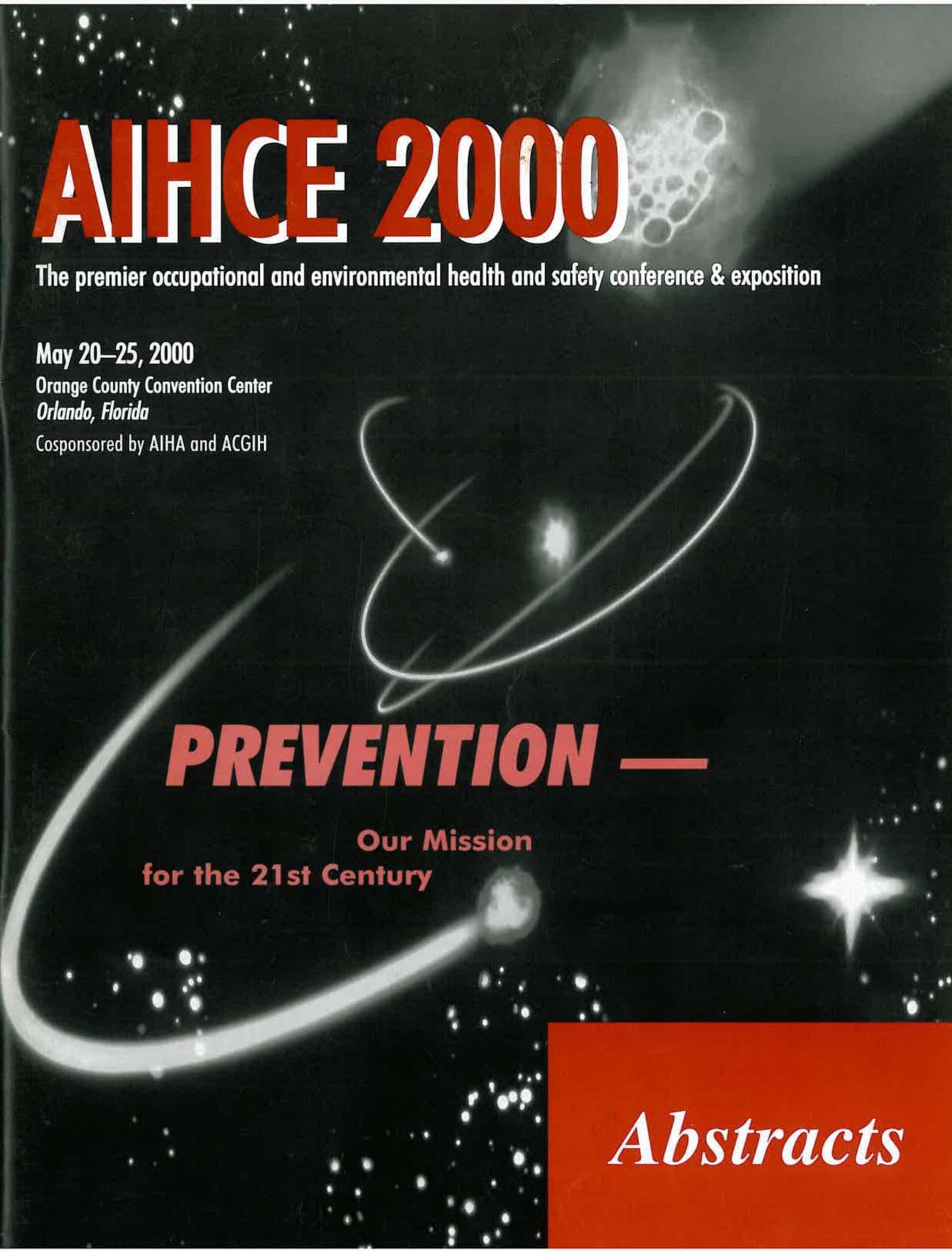


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