CDC Workplace Safety and Health™

NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2004-0101-2953
Transportation Security Administration
Baltimore-Washington International Airport (BWI)
Linthicum, Maryland

January 2005

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Mark M. Methner, Lisa J. Delaney, and Randy L. Tubbs of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies. Analytical support was provided by DataChem Laboratories and Ardith Grote of Division of Applied Research and Technology. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

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For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Highlights of the NIOSH Health Hazard Evaluation

Evaluation of exposure to contaminants and noise in the checked bag screening area

In April and July 2004, NIOSH conducted a health hazard evaluation at the Baltimore-Washington International (BWI) Airport Transportation Security Administration (TSA) baggage screening area. We measured levels of air contaminants and noise in the passenger baggage screening area.

What NIOSH Did

- We took air samples for carbon monoxide, oxides of nitrogen, diesel exhaust, and hydrocarbons.
- We measured noise levels.
- We talked with employees about their health concerns and work area.

What NIOSH Found

- On average, exposures to carbon monoxide, diesel exhaust, oxides of nitrogen, and hydrocarbons were within recommended levels.
- The noise exposures were within acceptable limits.
- Airline tugs can run on several different types of fuel sources, so air quality may be altered by products of combustion other than diesel exhaust.
- Airline employees often leave tugs idling when not in use, which could unnecessarily increase air contaminants.

What the TSA Employees Can Do

- Keep work areas free of debris.
- Report loud noise sources to TSA management.

What TSA Managers Can Do

- Work with airlines to make sure tugs are maintained and kept in good running order so that emissions are reduced.
- Work with airlines to make sure they train employees to turn off tugs when loading/unloading baggage near the screening areas.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2004-0101-2953

Health Hazard Evaluation Report 2004-0101-2953
Transportation Security Administration-Baltimore-Washington International Airport
Linthicum, Maryland
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SUMMARY

On January 21, 2004, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the Transportation Security Administration (TSA) at the Baltimore-Washington International Airport (BWI) in Linthicum, Maryland. The HHE request concerned potential health hazards among TSA workers in the "checked" baggage screening areas from exposure to contaminants found in exhaust emissions of tug and jet engines and noise from tugs, jets, conveyor systems, and baggage carousels in the checked baggage screening area. Reported health problems included respiratory distress, dizziness, possible hearing loss, and headaches. An initial site visit was made on April 1, 2004. On July 15-16, 2004, NIOSH investigators conducted area and personal breathing zone (PBZ) air samples for carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO), diesel exhaust particulate (measured as elemental carbon [EC]), and volatile organic compounds (VOCs). Full-shift personal noise monitoring was also conducted.

Concentrations of EC, a surrogate for diesel exhaust, ranged from 4 micrograms per cubic meter ($\mu g/m^3$) to 24 $\mu g/m^3$ with an airport-wide average of 11 $\mu g/m^3$. There is no NIOSH evaluation criterion for EC; however, the California Department of Health Services recommends keeping exposure levels below 20 $\mu g/m^3$. PBZ concentrations of NO_2 and NO ranged from "trace" to 0.19 parts per million (ppm). Area air samples of NO_2 and NO collected in the vicinity of workers ranged from "trace" to 0.13 ppm. Non-detectable NO_2 results (<0.1 ppm) were obtained from real time personal exposure monitors (full-shift and 15-minute short-term exposures) and were in agreement with the other method used to measure NO_2 exposure. PBZ exposure for CO ranged from non-detectable (<0.1 ppm) to 2 ppm (full-shift Time-Weighted Average [TWA]) and from non-detectable to 3 ppm (15-minute short-term exposures). Instantaneous peak values ranged from 2 to 221 ppm. Exposure to VOC's, including isopropanol and toluene, were very low.

Noise dosimetry results indicated no appreciable risk for occupational noise induced hearing loss at BWI. However, a few areas (i.e., Air Tran and Delta) do have noise levels that are high enough to warrant further evaluation.

The NIOSH investigators determined that a hazard does not exist from exposure to EC, CO, CO_2, NO_2, NO or VOCs. The sampling results indicate that, on average, none of the exposures exceeded occupational exposure limits. The measured noise levels provide little evidence of a serious noise problem. Recommendations for maintaining the air quality and further reducing noise exposures are provided in the Recommendations Section of this report.

Keywords: 4581 (Airports, Flying Fields, and Terminal Services) diesel exhaust, nitrogen dioxide, nitric oxide, carbon monoxide, noise, airport, screeners, TSA, respiratory, dizziness, headache, hearing loss.

Table of Contents

INTRODUCTION

On January 21, 2004, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Transportation Security Administration (TSA) to conduct a health hazard evaluation (HHE) at the Baltimore-Washington International Airport (BWI) in Linthicum, Maryland. The request specifically asked NIOSH to evaluate health hazards from exposure to contaminants found in the emissions of tug and jet engines and to evaluate the noise levels generated from tugs, jets, conveyor belts, and baggage carousels in the checked baggage screening area. The request indicated that some employees have experienced health problems possibly related to the work environment, including respiratory distress, dizziness, possible hearing loss, and headaches. In response to this request, NIOSH investigators conducted an initial site visit on April 1, 2004 and on July 15-16, 2004, collected area and personal breathing zone (PBZ) air sampling for carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO), diesel exhaust (measured as elemental carbon [EC]), and volatile organic compounds (VOCs). Noise monitoring was also conducted.

BACKGROUND

BWI began operations in 1950 and is currently operated by the Maryland Aviation Administration, which is part of the Maryland Department of Transportation. The airport covers approximately 3600 acres and accommodates both domestic and international flights. The passenger terminal covers 1.4 million square feet, has 69 gates, and consists of 4 concourses. BWI services 55 carriers and averages 648 flights per day. In 2003, approximately 54,000 passengers were processed each day. The largest carrier at the airport is Southwest Airlines. BWI is considered the 24th busiest airport in North America (based on annual passenger load).

On November 19, 2001, the Aviation and Transportation Security Act (ATSA) [49 CFR[1] Parts 1500 et al.], which established TSA within the Department of Transportation, was signed into law. The law required TSA to hire and train federal security employees to inspect all passengers and property for explosives and incendiaries before boarding and loading onto the airplane. This rulemaking transferred the Federal Aviation Administration rules governing civil aviation security to TSA. A deadline of December 31, 2002, was established for airports and TSA to implement this law. The TSA employees at BWI began screening both passengers and baggage in December 2002.

Approximately 120 full- and part-time screeners are employed by TSA at BWI. Full-time employees work an 8-hour shift while part-time employees work a 4-hour shift. Checked passenger bags are screened in 7 different areas, corresponding to the airline location within each concourse. The baggage screening areas that were evaluated were: Delta, Southwest, United, Air Tran, Northwest, U.S. Air, and the International terminal. Bags checked by passengers at the ticketing counter are brought to the baggage area via conveyor belts. The conveyor belts deposit bags onto carousels where TSA employees manually load them onto a belt-driven conveyor that routes each bag through an Explosive Detection System (EDS) machine. Some bags undergo additional testing using an Explosive Trace Detection (ETD) system. After examination the bags are loaded onto another carousel where airline personnel transfer the bags to carts attached to tugs for transport to the aircraft. On a daily basis, a large number of bags are handled and screened during "push" time periods when numerous flights from various airlines are scheduled to depart the airport within a narrow timeframe. It is during these times that tug traffic and the potential for exposure is highest.

All of the baggage screening areas use L3 3DX™ 6000 EDS machines. During the days NIOSH conducted air and noise sampling, BWI screened approximately 42,000 "checked" passenger bags. The baggage area was originally designed as a location for airline employees to pick up and drop off checked passenger bags using ground service tugs. Large, pedestal-mounted fans were present at each L3 machine to increase air movement and provide comfort to workers in the bag screening area. General exhaust ventilation is provided in each of the baggage screening areas.

Each airline is responsible for maintaining and operating its own tugs. The fuel source powering the tugs varies by airline but includes diesel, gasoline, propane, and electric.

METHODS

Upon receipt of the HHE request, additional information regarding suspected environmental contaminants was obtained from the TSA Occupational Safety and Health manager and local TSA-BWI management. During the initial site visit and subsequent telephone conversations with management and employees, an overview of the operation and layout of each of the baggage screening areas was obtained. Based on this information, the following air monitoring strategy was developed. Baggage screening areas were selected based on their anticipated baggage load for the day and the number of workers expected to occupy each area (i.e., screening areas with the most baggage and workers). Prior to each shift, workers were asked to volunteer to wear the various sampling devices.

Diesel Exhaust (Elemental Carbon)

Full-shift PBZ samples for elemental carbon (EC), a surrogate for diesel exhaust particulate, were collected on 37 millimeter quartz fiber filters (closed face) using SKC® AirChek® 2000 sampling pumps. Eight screeners were monitored on July 15, 2004, and nine screeners were monitored on July 16, 2004. Flow rates of approximately 2.5 liters per minutes (Lpm) were used to obtain the samples. The sampling pumps were calibrated before and after each sampling event against a primary standard (BIOS® Dry-Cal) to verify flow rate. The filters were placed as close as possible to the workers' breathing zone and connected via Tygon® tubing to the sampling pump. Screeners wore the sampling pump and filter for the entire work shift. After collection, the samples were sent to the NIOSH contract laboratory (DataChem, Salt Lake City, Utah) and analyzed in accordance with NIOSH Method 5040.[2] With this technique, a representative punch out of the filter is heated and analyzed with a thermal optical analyzer.

Nitrogen Dioxide (NO_2) and Nitric Oxide (NO)

Full-shift PBZ samples for NO_2 and NO were collected on sorbent tubes containing oxidizer plus a triethanolamine-treated molecular sieve in tandem using SKC® Pocket Pumps®. Six screeners were monitored on the first day of sampling and three were monitored the second day. Four area samples were collected for NO_2 and NO on the first day of sampling followed by 5 area samples collected on the second day. Flow rates of approximately 0.050 Lpm and 0.20 Lpm were used to collect the PBZ and area samples, respectively. Each sampling pump was calibrated before and after each sampling event against a primary standard (BIOS® Dry Cal) to verify flow rate. The sorbent tubes were placed as close as possible to the workers' breathing zone and connected via Tygon® tubing to the sampling pump. Screeners wore the sampling pump and filter for the entire work shift. After collection, the samples were sent to the NIOSH contract laboratory (DataChem, Salt Lake City, Utah) and analyzed in accordance with NIOSH Method 6014. Quantification was achieved via visible absorption spectrophotometry.[2]

In addition to sorbent tube sampling, NO_2 concentrations were measured using the Biosystems Toxilog Ultra®, a direct reading instrument equipped with electrochemical sensors that record and store average exposure, maximum 15-minute short-term exposure, and maximum peak exposure. These instruments were operated in a passive diffusion mode with a 30-second sampling interval. They were clipped to the belt of each worker for personal monitoring and worn for the entire work shift. Three screeners were monitored on each day of sampling. Stored data were downloaded to a laptop computer after sampling. Calibration of these monitors was accomplished before and after sampling according to the manufacturer's specifications.

Carbon Monoxide (CO)

Carbon monoxide exposures were evaluated using two types of instrumentation: the Biosystems Toxilog Ultra® and the Q-TRAK® Plus indoor air quality (IAQ) monitor model 8552/8554. The Toxilog Ultra® is a real-time, data-logging, passive CO monitor that logs average exposures, maximum 15-minute short-term exposures, and maximum peak exposures. These instruments were operated in a passive diffusion mode with a 30-second sampling interval. Seven personal samples were collected each day of sampling. Personal samples were collected by attaching the instrument to the belt of each worker. All monitors operated for the entire work shift.

The Q-TRAK® device measures CO in real-time and these measurements were compared with those from the Toxilog Ultra® device to ensure both devices were operating correctly. Instantaneous measurements of CO were taken throughout the baggage area at various times during the work shift. Instrument calibration for both the Toxilog Ultras and the Q-TRAK was completed according to the manufacturers' recommendations. A total of 34 measurements were taken during the two days of sampling.

Volatile Organic Compounds (VOCs)

Area air samples to screen for VOCs were collected on both days of sampling. The samples were collected on thermal desorption (TD) tubes attached by Tygon® tubing to SKC® Pocket Pumps® calibrated at a flow rate of 0.05 Lpm. The TD tubes, used for qualitative identification of VOCs, contain three beds of sorbent material: a front layer of Carbopack Y™, a middle layer of Carbopack B™, and a back section of Carboxen 1003™. The TD tubes were analyzed by the NIOSH laboratory in a Perkin-Elmer ATD 400 automatic thermal desorption system. The thermal unit was interfaced directly to an HP5890A gas chromatograph with an HP5970 mass selective detector according to the NIOSH method 2549.[2]

To analyze specific VOCs, (based on the results of the TD samples), full-shift area air samples were collected on charcoal tubes attached by Tygon® tubing to SKC® Pocket Pumps® calibrated at a flow rate of 0.2 Lpm. Charcoal tube samples were collected simultaneously, in a side-by-side configuration, with the TD tubes. Three area air samples, in different locations, were collected each day of sampling. The charcoal tubes were sent to DataChem Laboratories, Inc. (Salt Lake City, Utah) to be quantitatively analyzed for hydrocarbons of interest (identified on the TD tubes) using a Hewlett-Packard model 5890A gas chromatograph equipped with a flame ionization detector according to NIOSH methods 1300, 1400, 1501, and 1550 with modifications.[2]

Noise

TSA employees were selected to wear noise monitoring devices at the beginning of their work shift on each of the two days of sampling at BWI. NIOSH investigators chose workers from six baggage screening areas, Air Tran, Delta, Southwest, United, U.S. Air, and the International terminal, to represent the TSA screeners assigned to these areas during the two survey days. The employees wore the meters for the entire work shift. Area noise measurements were taken around the EDS screening machines in many of the area where employees worked. The analyzer was placed on a tripod with the microphone located at ear level for a standing employee in each of the tested areas.

Quest® Electronics Model Q-300 Noise Dosimeters were used to collect the daily noise exposure measurements from the employees volunteering to be in the NIOSH evaluation. The Quest dosimeters collect data so that one can directly compare the information with the three different noise criteria used in this survey, the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) and Action Level (AL), and the NIOSH Recommended Exposure Limit (REL). The dosimeter was secured on the worker's belt and the dosimeter's microphone attached to their shirt, halfway between the collar and the point of their shoulder. A windscreen provided by the manufacturer of the dosimeter was placed over the microphone during recordings. The noise information was downloaded to a personal computer for interpretation with QuestSuite® Professional computer software and the dosimeters reset for the next day. The dosimeters were calibrated before and after the work shift according to the manufacturer's instructions.

The spectral area noise measurements were made with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559 ½" random incidence response microphone. The analyzer allows for the analysis of noise into its spectral components in a real-time mode. The ½"-diameter microphone has a frequency response range (± 2 decibels [dB]) from 4 Hertz (Hz) to 21 kilohertz (kHz) that allows for the analysis of sounds in the region of concern. One-third octave bands consisting of center frequencies from 25 Hz to 20 kHz were integrated for 30 seconds and stored in the analyzer for later analysis for the baggage screening areas.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criteria. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH RELs,[3] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[4] and (3) the OSHA PELs.[5] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Diesel Exhaust (Elemental Carbon)

Diesel engines function by combusting liquid fuel without spark ignition. Air and fuel are introduced into the combustion chamber and ignition is accomplished by the heat of compression. The emissions from diesel engines consist of a complex mixture, including gaseous and particulate fractions. The composition of the mixture varies greatly with fuel and engine type, load cycle, maintenance, tuning, and exhaust gas treatment. The gaseous constituents include carbon dioxide, sulfur dioxide (SO_2), CO, NO, NO_2, and VOCs (e.g., ethylene, formaldehyde, methane, benzene, phenol, acrolein, and polynuclear aromatic hydrocarbons).[6,7,8,9] The particulate fraction (soot) is composed of solid carbon cores, produced during the combustion process, which tend to combine to form chains of particles or aggregates, the largest of which are in the respirable range (more than 95% are less than 1 micron in size).[10] Estimates indicate that as many as 18,000 different substances resulting from the combustion process may be adsorbed onto these particulates.[11] The adsorbed material contains 15B65% of the total particulate mass and includes compounds such as polynuclear aromatic hydrocarbons, a number of which are known mutagens and carcinogens.[4,5,12,13]

Many of the individual components of diesel exhaust are known to have toxic effects. The following health effects have been associated with some of the components of diesel exhaust: (1) pulmonary irritation from oxides of nitrogen; (2) irritation of the eyes and mucous membranes from SO_2, phenol, sulfuric acid, sulfate aerosols, and acrolein; and (3) cancer in animals from polynuclear aromatic hydrocarbons. Several studies confirm an association between exposure to whole diesel exhaust and lung cancer in rats and mice.[5] Limited epidemiological evidence suggests an association between occupational exposure to diesel exhaust emissions and lung cancer.[14] The agreement of current toxicological and epidemiological evidence led NIOSH in 1988 to recommend that whole diesel exhaust be regarded as a Apotential occupational carcinogen,@ as defined in the OSHA=s Cancer Policy (AIdentification, Classification, and Regulation of Potential Occupational Carcinogens,@ 29 CFR 1990).[5] Accordingly, NIOSH recommends that exposures be controlled to the lowest feasible concentration. Although OSHA and ACGIH have exposure limits for some of the individual components of diesel exhaust (i.e., NO_2, xylene, and CO), exposure limits have not been established for whole diesel exhaust. The California Department of Health Services' Hazard Evaluation System & Information Service (HESIS) recommends exposures to diesel exhaust particles (measured as EC) be kept below 20 micrograms per cubic meter (µg/m^3). This value was based on a risk assessment performed by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment that determined exposures to diesel particulate of 20 µg/m^3 over a working lifetime would create an excess lung cancer risk of one in a thousand.[15]

Nitrogen Dioxide (NO_2)

Nitrogen dioxide gas is an irritant to the mucous membranes and its inhalation may cause severe coughing, which can be accompanied by mild or transient headache. The following health effects were observed in humans exposed to NO_2 for 60 minutes: at 100 ppm, pulmonary edema and death; at 50 ppm, pulmonary edema, with possible subacute or chronic lesions in the lungs; and, at 25 ppm, respiratory irritation and chest pain.[16,17] The effects of chronic low exposures are not well characterized in humans, but NO_2 would be expected to have an irritant effect upon the general mucosal surfaces and on the lower respiratory tract.[16] Chronic exposures to 0.2 ppm with daily excursions to 0.8 ppm in mice were shown to cause decreased pulmonary function. This gas has not been shown to have teratogenic, mutagenic, or directly carcinogenic effects.[17] The NIOSH REL for NO_2 is 1 ppm as a 15-minute STEL.[3] The OSHA ceiling concentration is 5 ppm.[5] The ACGIH TLV-TWA is 3 ppm and the TLV-STEL is 5 ppm.[4]

Nitric Oxide (NO)

Nitric oxide is a colorless gas that converts spontaneously in air to NO_2. Since this oxidation rate occurs more rapidly at higher NO concentrations, it is often difficult to identify the effects of NO exposures without considering the concomitant effects of NO_2.[18] NO is a component of photochemical smog with ambient air concentrations reaching as high as 2.65 ppm.[19] The most common occupational exposures to NO occur when it is formed as a by-product in the preparation of nitrosylcarbonyls and nitric acid, tobacco smoke, and from combustion of propane, diesel, and gasoline engines.[16] In humans exposed to NO between 10 ppm and 40 ppm, significant lung vasodilation effects were observed.[17] A comparative analysis of inhaled and exhaled breath in humans after exposure to NO at concentrations of 5, 1, 0.5, and 0.33 ppm showed 85% to 93% retention in the body.[18]

Animal studies indicate that NO has an affinity for ferrous hemoglobin, which normally transports oxygen in the blood. The two substances react to form nitrosyl hemoglobin, a compound that is incapable of oxygen transport.[18] This toxic action resembles that of CO. Exposures to mice to 5000 ppm for 6 to 8 minutes and to 2500 ppm for 12 minutes were lethal.[17]

Both NIOSH and OSHA have established a TWA exposure criterion of 25 ppm for NO.

Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless, tasteless gas produced by incomplete burning of carbon-containing materials such as gasoline or propane fuel. The initial symptoms of CO poisoning may include headache, dizziness, drowsiness, and nausea with symptoms advancing to vomiting, loss of consciousness, and collapse if prolonged or high exposures are encountered. If the exposure level is high, loss of consciousness may occur without other symptoms. Coma or death may occur if high exposures continue.[4,17,20,21,22,23] The display of symptoms varies widely from individual to individual, and may occur sooner in susceptible individuals such as young or aged people, people with preexisting lung or heart disease, or those living at high altitudes.

The NIOSH REL for CO is 35 ppm for an 8-hour TWA exposure, with a ceiling limit of 200 ppm which should not be exceeded.[20,18] The ACGIH recommends an 8-hour TWA TLV of 25 ppm.[4] The OSHA PEL for CO is 50 ppm for an 8-hour TWA exposure.[5] The immediately dangerous to life or health concentration (IDLH) is 1200 ppm, a level which Aposes a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.@[24]

Volatile Organic Compounds (VOCs)

This is a large class of organic chemicals (i.e., containing carbon) that have a sufficiently high vapor pressure to allow some of the compound to exist in the gaseous state at room temperature. They are emitted in varying concentrations from numerous indoor sources including carpeting, fabrics, adhesives, resins, solvents, paints, cleaners, waxes, cigarettes, and combustion sources.

Noise

Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.[25] While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hz (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.[26]

The A-weighted decibel (dBA) is the preferred unit for measuring sound levels to assess worker noise exposures. The dBA scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dBA scale is logarithmic, increases of 3 dBA, 10 dBA, and 20 dBA represent a doubling, tenfold increase, and hundredfold increase of sound energy, respectively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)[27] specifies a maximum PEL of 90 dBA for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship, or exchange rate. This means that a person may be exposed to noise levels of 95 dBA for no more than 4 hours, to 100 dBA for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dBA is allowed by this exchange rate. The duration and sound level intensities can be combined in order to calculate a worker's daily noise dose according to the formula:

$$\text{Dose} = 100 \text{ X } (C_1/T_1 + C_2/T_2 + ... + C_n/T_n),$$

where C_n indicates the total time of exposure at a specific noise level and T_n indicates the reference duration for that level as given in Table G-16a of the OSHA noise regulation. During any 24-hour period, a worker is allowed up to 100% of his daily noise dose. Doses greater than 100% are in excess of the OSHA PEL.

The OSHA regulation has an additional action level (AL) of 85 dBA; an employer shall administer a continuing, effective hearing conservation program when the 8-hour time-weighted average (TWA) value exceeds the AL. The program must include monitoring, employee notification, observation, audiometric testing, hearing protectors, training, and record keeping. All of these requirements are included in 29 CFR 1910.95, paragraphs (c) through (o). Finally, the OSHA noise standard states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dBA, feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels.

NIOSH, in its Criteria for a Recommended Standard,[28] and the ACGIH,[4] propose exposure criteria of 85 dBA as a TWA for 8 hours, 5 dB less than the OSHA standard. The criteria also use a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dBA for 8 hours, but to no more than 88 dBA for 4 hours or 91 dBA for 2 hours. Twelve-hour exposures have to be 83 dBA or less according to the NIOSH REL.

RESULTS

Air Sampling Results

The results of the air sampling for diesel exhaust (EC) are shown in Table 1. A total of 19 samples (17 PBZ and 2 area) were collected in the different baggage screening areas over the 2 day sampling period. The lowest PBZ concentration of EC was 4 µg/m^3 (Delta) and the highest was 24 µg/m^3 (United). The overall average for all PBZ samples was 11 µg/m^3. The two area air samples were 8 µg/m^3 and 15 µg/m^3 (Air Tran and United, respectively). The minimum detectable concentration (MDC) for the diesel exhaust samples was 0.4 µg/m^3 and was calculated based on the analytical instrument limit of detection (LOD) for EC assuming an average sample volume of 990 liters of air. The minimum quantifiable concentration (MQC) was 0.9 $\mu g/m^3$ and was calculated based on the analytical instrument limit of quantification (LOQ).

The results of the air sampling for NO and NO_2 appear in Table 2. A total of 9 full-shift PBZ samples were collected. Concentrations of NO ranged from "trace" (measurement fell between the MDC and the MQC), to 0.19 ppm, and none exceeded the REL of 25 ppm. All samples collected and analyzed for NO_2 were found to contain very low "trace" amounts, and none approached the TLV TWA of 3 ppm. The MDC for PBZ samples for NO was calculated to be 0.04 ppm assuming an average sample volume of 20 liters of air. The MDC for PBZ samples for NO_2 was calculated to be 0.02 ppm assuming an average sample volume of 20 liters of air.

A total of nine full-shift area air samples for NO and NO_2 were collected in the center of various screening areas. Concentrations of NO ranged from "none detected" to 0.13 ppm, while NO_2 concentrations ranged from 0.03 to 0.10 ppm. The MDC for area air samples for NO and NO_2 was calculated to be 0.01 ppm assuming an average sample volume of 75 liters of air.

NO_2 exposure data collected using the Toxilog Ultra® device appear in Table 3. Full-shift TWA and short-term exposures were all extremely low (0.0 to 0.1 ppm). Instantaneous peak concentrations ranged from 0.3 ppm to 4.4 ppm.

Personal full-shift TWA exposures for CO ranged from 0 ppm to 2 ppm; 15-minute short-term exposures ranged from 0 ppm to 3 ppm. The results from the Toxilog Ultra® sampling for CO are shown in Table 4. Instantaneous peak exposures ranged from 2 ppm to 221 ppm.

Instantaneous measurements of ambient air carbon dioxide (CO_2), CO, temperature, and relative humidity measurements were collected using the Q-TRAK® direct-reading instrument in various areas within the bag screening operation during both days of sampling. Of particular interest was the average CO concentrations collected in the areas occupied by employees because of the hazard associated with exposure to elevated levels of CO. The average values for CO ranged from 0.2 ppm to 7 ppm, with the highest reading taken within the Air Tran screening area. A summary of all measurements, grouped by area, appears in Table 5.

Six full-shift general area air samples for VOCs were collected across the two days of sampling. The predominant VOCs qualitatively identified on the TD tubes and subsequently analyzed quantitatively via charcoal tubes were isopropanol and toluene. Isopropanol concentrations ranged from trace to 0.82 mg/m^3 and toluene ranged from trace to 0.13 mg/m^3. For comparison, the eight-hour ACGIH TLV for these substances are 492 mg/m^3 for isopropanol and 188 mg/m^3 for toluene. A summary of the data collected for these two substances appears in Table 6.

Noise

A total of 14 employees initially volunteered to wear a noise dosimeter for a day. One employee decided against wearing the meter less than one hour into the work shift and the data from this employee were discarded. One of the dosimeters worn by a TSA employee assigned to the Delta baggage screening area failed to record any noise information. Thus, 12 full-shift samples were analyzed and the results are presented in Table 7. All of the tested employee doses were well below the two OSHA evaluation criteria of 100% of the PEL or 50% of the action level. There were two employees in the Air Tran screening area that did exceed the NIOSH REL with noise doses of 203% and 159%, respectively. Two other TSA employees, one working in the Air Tran screening area and one in the Delta screening area, had REL doses of 88% and 97%, respectively.

The real-time noise data for the two employees who exceeded the NIOSH REL are presented in Figures 1 and 2. In both plots, there are one or two, 1-minute periods that exceed 100 dBA. The remainder of the day is generally between

80 and 90 dBA. These high peaks are not observed in the other two graphs (Figures 3 & 4). Also, there is no consistency in the time at which these peaks occurred for the three remaining employees working in the same Air Tran screening area, a finding which rules out the existence of large scale noisy events that would impact the entire work area. Rather, these results suggest noise which is fairly localized to the area where the employees performed their duties.

The area noise samples did not reveal any noteworthy patterns of frequency or intensity. The values measured with the real-time analyzer ranged from 72 to 84 dBA and 78 to 86 dB on the unweighted, sound pressure level (SPL) scale. The quieter values were consistently measured in the International terminal screening area while the louder values were captured in the Air Tran location.

Workplace Information

Environmental control of each baggage screening area relies mainly on general dilution ventilation systems. These systems are thermostatically controlled and rely on 100% outside make-up air to ventilate the baggage screening areas. Additionally, all baggage screening areas have pedestal-type fans to provide comfort during warm periods.

Across airlines, a variety of tugs and fuels are used (gasoline, diesel, propane, electric). Despite a request from TSA to the airlines regarding tug maintenance schedules and records, no information was provided. Also, we observed tugs frequently left idling near TSA screeners while airline employees load and unload bags. This was in spite of the fact that employees reported on the days of our survey that airline employees were more likely than usual to turn off tugs.

Vinyl gloves are available to all employees. Isopropanol is the only chemical used by TSA employees to periodically clean the table tops where manual bag inspection and ETD processing occurs. No formal written hearing protection program is currently in place at the airport.

DISCUSSION

A total of 17 EC samples were collected from the PBZ's of workers on 2 different shifts over 2 days (Table 1). The airport-wide average for EC was 11 µg/m^3. Individual PBZ concentrations of EC ranged from 4 µg/m^3 to 24 µg/m^3. The highest exposure (24 µg/m^3) slightly exceeded the California HESIS recommendation of 20 µg/m^3. This particular employee worked in the United Airlines baggage screening area on Friday afternoon (July 16th). In comparing the average EC values across different baggage screening areas, Northwest Airlines was the highest and the International terminal was the lowest. These average values were consistent, with a relatively narrow range of 7.1 µg/m^3 to 15 µg/m^3. Based on the experience of the NIOSH investigators and compared to other NIOSH diesel exhaust studies, the measured EC levels are not considered unusually high. The variation in exposures to diesel exhaust is likely due to the presence or absence of diesel powered tugs in the area as well as the efficiency and effectiveness of the ventilation systems within each baggage screening area. Also, each airline owns and operates their own tugs and the fuel source varies; therefore, employee exposures may vary depending on their work location.

A total of 9 PBZ samples each for NO_2 and NO were collected on 2 different shifts over 2 days (Table 2). PBZ concentrations measured for NO_2 and NO were found to range from trace to 0.19 ppm. These results are in agreement with the NO_2 results obtained using the real-time Toxilog Ultra® monitors; full-shift and 15-minute short-term exposures were all very low to non-detectable (Table 3). The single Northwest Airlines PBZ sample had the highest concentration measured for NO (0.19 ppm). This measurement, however, is approximately 132 times less than the ACGIH 8-hour TLV of 25 ppm. All PBZ measurements for NO_2 were found to be trace. Area air samples for NO_2 and NO were found to be in the same concentration range as that observed with the PBZ samples. All values were very low.

A total of 14 full-shift CO samples were collected from workers across 2 days. Full-shift TWA exposures ranged from 0 ppm to 2 ppm (Table 4). Peak values ranged from 2 ppm to 221 ppm, with one measurement exceeding the OSHA ceiling limit of 200 ppm. Since the worker wearing this monitor was an admitted cigarette smoker, the cigarette smoke (which contains CO) could have been a contributing factor to his measured exposure. No measurement approached the IDLH value of 1200 ppm and none of the 15 minute STEL measurements exceeded 3 ppm.

Instantaneous ambient air CO concentrations obtained in the different screening areas were in agreement with the Toxilog Ultra® instruments. No substantial difference in average CO concentration was noted across the two days of sampling (1.4 ppm versus 1.3 ppm) (Table 5). The highest instantaneous reading obtained across all baggage screening areas occurred in the Air Tran area (7.1 ppm).

Thermal desorption sampling for a variety of VOC's did not identify any unusual compounds. Full-shift area samples for isopropanol and toluene, the two predominant VOCs, were well below any occupational exposure limits (Table 6).

Throughout the course of this study, environmental variables such as temperature, relative humidity and CO_2 remained fairly constant. Temperatures increased in the afternoon, while relative humidity decreased, as one would expect during the summer season (Table 5).

In general, tug exhaust emissions were considered the primary source of CO in the bag screening area. However, we can not rule out the possibility of a worker taking a break outside the baggage screening area and receiving exposure from other sources such as automobiles, buses, or exhaled cigarette smoke.

Although this air sampling effort does not show an inhalational hazard in the baggage screening area, the potential exists for increased exposure to tug exhaust emissions if the tugs are not properly maintained or if new tugs are purchased that do not procedurally operate under the same conditions of those in the area on the day of the NIOSH survey (e.g., shut off tugs while loading/unloading). TSA management is currently working with the airlines to ensure that each airline is following manufacturer-recommended maintenance procedures for the tugs. Recently, airline employees have been instructed to turn off the tug engines when loading/unloading baggage and to follow all speed limit and driving rules in the area. TSA employees reported that airline employees often leave the tugs idling while loading/unloading bags or when exiting the tug for short durations. Leaving the engine running unnecessarily contributes to increased concentrations of airborne contaminants.

Each baggage screening area is mostly enclosed, with openings to the outside environment via garage-type doorways. Depending on the outdoor environmental conditions, each baggage basement can be naturally ventilated by winds. Alternatively, no wind and/or certain directional wind flow conditions may provide less natural ventilation to these areas. Although mechanical ventilation systems are present in each of the baggage screening areas, the operational efficiency and effectiveness of these systems were not evaluated. The large pedestal-type fans present in each of the screening areas appeared to provide some cooling relief to the workers when the ambient temperature increased. However, the effectiveness of the pedestal-type fans in providing control of airborne contaminants was not directly evaluated.

The baggage screening area for Air Tran was the noisiest location. While none of the dosimeter readings exceeded the OSHA evaluation criteria, two of the three tested employees did exceed the NIOSH REL for noise, with the third employee having one of the higher noise doses which did not exceed the NIOSH criterion. The noise levels in the International terminal screening area and the United Airlines, Southwest

Airlines, and U.S. Air areas had little impact on the TSA employees. The one dosimeter evaluation in the Delta Airlines screening area was one of the higher noise doses that did not exceed the criteria. Because these evaluations were made for only one day in area and because the noise exposures can vary because of baggage load and weather conditions (doors open or closed, etc.), TSA should consider additional noise monitoring to better determine the noise exposures which their employees encounter in their work activities.

None of the TSA employees at BWI were observed wearing hearing protection devices (HPDs) during the NIOSH evaluation. However, if certain screening areas, such as Air Tran, are found to consistently exceed any of the evaluation criteria, then the use of HPDs should be considered as a way to temporarily reduce employee noise exposures while engineering or administrative controls are put into place. Once HPDs are offered to the employees, then NIOSH would recommend that a hearing loss prevention program be put into place that would include employee training, audiometric testing, noise monitoring, and record keeping.

CONCLUSIONS

An inhalational hazard to tug and jet exhaust emissions did not exist at the time of the NIOSH visit. Conditions affecting the results include dilution ventilation achieved via fans and ductwork, as well as the presence of pedestal-type fans. Exposures, however, could increase if tugs are not properly maintained, sit in idle mode for extended periods of time, or if tug traffic increases. Weather conditions may also affect contaminant concentrations in the area. Even though the contaminant levels were below relevant occupational exposure limits, it is important to continue to work with the airlines to ensure that tugs are maintained according to standard operating procedures (e.g., routine engine tune-ups, oil and oil filter changes). Good communication and cooperation with the airlines will help to ensure this is accomplished.

There does not appear to be a risk for occupational noise-induced hearing loss for the TSA baggage screeners at BWI airport. A few of the areas, i.e., Air Tran and Delta, do have noise levels that are high enough to warrant further evaluation of the workers' noise exposures through further dosimeter testing.

RECOMMENDATIONS

1. Implement a procedure for employees to report changes in their work environment to TSA management. These reports, when applicable, could trigger investigations toward correcting any perceived hazard(s). Any results from these investigations should be communicated back to the affected employees in a timely manner.

2. Maintain and operate tugs according to manufacturer service recommendations.

3. Conduct additional noise dosimeter testing in the Air Tran and Delta baggage screening areas to better evaluate workers' exposures.

4. Institute a noise monitoring program for areas that undergo changes which may alter the noise impact on employees or in areas where noise complaints originate.

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Table 1
TSA- Baltimore-Washington International Airport
Personal Breathing Zone and Area Diesel Exhaust (Elemental Carbon) Results (μg/m^3)
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

Location	Number of Samples	Average	Std. Dev.	Minimum	Maximum
Air Tran Baggage	2	9.2	1.6	8.1	10.4
International Baggage	2	7.1	1.4	6.1	8.0
United Baggage	2	14.6	12.8	5.6	23.7
Delta Baggage	2	7.8	5.4	4.0	11.6
Southwest Baggage	6	13.1	2.9	9.6	17.4
US Air Baggage	2	8.7	1.2	7.9	9.6
Northwest Baggage	1	15.4	N/A	N/A	N/A
All PBZ Samples	**17**	**11.1**	**4.9**	**4**	**23.7**
Air Tran (Area)	1	8.0	N/A	N/A	N/A
United (Area)	1	14.6	N/A	N/A	N/A

μg/m^3 = micrograms per cubic meter

Minimum detectable concentration (0.4 μg/m^3)
Minimum quantifiable concentration (0.9 μg/m^3)

Table 2
TSA- Baltimore-Washington International Airport
Personal Breathing Zone (PBZ) and Ambient Air
Nitric Oxide (NO) and Nitrogen Dioxide (NO_2) Results
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

PBZ samples by Location

Location	Nitric Oxide Conc. (ppm)	Nitrogen Dioxide Conc. (ppm)
Air Tran	Trace	Trace
Air Tran	Trace	Trace
Air Tran	Trace	Trace
International	Trace	Trace
United	0.16	Trace
United	Trace	Trace
Southwest	0.18	Trace
Northwest	0.19	Trace
Delta	0.12	Trace
	MDC = 0.04 ppm MQC = 0.12 ppm ACGIH – TLV = 25 ppm OSHA – PEL = 25 ppm NIOSH – REL = 25 ppm	MDC = 0.02 ppm MQC = 0.08 ppm ACGIH – TLV = 3 ppm OSHA – PEL = 5 ppm (Ceiling Limit) NIOSH – REL = 1 ppm (15 minute STEL)

General area air samples by location

Location	Nitric Oxide Conc. (ppm)	Nitrogen Dioxide Conc. (ppm)
Air Tran	Trace	0.06
United	0.10	0.07
United	Trace	0.06
United	0.06	0.03
Southwest	0.08	0.07
Southwest	0.13	0.10
Delta	Trace	0.05
Delta	0.09	0.09
US Air	ND	0.09
	MDC = 0.01 ppm MQC = 0.03 ppm	MDC = 0.01 ppm MQC = 0.02 ppm

ND = None Detected (Measurement was less than the MDC)
MDC = Minimum Detectable Concentration
MQC = Minimum Quantifiable Concentration
Trace = Value was below the MQC, but above the MDC

Table 3
TSA- Baltimore-Washington International Airport
Nitrogen Dioxide (NO_2) Toxilog Ultra® Results (ppm)
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

Date	Time On	Time Off	Location	TWA	STEL	Peak
7/15/2004	5:24 AM	11:35 AM	United	0	0	0.6
	4:51 AM	12:15 PM	Southwest	0	0.1	0.3
	5:44 AM	12:44 PM	Southwest	0	0	1.4
7/16/2004	1:16 PM	8:54 PM	Delta	0	0	0.9
	1:07 PM	8:20 PM	Air Tran	0	0.1	2.5
	1:27 PM	7:53 PM	United	0.1	0	4.4

ppm = parts per million.
TWA = Time-Weighted Average = average airborne concentration of a substance over the sampling period
STEL = Short-term exposure Limit = 15-minute TWA exposure
Peak = Highest measured concentration during the work day

Table 4
TSA- Baltimore-Washington International Airport
Carbon Monoxide (CO) Toxilog Ultra® Results (ppm)
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

Date	Time On	Time Off	Location	TWA	STEL	Peak
7/15/2004	5:44 AM	12:44 PM	Southwest	0	0	2
	5:37 AM	11:55 AM	Air Tran	1	0	18
	5:14 AM	11:59 AM	Northwest	1	1	46
	5:03 AM	12:24 PM	Southwest	0	3	36
	4:45 AM	11:58 AM	Air Tran	1	1	15
	4:51 AM	12:16 PM	Southwest	0	0	15
	5:19 AM	11:36 AM	United	0	3	42
7/16/2004	1:29 PM	7:54 PM	United	1	1	82
	1:01 PM	9:00 PM	Southwest	1	0	195
	1:36 PM	7:56 PM	United	0	0	5
	1:07 PM	8:17 PM	Air Tran	2	0	221
	12:59 PM	8:50 PM	Southwest	1	1	28
	1:48 PM	8:22 PM	Air Tran	0	0	83
	1:21 PM	8:53 PM	Delta	0	0	33

ppm = parts per million
TWA = Time-Weighted Average = average airborne concentration of a substance over the sampling period
STEL = Short-term exposure = 15-minute TWA exposure
Peak = Highest measured concentrations during the work day

Table 5
TSA- Baltimore-Washington International Airport
Environmental Conditions (Airport-wide)
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

Date (7-15-2004)	**CO2 (ppm)**	**CO (ppm)**	**Temp (F)**	**Rel. Hum. (%)**
Average	404	1.4	81.4	48.4
Standard Deviation	65.4	1.3	3.4	4.9
Minimum	170	0.2	73.8	36.2
Maximum	460	6.0	88.9	56.3
No. of Measurements	20	20	20	20
Date (7-16-2004)	**CO2 (ppm)**	**CO (ppm)**	**Temp (F)**	**Rel. Hum. (%)**
Average	434	1.3	85.4	41.3
Standard Deviation	43.2	1.8	1.4	3.7
Minimum	350	0.0	82.6	37.0
Maximum	529	7.1	88.3	52.8
No. of Measurements	14	14	14	14

ppm = Parts per million
Temp (F) = Temperature in Degrees Fahrenheit
Rel. Hum. (%) = Relative Humidity in Percent
CO_2 = Carbon Dioxide
CO = Carbon Monoxide

Table 6

TSA- Baltimore-Washington International Airport
Volatile Organic Compounds – General Area Air Samples
HETA 2004-0101-2953
Linthicum, Maryland
July 15-16, 2004

Date	Location	Sampling Duration (min)	Isopropanol Concentration (mg/m^3)	Toluene Concentration (mg/m^3)
7/15/2004	Air Tran	384	0.57	0.06
7/15/2004	United	321	Trace	0.13
7/15/2004	Southwest	386	0.82	0.06
7/16/2004	United	404	0.59	0.06
7/16/2004	Delta	405	0.55	Trace
7/16/2004	Southwest	405	Trace	Trace
			MDC = 0.2 mg/m^3	MDC = 0.02 mg/m^3
			MQC = 0.5 mg/m^3	MQC = 0.05 mg/m^3

mg/m^3 = milligrams of substance per cubic meter of air
MDC = Minimum Detectable Concentration
MQC = Minimum Quantifiable Concentration
Trace = Value was below the MQC, but above the MDC

Table 7
Personal Noise Dosimeter Data
TSA-Baltimore/Washington International Airport
HETA 2004-0101-2953
Dulles, Virginia
July 15-16, 2004

Worker Location	Sample Time hh:mm	8-hr PEL % Dose	8-hr AL % Dose	8-hr REL % Dose
July 15, 2004				
Air Tran: Screener #1	07:11	6.1	20.7	202.9
Air Tran: Screener #2	07:11	12.4	27.6	158.6
Air Tran: Screener #3	06:16	10.0	24.7	87.5
International: Screener #1	06:43	1.0	6.5	26.2
International: Screener #2	06:42	2.5	14.0	44.9
United: Screener #1	06:11	0.6	6.0	25.9
United: Screener #2	06:02	1.3	4.3	30.6
July 16, 2004				
Delta: Screener #1	07:24	7.8	27.5	97.1
Southwest: Screener #1	07:38	2.6	9.6	43.4
Southwest: Screener #2	07:57	0.3	2.8	17.2
Southwest: Screener #3	07:55	0.2	4.5	19.4
U.S. Air: Screener #1	06:42	1.1	6.2	25.7

Dosimeter data for TSA employees working at the baggage screening machines. Sampling time is reported as the hours and minutes that the device was on the worker. All percent dose criteria, permissible exposure limit (PEL), action level (AL), and recommended exposure limit (REL), have been extrapolated to an 8-hr time-weighted average for each worker.

Figure 1
TSA-Baltimore/Washington International Airport
Air Tran Baggage Screener #1
HETA 2004-0101
Baltimore, Maryland
July 15, 2004

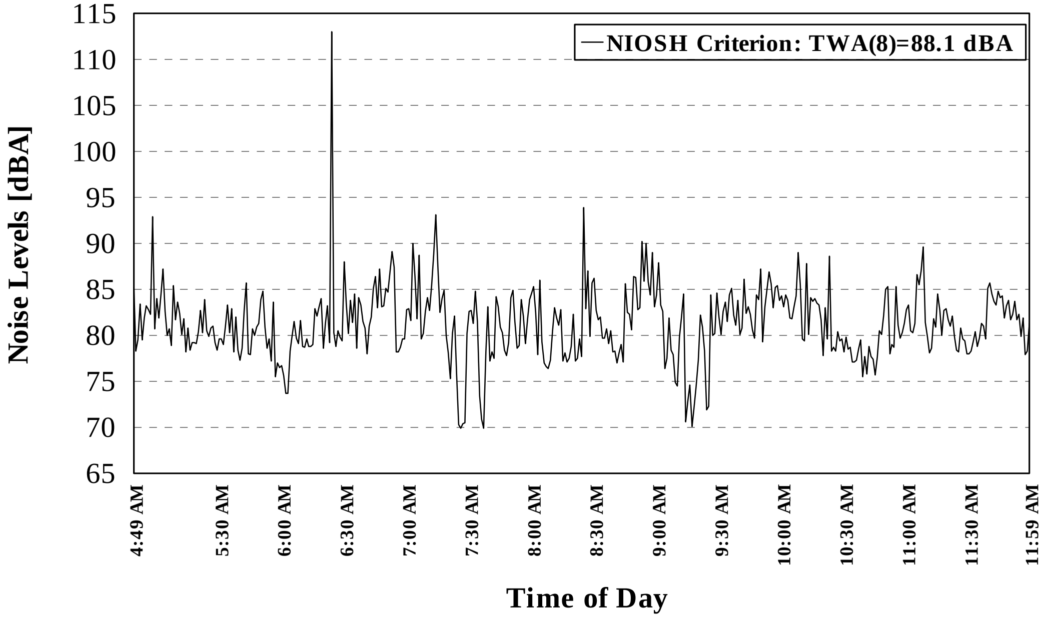


Figure 2
TSA-Baltimore/Washington International Airport
Air Tran Baggage Screener #2
HETA 2004-0101
Baltimore, Maryland
July 15, 2004

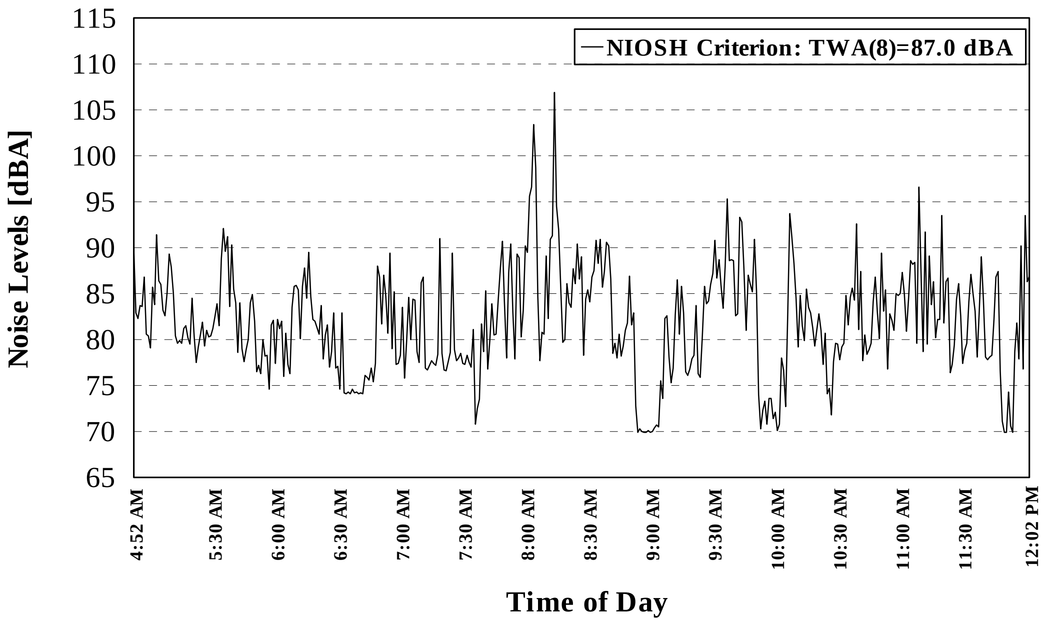


Figure 3
TSA-Baltimore/Washington International Airport
Air Tran Baggage Screener #3
HETA 2004-0101
Baltimore, Maryland
July 15, 2004

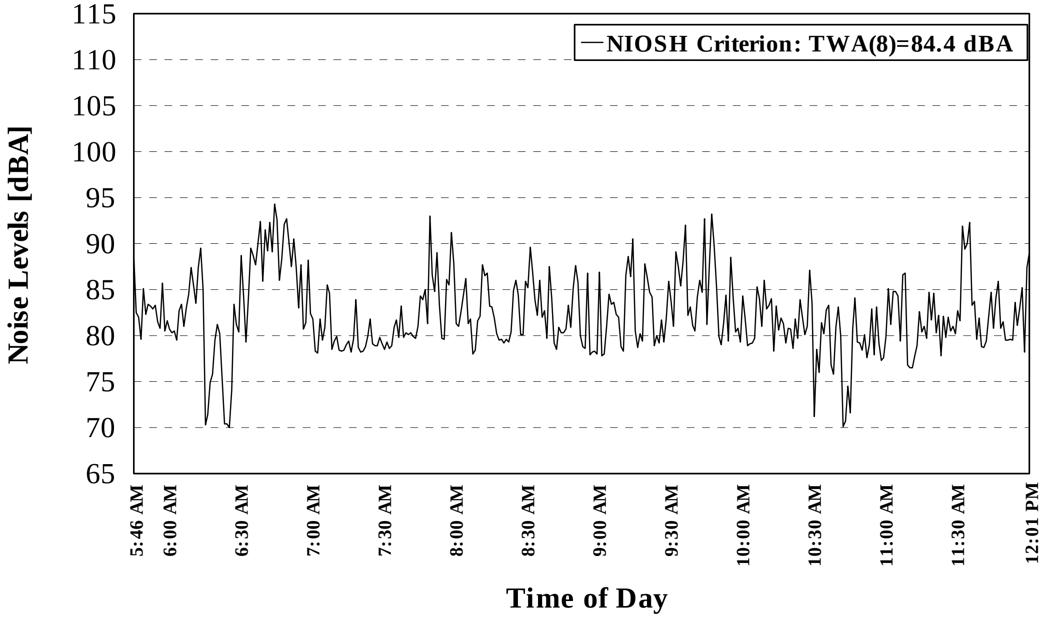
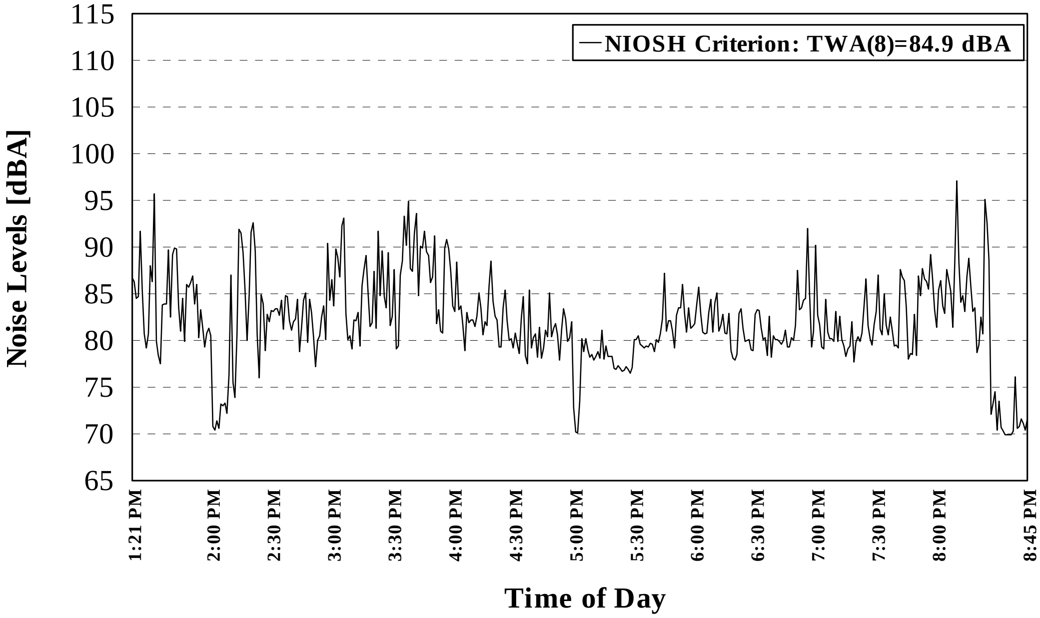


Figure 4
TSA-Baltimore/Washington International Airport
Delta Baggage Screener
HETA 2004-0101
Baltimore, Maryland
July 16, 2004



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