CDC Workplace Safety and Health™

NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2004-0130-2945
Transportation Security Administration-Palm Beach International Airport
West Palm Beach, Florida

August 2004

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

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 Lisa J. Delaney, Mark Methner, 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 Deborah Gibson and Shawna Watts. Review and preparation for printing were performed by Penny Arthur.

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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 March and April 2004, NIOSH conducted a health hazard evaluation at the Palm Beach International Airport TSA baggage screening area. We measured levels of air contaminants and noise in the ramp area during passenger baggage screening.

What NIOSH Did

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

What NIOSH Found

- All air samples were within recommended levels.
- The noise levels were low.
- Housekeeping in the ramp area was poor.
- Cracks in the floors caused tug carts to make noise when passing over.
- Airline tugs can run on several different types of fuel sources.
- Airline employees often leave tugs idling when not in use.

What TSA Managers Can Do

- Fill and smooth cracks in floor.
- Maintain good housekeeping practices.
- Work with airlines to make sure tugs are maintained according to operating procedures.
- Work with airlines to make sure they train employees to turn off tugs when not in use.

What the TSA Employees Can Do

- Report loud noise sources to TSA management.
- Keep personal radios at a level that only employees in the immediate area can hear.

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 # 2004-0130-2945

Health Hazard Evaluation Report 2004-0130-2945
Transportation Security Administration-Palm Beach International Airport
West Palm Beach, Florida
August 2004

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SUMMARY

On February 6, 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 Palm Beach International Airport in West Palm Beach, Florida. The HHE request concerned health hazards 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. The request also described ergonomic hazards and heat stress as potential workplace hazards. These latter hazards will be addressed in a separate evaluation. Reported health problems included allergies, respiratory distress, repetitive stress injuries, back injuries, possible hearing loss, and dehydration due to heat. An initial site visit was made on March 24, 2004. On April 17-18, 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 below the minimum detectable concentration (MDC) to 11.2 micrograms per cubic meter (µg/m^3). There is no NIOSH evaluation criteria for EC, although the California Department of Health Services recommends keeping levels below 20 µg/m^3. PBZ concentrations of NO_2 and NO were below the limit of detection of 2 µg/sample. Similar non-detectable NO_2 results were obtained from real time personal exposure monitors (full-shift and 15-minute short-term exposures).

All but one PBZ exposure for CO ranged from non-detected to 1 part per million (ppm) (full-shift Time-Weighted Average [TWA]) and from non-detected to 8 ppm (15-minute short-term exposures). One employee working at Explosive Detection System (EDS) machine 6 measured an instantaneous peak exposure of 1150 ppm on the first day of sampling. This employee's TWA and short-term exposures were 10 ppm and 284 ppm respectively.

VOCs were identified via thermal desorption tubes and quantified via charcoal tubes. The dominant compounds identified were isopropyl alcohol, acetone, benzene, toluene, and xylenes. Charcoal tube analysis found trace levels of acetone and low levels of isopropyl alcohol. Airborne concentrations of benzene, toluene, xylenes, and total hydrocarbons were below their respective MDCs.

The OSHA Permissible Exposure Limit (PEL) for noise of 90 A-weighted decibels [dB(A)] was not exceeded in any of the 15 dosimeter samples. There was, however, one instance in the Lane 1 area where the OSHA Action Level (AL) was greater than 50% and two instances (Lane 1 and Lane 7) where the NIOSH criterion exceeded 100%. Area spectral noise measurements indicated that at each of the nine EDS baggage screening machines there is a great deal of lower frequency (<250 Hz) sound energy in the area, and that the output side of the machine is a few decibels greater than the input side of the machine. However, none of the A-weighted values approach the NIOSH criterion of 85 dBA.

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 none of the chemicals were detected at concentrations exceeding occupational exposure limits. Therefore, an inhalation hazard to those compounds did not exist at the time of the NIOSH visit. 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

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INTRODUCTION

On February 6, 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 Palm Beach International Airport (PBI) in West Palm Beach, Florida. 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 allergies, respiratory distress, repetitive stress injuries, back injuries, possible hearing loss, and dehydration due to heat. In response to this request, NIOSH investigators conducted an initial site visit on March 24, 2004 and on April 17-18, 2004, conducted 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. A separate evaluation will address ergonomic and heat stress concerns.

BACKGROUND

PBI began operations with one small runway in 1936. The most recent expansion in 1988 created 560,000 square feet of terminal space. The terminal includes 3 concourses, 25 passenger gates (with the potential for 24 more), and a two-story concession mall. This facility serves nearly 6 million passengers each year and there are 16 commercial and commuter airlines currently operating out of the airport.

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 PBI began screening both passengers and baggage in December 2002.

Approximately 85 full- and part-time screeners are employed by TSA at PBI. Full-time employees work an 8-hour shift and part-time employees work a 4-hour shift. All checked passenger bags are screened in one large area. 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.

The baggage area is open to the tarmac on the south side and consists of 14 carousels and 9 L3 3DX™ 6000 EDS machines. Each EDS machine is located between 2 carousels. EDS machines 1 and 2 and 4 and 5 are located between 2 carousels designed to accommodate the larger airlines. During peak travel periods in the winter months, more than 350,000 bags are screened monthly. 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 exhaust fans at each work station were recently installed to increase air movement in the bag area. These exhaust fans exhaust directly outside.

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 Jill Lozis, TSA Occupational Safety and Health manager, and local TSA PBI management. During the initial site visit and subsequent telephone conversations with management and employees, the main areas of concern were identified and an environmental monitoring strategy was developed. The monitoring methodology is described below.

Diesel Exhaust (Elemental Carbon)

Full-shift PBZ employee exposures to 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. Nine screeners were monitored on April 17, 2004, and seven screeners were monitored on April 18, 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 exposures to NO_2 and NO were collected on sorbent tubes containing oxidizer plus a triethanolamine-treated molecular sieve in tandem using SKC® Pocket Pumps®. Four screeners were monitored on each day of sampling. One area sample was collected for NO_2 and NO each day of sampling. Flow rates of approximately 0.025 Lpm were used to collect the samples. 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, UT) 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 log 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. 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. Nine personal samples were collected on April 17, 2004, and five personal and three area samples were collected on April 18, 2004. Personal samples were collected by attaching the instrument to the belt of each worker. For area samples, the monitors were placed at fixed locations within designated work areas. 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 Ultras. Instantaneous measurements of CO were taken throughout the baggage area during the work shift. The Q-TRAK was also used to identify sources of the contamination in the area. Instrument calibration for both the Toxilog Ultras and the Q-TRAK was completed according to the manufacturers' recommendations.

Volatile Organic Compounds (VOCs)

Area air samples that 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 0.05 Lpm. Charcoal tube samples were collected simultaneously, in a side-by-side configuration, with the TD tubes. The charcoal tubes were sent to DataChem Laboratories, Inc. (Salt Lake City, UT) 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

Quest® Electronics Model Q-300 Noise Dosimeters were used to collect the daily noise exposure measurements from the employees that had volunteered 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.

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 PBI. They were chosen so that most of the nine EDS screening machines were represented on each day. Employees reported to the supervisor's area before being assigned to a screening machine and the meters were placed on them at this time. The meters were worn for the entire work shift, through lunch and breaks. The meters were removed at the end of the shift when the employees reported back to the supervisor's area. Area noise measurements were taken at both the baggage input side and output side of the EDS screening machines in the general area where the employees worked. The analyzer was placed on a tripod with the microphone located at ear level for a standing employee. Additional area measurements were taken while jet aircraft taxied on the tarmac toward gate C-1, located adjacent to the baggage screening area where TSA employees were located.

Workplace Information

To aid in characterizing the source of the contamination, and in selecting appropriate sampling methods, NIOSH investigators asked TSA to request information from the airlines regarding the year, make, model of tugs; fuel and engine type; preventive maintenance schedules; and emission testing results.

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 is compressed in the combustion chamber, fuel is introduced, 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 ($\mu g/m^3$). 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 over a working lifetime of 20 $\mu g/m^3$ 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. The oxidation rate occurs more rapidly at higher NO concentrations.[18] Therefore, it is difficult to identify the effects of NO exposures without considering the concomitant effects of NO_2. 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. The IDLH exposure condition 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 Hertz (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 [dB(A)] is the preferred unit for measuring sound levels to assess worker noise exposures. The dB(A) 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 dB(A) scale is logarithmic, increases of 3 dB(A), 10 dB(A), and 20 dB(A) 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 dB(A) 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 dB(A) for no more than 4 hours, to 100 dB(A) for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dB(A) 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:

Dose = 100 X (C1/T1 + C2/T2 + ... + Cn/Tn),

where Cn indicates the total time of exposure at a specific noise level and Tn 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 dB(A); 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 dB(A), 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 dB(A) as a TWA for 8 hours, 5 dB less than the OSHA standard. These criteria also use a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dB(A) for 8 hours, but to no more than 88 dB(A) for 4 hours or 91 dB(A) for 2 hours. Twelve-hour exposures have to be 83 dB(A) 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. Concentrations of EC ranged from <1 $\mu g/m^3$ to 11.2 $\mu g/m^3$. The minimum detectable concentration (MDC) of 1 $\mu g/m^3$ was calculated based on the LOD assuming an average sample volume of 1116 liters of air.

All of the PBZ concentrations measured for NO_2 and NO were below their MDCs of 291 $\mu g/m^3$ and 190 $\mu g/m^3$, respectively (assuming an average sample volume of 10.9 liters of air). Full-shift TWA and short-term exposures for NO_2 measured using the Toxilog Ultras were all non-detectable. Instantaneous peak concentrations ranged from 0.1 ppm to 1.5 ppm.

Personal full shift TWA exposures for CO ranged from non-detected to 1 ppm; 15-minute short-term exposures ranged from non-detected to 2 ppm. The results from the Toxilog Ultra sampling for CO are shown in Table 2. One employee working in Lane 6 had a measured instantaneous peak exposure of 1150 ppm at 1:30 pm. A graph of the instantaneous CO measurements during this employee's shift is shown in Figure 1. The employee's TWA and STEL exposures were 12 ppm and 6 ppm respectively. Full shift and 15-minute short-term concentrations of CO collected on a screener working in the adjacent lanes (Lane 4 and Lane 5) on the same day were non-detected, with an instantaneous peak exposure of 19 ppm. A graph of the instantaneous CO measurements during this employee's shift is shown in Figure 2. Full shift and 15-minute short-term concentrations of CO collected on a screener working in the same location the next day were non-detected and the instantaneous peak exposure was 22 ppm. A graph of these measurements are shown in Figure 3.

Area instantaneous CO samples were collected using the Q-TRAK in various areas within the bag screening operation during both days of sampling. CO concentrations taken in the work areas of employees ranged from 0.5 ppm to 9 ppm. CO concentrations taken near passing tugs or idling tugs ranged from 15 ppm to 600 ppm. The results from area Q-TRAK CO sampling are shown in Table 3.

The dominant VOCs qualitatively identified on the TD tubes and subsequently analyzed quantitatively on the charcoal tubes; included isopropyl alcohol (IPA), acetone, benzene, toluene, xylene, and total hydrocarbons. All area samples for benzene, toluene, xylenes, and total hydrocarbons were below the analytical limit of detection. Full-shift area samples for IPA were detected in trace amounts (between the MDC and minimum quantifiable concentration [MQC]). One full-shift area sample contained a trace amount of acetone.

Noise

Eight TSA screeners wore noise dosimeters on Saturday during their work shift and seven wore dosimeters on Sunday. The screeners were generally assigned to one EDS screening machine, although a few employees worked in two areas during their shift. The noise exposure results for each individual are shown in Table 4 and are compared to the three different noise criteria used in this survey, the OSHA PEL and AL, and the NIOSH REL. The OSHA criteria use a 90 dBA criterion and 5-dB exchange rate for the PEL and AL. The difference between the two is the threshold level employed, with a 90 dBA threshold for the PEL and an 80 dBA threshold for the AL. The threshold level is the lower limit of noise values included in the calculation of the criteria; values less than the threshold are ignored by the dosimeter. The NIOSH criterion differs from OSHA in that the criterion is 85 dBA, the threshold is 80 dBA, and it uses a 3-dB exchange rate. The data in the table are reported as the % daily dose for each noise criteria as an 8-hr TWA.

The OSHA PEL was not exceeded in any of the 15 dosimeter samples. There was one instance where the OSHA AL was greater than 50% and two instances where the NIOSH criterion exceeded 100%. All of the noise samples greater than the criteria occurred on Saturday. The worker with the highest recorded noise exposures worked in Lane 1. A graph of this employee's noise levels throughout the day is shown in Figure 4. The daily noise levels varied throughout the day with several extended time periods where the noise was between 90-95 dBA. There were two additional periods where the 1-min. average was 110 dBA and 103 dBA. Because of these results, an area sample was located in the vicinity of Lane 1 on the second day of the evaluation (Figure 5). On Sunday, the noise levels in this area were consistently between 80-85 dBA which does not confirm the personal noise levels recorded on Saturday at Lane 1. The second instance where the NIOSH REL was measured greater than 100% was in Lane 7 on the first day of the survey. While Lane 7 was not monitored on the second day, the two adjacent lanes (Lane 6 and Lane 8) were measured at 26% and 42%, respectively, on Sunday.

Area spectral noise measurements were made on the two survey days at each of the nine EDS baggage screening machines. Samples were integrated over 30 seconds at the input and output sides of the machines, near where employees performed their job tasks. The overall results of these measurements are shown in Table 5. The noise levels from spectra that have no weighting network (dB SPL) and spectra that have an A-weighting network[27] (dBA) were calculated for each location by the analyzer. The unweighted values are consistently greater than the A-weighted values at all nine screening machines which indicates that there is a great deal of lower frequency (<250 Hz) sound energy in the area. Also, the output side of the machine is a few decibels greater than the input side of the machine. None of the A-weighted values approach the NIOSH criterion of 85 dBA. Additional area measurements were made while a jet aircraft taxied and parked at Gate C-1. The weighted and unweighted values at Lane 2 were 82 dBA and 85 dB SPL, respectively while the aircraft moved into position at the gate.

Workplace Information

One airline responded to the TSA request for information. JetBlue operates 3 gasoline tugs that receive routine maintenance and has a preventive maintenance schedule in place. Tugs are frequently left idling near TSA screeners while airline employees load and unload bags. Employees reported on the days of our survey that airline employees were more likely than usual to turn off tugs.

Due to security measures and lack of adequate space, employee break areas are located in the bag area next to the EDS machines. Bathrooms are located inside the terminal. Employees do not readily have access to soap and water to wash before eating.

In general, housekeeping in the ramp area was poor. Many areas were cluttered with items which create a trip hazard. Cracks on floors and uneven walking surfaces also create a trip hazard for employees. In addition, empty metal carts being pulled by tugs pass over cracks in the concrete floor resulting in "cart bounce", which creates unnecessary noise. Also, a large crack in the floor, creating a potential trip hazard, was noted in the ramp entrance area between Lanes 8 and 9.

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

DISCUSSION

None of the evaluated chemicals were detected at concentrations exceeding occupational exposure limits. Concentrations of EC ranged from <1 $\mu g/m^3$ to 11.2$\mu g/m^3$. The highest exposure (11.2 $\mu g/m^3$) is half the CA HESIS recommendation of 20 $\mu g/m^3$. This employee worked at EDS machine 2 on Sunday afternoon (April 18th). The next highest EC exposure (9.5 $\mu g/m^3$) was measured on the employee working at EDS machines 4 and 5 on Saturday morning (April 17th). 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. Each airline owns and operates their own tugs and the fuel source varies; therefore, employee exposures may vary depending on their work location.

PBZ concentrations measured for NO_2 and NO were below the limit of detection of 2 µg/sample. These results are in agreement with the NO_2 results from the real time Toxilog Ultra monitors; full-shift and 15-minute short-term exposures were all non-detectable. All but one personal full shift TWA and 15-minute short-term exposures for CO ranged from non-detected to 1 ppm and from non-detected to 8 ppm, respectively. One employee working at Lane #6 had an instantaneous peak exposure of 1150 ppm at 1:30 pm. This employee's TWA and short-term exposures were 10 ppm and 284 ppm, respectively. The employee's exposure to CO exceeded the OSHA ceiling limit of 200 ppm and approached the IDLH value of 1200 ppm. The CO exposures for employees working in the adjacent lanes (Lane 4/5 and Lane 7) on the same day were very low. Likewise, the sample for CO collected on a screener working in the same location the next day measured a full shift and 15-minute short-term concentration of 0 ppm and an instantaneous peak exposure of 22 ppm. Area measurements at and near tug exhausts using the Q-TRAK Plus ranged from 39 ppm to 600 ppm.

These results did not approach the instantaneous peak measurement measured on the screener working at Lane 6. Based on the related CO results, it is difficult to determine the source responsible for high concentrations of CO or if equipment malfunction occurred. In general, tug exhaust emissions were considered the primary source of CO in the bag screening area. However, NIOSH 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.

Thermal desorption sampling for hydrocarbons did not identify any unusual compounds. Full-shift area samples for IPA (the most prominent compound detected) were well below any occupational exposure limits.

Although this air sampling does not show an inhalational hazard in the bag area, the potential exists for increased exposures 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.

The baggage area is open to the ramp/tarmac on the south side. Depending on the outdoor environmental conditions, the bag screening area can be naturally ventilated by strong winds. Alternatively, calm winds and certain directional wind flows do not provide natural ventilation to the area. In addition, large fans attached to duct work exhausting outside the area are located near each EDS machine. These exhaust fans help reduce the build up of contaminants in the area. Employees reported that on the days of our sampling the environmental conditions were optimal.

The measured noise levels over the two survey days provide little evidence of a serious noise problem for the baggage screeners in this area. Most of the personal noise measurements and all of the area measurements are below relevant exposure evaluation criteria. For those locations where a criterion was exceeded, there was not a similar finding for employees working in adjacent areas or on the second day of sampling.

Major noise sources identified during the evaluation were the ventilation system, aircraft, airline tugs and carts, and the movement of luggage from conveyors onto the screening machines and from the machines to tables for additional inspection, or onto the airlines' conveyors for delivery to the aircraft. While none of these sources are intense enough to increase the risk of occupational hearing loss, if any of them can be reduced it would improve the overall conditions of the work area. Experience in the workplace has shown that noise levels above 80 dBA force people to speak loudly to be clearly heard and in levels above 85 dBA, they have to shout.[29] Dosimeter data and area spectra show that noise at this level is common in the area where the TSA screeners work.

CONCLUSIONS

An inhalational hazard to tug and aircraft exhaust emissions did not exist at the time of the NIOSH visit. Conditions affecting the results include good dilution ventilation due to the area being relatively open to the outside environment and large exhaust fans at each EDS machine. 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.

A complete, formal hearing conservation program that meets the regulatory requirements of OSHA is not needed at this airport for TSA baggage screeners. However, conditions adversely affecting noise levels in this workplace exist. For example, any cracks should be filled, eliminating noise that results from carts bouncing after hitting them. Additionally, any change in the configuration of the floor plan such as added workers, machinery, or aircraft could increase noise levels. Any perceived increase in employees' noise exposures from these changes needs to be documented through additional noise testing.

Even if the noise levels in this work area do not increase, it would be beneficial to attempt to lower noise levels to help improve communication between employees. In some areas noise levels are high enough to cause workers to raise their voices or shout in order to be heard over the background noise, which can strain one's voice over a period of time.

RECOMMENDATIONS

1. Employees should report any perceived increases in noise in the workplace. The information should be logged by management and trigger a noise evaluation. Results of the noise evaluation should be reported to the employees, including determination of the exposure levels and corrective measures that were taken.

2. There are several cracks in the floor where airline tugs and carts traveled. Many were noted near the airlines' baggage conveyors adjacent to the tarmac. These should be filled and smoothed to reduce the impact noise created by carts bouncing over the cracks.

3. Personal radios were clearly audible during the work shift. These should be kept at a level where they can be heard by employees in the immediate area only without impacting workers two or three lanes away.

4. Housekeeping should be improved in the area. Trash or debris should be thrown away. Debris in the area has the potential to be drawn towards the intake side of the exhaust fan system and clog the intake grating. Should this happen, the overall efficiency and effectiveness of the entire system will be greatly diminished. TSA items should be appropriately stored and free from walkways to avoid trip hazards.

5. Break tables should be cleaned and employees should be encouraged to wash their hands with soap and water or use an alcohol-based hand rub prior to eating or smoking.

6. Ensure that tugs are maintained and operated according to standard operating procedures. Good communication and cooperation with the airlines will help to ensure this is accomplished. It may be beneficial to engage both TSA and airline management to work toward the common goal of improving air quality in the bag area.

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Table 1
TSA- Palm Beach International Airport
Personal Diesel Exhaust (Elemental Carbon) Results
HETA 2004-0130
West Palm Beach, Florida
April 17-18, 2004

Employee Location	Sample Duration (min)	Concentration (μg/m^3)
April 17, 2004		
EDS 4&5	361	9.5
EDS 7	388	Trace
EDS 9	397	8.4
EDS 3	401	7.4
EDS 1	388	5.0
EDS 8	484	6.1
EDS 8 (30 min at 9)	473	6.5
EDS 1	473	3.7
EDS 6	453	4.5
April 18, 2004		
EDS 9	470	5.4
EDS 8	485	4.9
EDS 2	484	11.2
EDS 3	494	7.6
EDS 6	488	5.6
EDS 7	470	ND
EDS 5 *	?	Trace
MDC	Assuming an average volume of 1116 Liters	1
MQC		4

μg/m^3 = micrograms per cubic meter
EDS = Explosive Detection System
ND = Value was below the minimum detectable concentration (MDC)
Trace = Value between the MDC and the minimum quantifiable concentration (MQC)
* Unknown run time. Pump was off at end of shift.

Table 2
TSA- Palm Beach International Airport
Personal Toxilog Ultra Carbon Monoxide Results
HETA 2004-0130
West Palm Beach, Florida
April 17-18, 2004

Employee Work Location	TWA (ppm)	Short-term exposure (ppm)	Peak (ppm)
April 17, 2004			
EDS 3	0	1	18
EDS 1	1	2	21
EDS 8	0	2	20
EDS 7	0	1	22
EDS 6	12	6	1150*
EDS 4 & 5	0	0	19
EDS 4	0	1	27
EDS 3	0	0	33
EDS 9	0	1	25
April 18, 2004			
EDS 3	0	1	26
EDS 2	1	0	71
EDS 5	0	0	17
EDS 6	0	0	22
EDS 8	0	0	16
EDS 5	0	1	14
EDS 1 & 2	0	0	7
Supervisor Break area between EDS 5&6	1	0	88
NIOSH	REL 35	Ceiling 200	-
OSHA	PEL 50	-	-

ppm = parts per million.
* = suspect value, validity unknown
TWA = Time-Weighted Average = average airborne concentration of a substance during a normal 8- to 10-hour workday
Short-term exposure = 15-minute TWA exposure
Peak = Highest measured concentrations during the work day
EDS = Explosive Detection System
NIOSH REL = National Institute for Occupational Safety and Health Recommended Exposure Limit
NIOSH C = Ceiling Value that should not be exceeded at anytime
OSHA PEL = Occupational Safety and Health Administration Permissible Exposure Limit

Table 3
TSA-Palm Beach International Airport
Area Q-TRAK Plus Carbon Monoxide Results (ppm)
HETA 2004-0130
West Palm Beach, Florida
April 17-18, 2004

Work Location	Activity Description	Time	CO (ppm)
April 17, 2004			
Break Area by EDS 5	Light tug activity nearby	8:15 AM	4.1
EDS 3	Light tug activity nearby	8:16 AM	0.5
EDS 3 by passenger bag return carousel	Light tug activity nearby	8:18 AM	0.5
EDS 2	-	8:19 AM	1.5
EDS 9 by entrance to ramp	-	8:20 AM	1
EDS 3 by entrance to ramp	Jet at gate	9:05 AM	1.1
EDS 9	Near running tug	10:25 AM	39
April 18, 2004			
EDS 9	Bag Screening	11:44 AM	1.4
Partitioned Office between EDS 9 and 8	-	11:46 AM	1.9
EDS 8	Bag Screening	11:47 AM	1.6
EDS 8/9	Tug passing aisle	11:51AM	9
EDS 7	Bag Screening	11:54 AM	1
EDS 6	Bag Screening	11:59 AM	0.9
EDS 5	Bag Screening	12:01 PM	0.8
EDS 4	Bag Screening	12:11 PM	3.5
EDS 2/3	Near tug starting up	12:16 PM	15
EDS 1/2	Bag Screening	12:20 PM	1.7
EDS 5/6	Tug passing aisle	1:18 PM	5
-	Gas tug at exhaust	3:14 PM	60
-	Gas tug at exhaust	4:15 AM	600

ppm = parts per million

EDS = Explosive Detection System

Table 4
TSA-Palm Beach International Airport
Personal Noise Dosimeter Data
HETA 2004-0130
West Palm Beach, Florida
April 17-18, 2004

Worker Location	Sample Time hh:mm	8-hr PEL % Dose	8-hr AL % Dose	8-hr REL % Dose
April 17, 2004				
EDS: Lane 1	07:39	40.0	57.6	351.2
EDS: Lane 3	06:15	3.1	11.2	41.3
EDS: Lane 4	06:20	1.3	7.8	26.7
EDS: Lanes 4 & 5	07:36	2.3	11.9	38.0
EDS: Lane 6	07:58	8.6	25.7	90.4
EDS: Lane 7	08:01	18.1	34.3	181.0
EDS: Lane 8	08:02	0.6	5.9	21.8
EDS: Lane 9	06:08	3.9	11.9	47.9
April 18, 2004				
EDS: Lane 2	08:02	1.2	16.4	45.4
EDS: Lanes 2 & 5	07:49	10.1	24.6	97.2
EDS: Lane 3	06:42	2.1	12.2	39.7
EDS: Lane 5	08:02	1.0	8.2	28.1
EDS: Lane 6	08:08	0.4	7.2	25.5
EDS: Lane 8	04:30	3.5	12.4	42.0
EDS: Lane 9	07:49	7.2	16.7	64.2

Dosimeter data for TSA employees screening baggage at the Explosive Detection System (EDS) 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.

Table 5
TSA-Palm Beach International Airport
Area Noise Samples
HETA 2004-0130
West Palm Beach, Florida
April 17-18, 2004

Screening Lane	Input Side		Output Side	
	dB SPL	dBA	dB SPL	dBA
1	83.3	75.7	85.7	77.5
2	82.7	74.8	82.9	76.6
3	81.7	74.7	83.0	77.7
4	81.7	73.4	83.9	76.9
5	81.7	74.3	83.1	75.4
6	81.9	75.2	82.5	77.1
7	81.3	72.4	80.9	73.5
8	80.9	73.0	82.9	75.9
9	82.1	74.7	80.9	74.6

Overall area noise levels at each of the EDS baggage screening machines measured at the input side where baggage is moved from the carrousel to the conveyor belt and at the output side where the baggage is further inspected or placed on the airline's carrousel for delivery to the aircraft. Values are reported as unweighted (dB SPL) or weighted (dBA).

Figure 1
TSA-Palm Beach International Airport
Instantaneous CO Results for Screener Working in Lane 6
HETA 2004-0130
West Palm Beach, FL
April 17, 2004

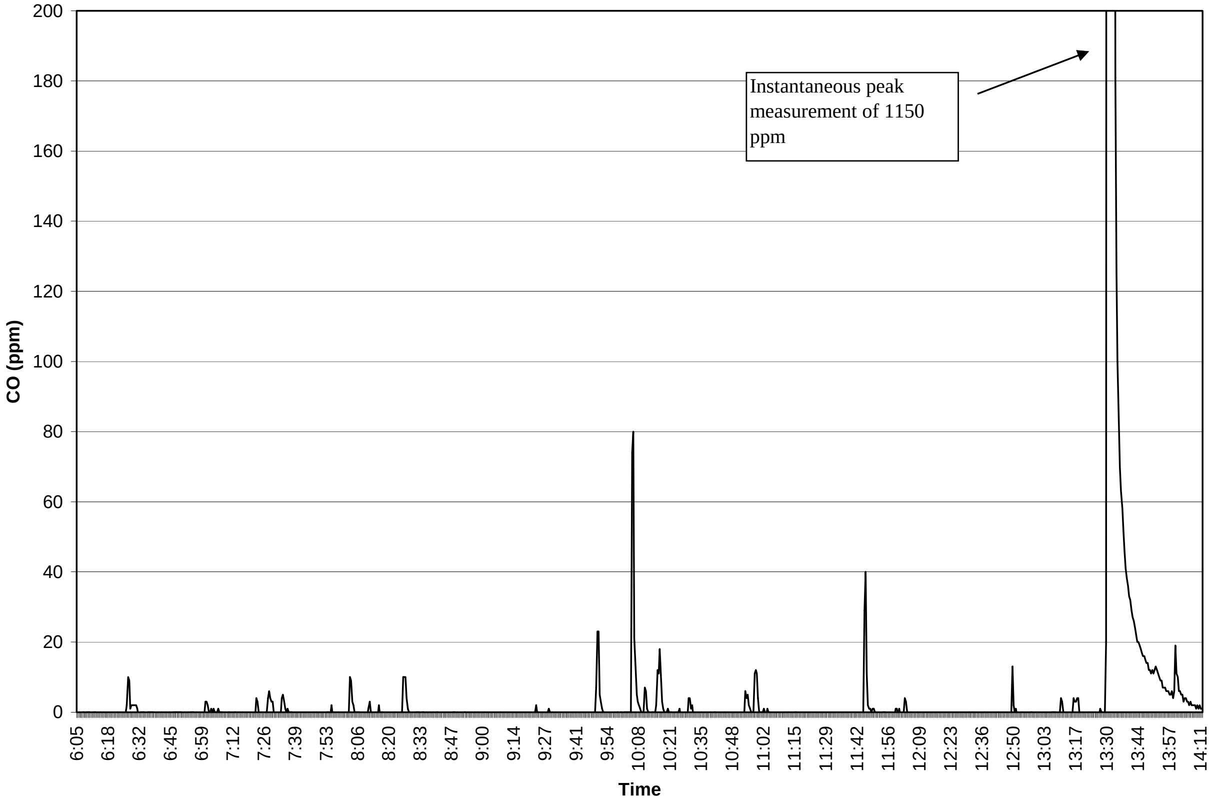


Figure 2
TSA-Palm Beach International Airport
Instantaneous CO Results for Screener Working in Lane 4 & 5
HETA 2004-0130
West Palm Beach, Florida
April 17, 2004

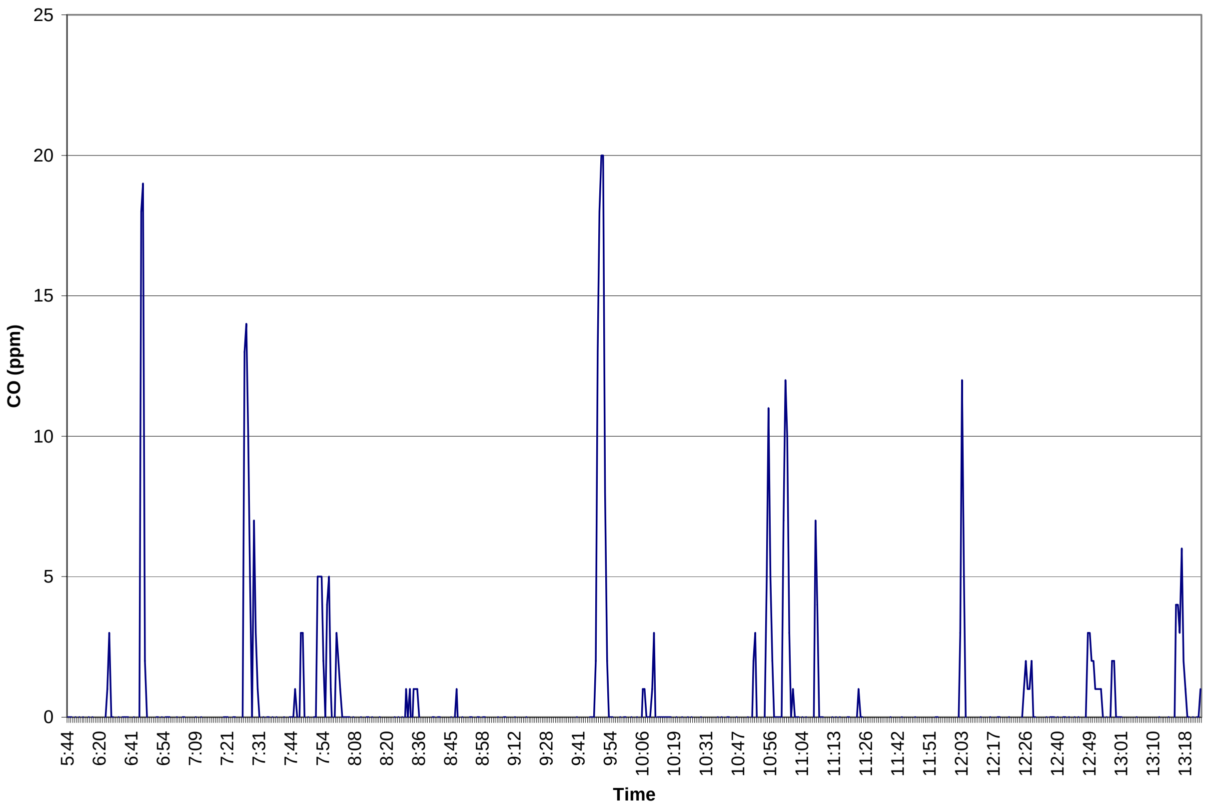


Figure 3
TSA-Palm Beach International Airport
Instantaneous CO Results for Screener Working in Lane 6
HETA 2004-0130
West Palm Beach, Florida
April 18, 2004

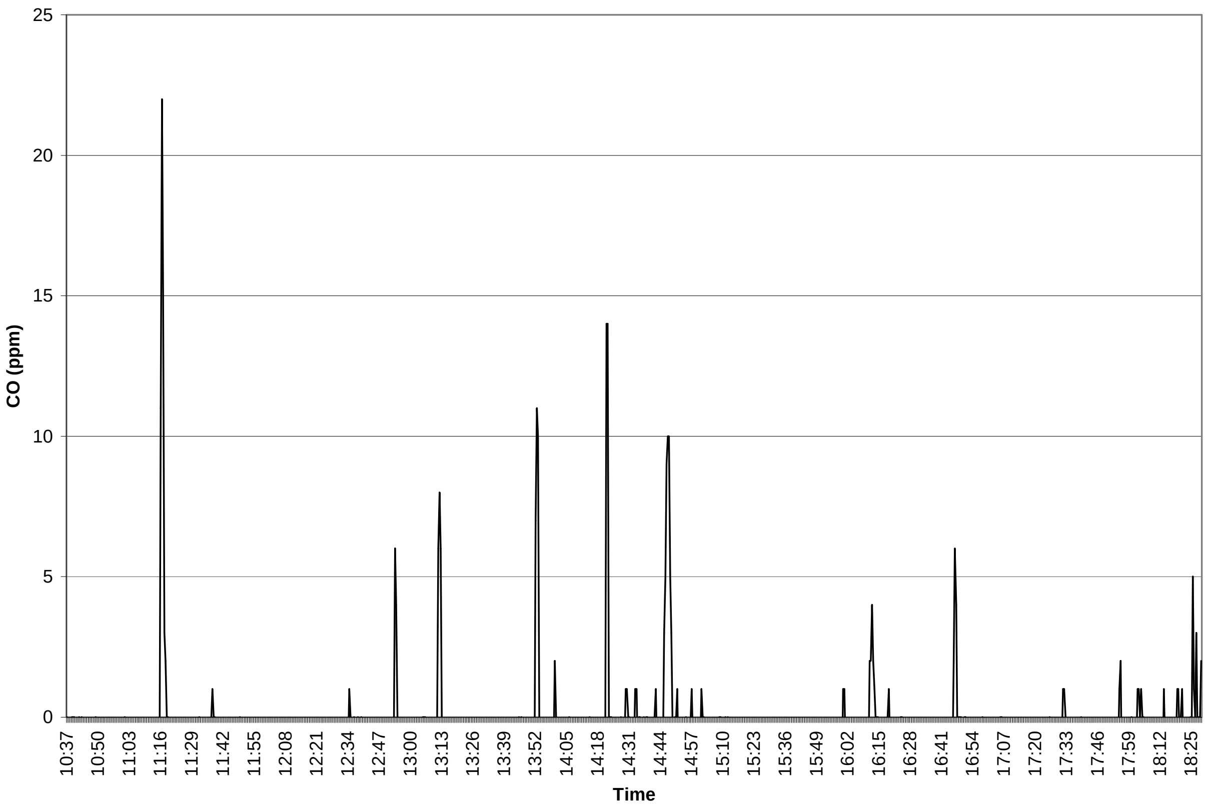


Figure 4
TSA-Palm Beach International Airport
E3 - Lane 3 Baggage Screener
HETA 2004-0130
Palm Beach, Florida
April 17, 2004

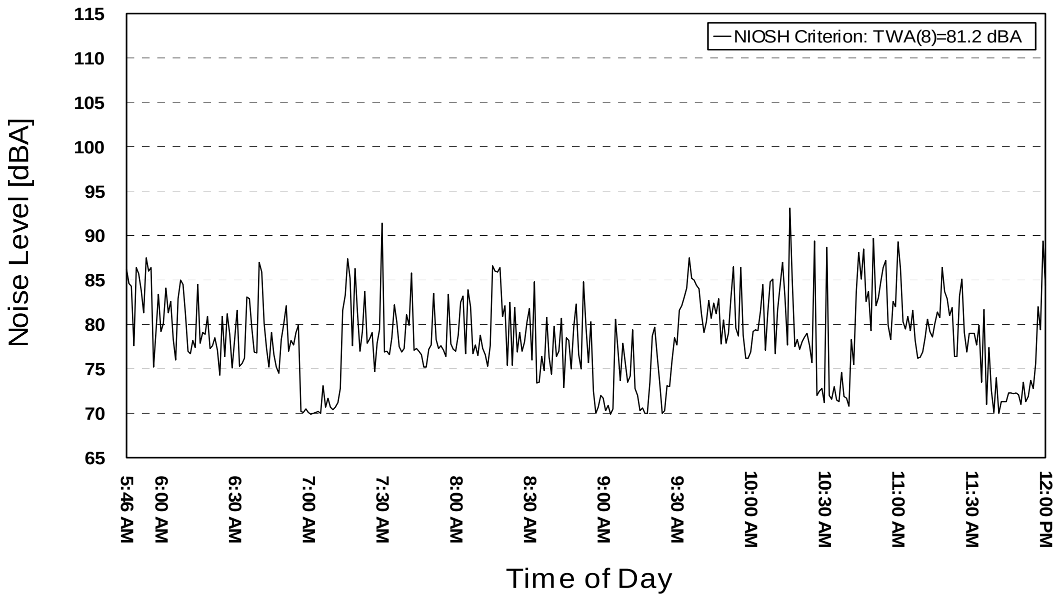
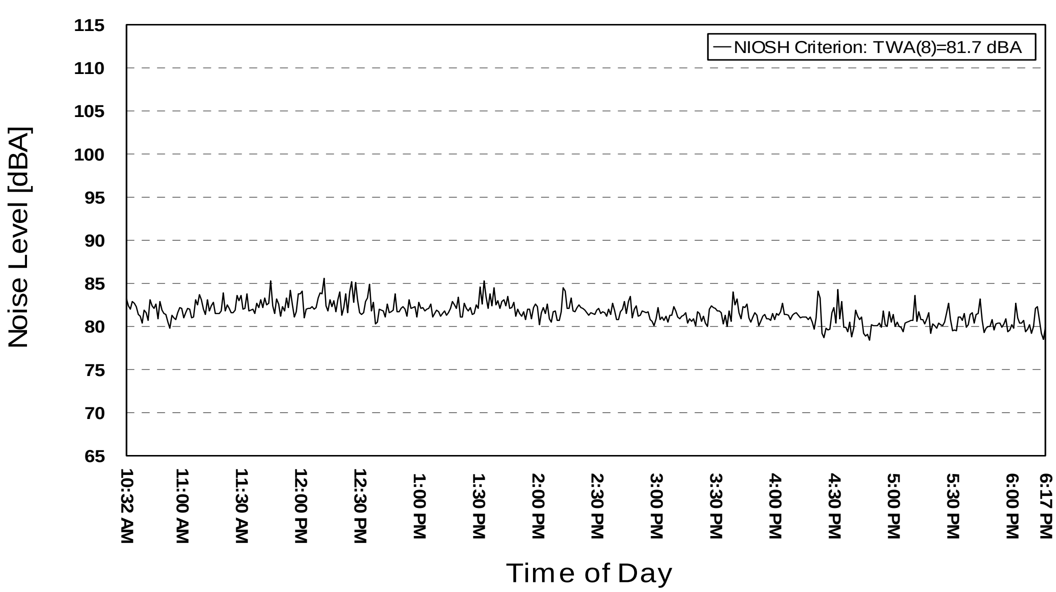


Figure 5
TSA-Palm Beach International Airport
E3 - Lane 1 Area Sample from Concrete Pole near Output Side of Machine
HETA 2004-0130
Palm Beach, Florida
April 18, 2004



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