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Immigration and Naturalization Service
San Ysidro, California

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PREFACE

The Hazard Evaluations and Technical Assistance Branch of 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 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 employer 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.

The Hazard Evaluations and Technical Assistance Branch 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 the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by J. Clinton Morley and Randy L. Tubbs of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Robert McCleery. Analytical support was provided by Ardith Grote. Desktop publishing was performed by Kendria N. Simpson. Review and preparation for printing was performed by Penny Arthur. A one-page, plain language supplement to this HHE was prepared by J. Clinton Morley and included with the initial distribution of the final report. This HHE Supplement can be found at the end of this report.

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Health Hazard Evaluation Report 97–0291–2681
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SUMMARY

On August 15, 1997, the National Institute for Occupational Safety and Health (NIOSH) received a request for health hazard evaluation at the San Ysidro Port of Entry (POE) from the U.S. Immigration and Naturalization Service (INS). The request asked NIOSH to assess employee exposures to vehicle exhaust and noise. Reported health effects among INS inspectors included headaches, dizziness, breathing problems, and difficulty hearing.

A site visit was conducted September 17–19, 1997, by NIOSH scientists including two industrial hygienists and a psychoacoustician. Personal air samples were collected for carbon monoxide (CO), hydrocarbons, lead particulate, and noise exposures were measured. Area air samples were collected for carbon monoxide, hydrocarbons, noise, carbon dioxide, temperature, humidity, and qualitative volatile organic compounds. A limited ventilation survey was also conducted as part of the initial site visit.

Personal and area air samples for noise, lead, carbon dioxide, and hydrocarbons were all within acceptable occupational health criteria. Personal and area air samples for CO were below the occupational health criteria that had been established for full–shift exposures. This is due to the administrative practice of job rotation which prevents INS inspectors from working in a CO exposure area for longer than one hour intervals. However, personal and area sampling for CO identified one–minute peak exposures to carbon monoxide that were greater than the NIOSH recommended ceiling concentration of 200 parts per million (ppm). A ceiling concentration is a contaminant level that should not be exceeded at any point during a workshift. The ceiling was surpassed in three of the four full–shift personal air samples for CO. A 24–hour area sample which monitored the primary inspection area of lane 7 recorded seven one–minute peaks greater than the NIOSH ceiling. A 24–hour area sample which monitored the pre–primary inspection area of lane 7 recorded 22 one–minute peaks greater than the NIOSH ceiling concentration. The reported health effects of headache, dizziness, and breathing problems are consistent with exposure to CO.

INS inspectors are exposed to one–minute peak concentrations of CO that exceed the NIOSH and CalOSHA recommended ceiling criteria of 200 ppm. Engineering control improvements, administrative control changes, and/or the use of personal protective equipment are recommended to reduce CO exposures. Any change should be followed with integrated personal dosimetry of INS inspectors to verify that no employee is exposed to concentrations of CO in excess of the occupational exposure limits. The reported health effects of headache, dizziness, and breathing problems are consistent with exposure to CO.

Keywords: SIC 9721 (International Affairs), Border Crossing Station, San Ysidro, Immigration and Naturalization Service, Carbon Monoxide, Lead, Noise, VOCs

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INTRODUCTION

On August 15, 1997, the National Institute for Occupational Safety and Health (NIOSH) received a request for health hazard evaluation (HHE) at the San Ysidro Port of Entry (POE) from an employer representative of the U.S. Immigration and Naturalization Service (INS). The request asked NIOSH to assess noise exposure and vehicle exhaust exposures, specifically carbon monoxide (CO), carbon dioxide, hydrocarbons, and lead. Reported health effects among INS inspectors included headaches, dizziness, breathing problems, and difficulty hearing. On September 17–19, 1997, NIOSH investigators (including two industrial hygienists and a psychoacoustician) conducted a site visit to evaluate the exposures of concern identified in the HHE request.

BACKGROUND

The San Ysidro POE is the largest land border crossing station in the world. This POE is the primary border crossing between Tijuana, Mexico, and both San Diego and Los Angeles, California. Approximately 300,000 people and 80,000–100,000 vehicles cross this border daily. The crossing is limited to light vehicle traffic (automobiles & pick–up trucks), although diesel buses drop–off people at the pedestrian crossing area. Typically, traffic is backed up across the border with several hundred vehicles waiting to cross through one of the 24 vehicle inspection lanes.

Vehicles entering the U.S. from Mexico come from a standard multiple lane highway. The highway fans out at the entrance to the port into 24 lanes. Vehicles select one of the lanes for primary vehicle inspection. When a vehicle arrives at the primary inspection area, an INS inspector will stop the vehicle for inspection and the presentation of passports, immigration papers, etc. Most vehicles pass through this primary inspection into the U.S. Occasionally, an automobile will be sent to secondary inspection.

The secondary inspection area is located behind the administration building. Automobiles are turned off during the secondary inspections; therefore, this area was not identified as an area of high vehicle exhaust exposure by the HHE requestor. As such, this area was not studied as part of this HHE.

A "push" is a term used by the INS to define one inspector working in an inspection lane as cars pass through the border. For example, if lanes 1–20 were in a "push" position, then lanes 21–24 would be closed. To conduct inspections, the INS officers generally stand inside or near an enclosed and ventilated booth at the primary inspection location. There are a total of 24 booths where inspectors can stand during the vehicle inspection, one for each vehicle inspection lane. A large canopy roof covers the 24 lanes where the primary inspections are conducted. This canopy extends from the primary inspection area back to the administration building.

The 24 inspection booths are all the same design, equal in size and configuration, and are supplied air from overhead ducts. The air enters a booth through ceiling vents on the east and west end of each booth. The air can be heated, but is not air–conditioned. Most of the INS inspectors' job responsibilities require them to work outside the booths; however, the booths are used to record data and input information into a computer. The booths have sliding glass doors on the east side which are frequently left open to facilitate access between the inside of the booth and the vehicles. Inspectors frequently enter and exit the booths throughout a rotation in the primary vehicle inspection area. Inspectors typically work two one–half hour rotations in the primary vehicle inspection area before rotating to other areas where vehicle exhaust exposures are lower or non–existent, such as secondary inspection, pedestrian traffic, or the office. This policy of job rotation was implemented to control full–shift exposures to vehicle exhaust. An INS inspectors' 9 or 10 hour workshift is typically broken into 18 one–half hour shifts in various locations of the port. INS inspectors typically work four hours of a nine–hour workshift in the primary inspection area where they are exposed to vehicle exhaust. At no time are INS inspectors assigned to work in the primary inspection area for more than two consecutive half–hour shifts.

Each lane also has a local exhaust ventilation system in the primary inspection area. The pavement exhaust system consists of an approximate 2'x4' exhaust grate located beneath a stopped automobile. Although most vehicle exhausts come from the rear of an automobile, most cars pulling into the primary inspection area stop with the pavement exhaust grate under the middle of the automobile. The pedestal exhaust system consists of a 2'x2' exhaust grate along the side of the automobile to capture exhausts coming from the rear driver side. The pedestal exhaust is located in an appropriate area to capture exhaust coming from most automobiles.

During times of heavy traffic, hundreds of cars can be backed–up in the 24 inspection lanes. At this time, a second INS inspector is sent out to work in the pre–primary inspection area. This is called a "double push" and inspectors stand approximately 21 yards in front of the primary inspection booth. For example, an INS inspector working in an administration building may be told to "double push lane 7." The inspector would then go approximately 21 yards in front of lane 7 to inspect vehicles and check passports and immigration papers, thereby speeding traffic through the port. The INS inspector working in a "double push" position does not have the advantage of a booth to stand in or local exhaust ventilation. Additionally, INS inspectors working in the pre–primary inspection area are exposed to exhaust from multiple vehicles in front of, behind, and on both sides of the pre–primary inspection area. INS inspectors working in a "double push" position typically stay in that position until the traffic has died down, at which time the inspector will return to the position they left or their next position in their rotation schedule.

The U.S. Customs Service operates a Brüel & Kjær (B&K) model 1302 monitor with a model 1309 multi–port sampler to monitor CO concentrations from seven areas. Six CO sampling ports are located at the primary inspection booths and one sampling port is located directly outside the operations office. Air samples are collected every minute, analyzed by the B&K, and recorded by a computer. The data are processed and graphically displayed for monitoring purposes. The system has been in operation since March or April 1995; however, the CO monitor was being serviced during the NIOSH survey.

Dilution ventilation for the canopy is provided by six fans mounted on the canopy roof. These fans respond to sensors which turn the fans on when CO levels reach 35 parts per million (ppm). A total of 18 sampling ports are dispersed throughout the canopy. These sampling ports go to overhead sensors that are calibrated every six months to trigger at 35 ppm CO. When the sensors detect 35 ppm CO, the overhead fans turn on and exhaust air above the canopy.

In 1973 and 1974, the San Ysidro POE was one of 16 border crossing stations involved in a study that resulted in the NIOSH publication, *Industrial Hygiene Surveys at U.S. Border Crossing Stations during August 1973 – June 1974.*[1] In most circumstances, full–shift overexposures to vehicle exhaust, including CO, were not found; however, the CO monitoring conducted during these surveys was not integrated and did not evaluate peak exposures to CO. Since this survey, U.S. automobile emissions have been substantially lowered by the use of exhaust gas recirculation (EGR), lean fuel–air mixtures, fuel injection systems, and catalytic converters. However, many vehicles crossing the San Ysidro border are older models that do not have these emission controls and are not in good operating condition. In some cases the cars crossing into the U.S. use leaded fuel. Automobiles that use leaded fuel, exhaust greater concentrations of contaminants because they can not use catalytic converters for emission control. Furthermore, traffic volume has increased significantly since the 1970s.

In 1995, NIOSH investigators conducted an HHE at the San Ysidro POE in response to a request from the U.S. Customs Service to evaluate CO exposures among U.S. Customs Inspectors.[2] This study identified overexposures to CO and deficiencies in the local exhaust ventilation systems. Recommendations were made to address these overexposures; however, INS officials reported that these recommendations have not been fully implemented.

METHODS

Noise

To continuously monitor personal noise exposures, Quest® Electronics Model M–27 Noise Logging Dosimeters were worn by employees during the workshift. The dosimeters were attached to the employee's belt and a small remote microphone was fastened to the work uniform (facing forward) at a mid–point between the ear and outside the employee's shoulder. The dosimeters were worn for the entire workday, including the employees' breaks and the lunch period. At the end of the workshift, the dosimeters were removed and paused to stop data collection. The information was downloaded to a personal computer for interpretation with Quest® Electronics M–27 computer software. The dosimeters were calibrated before and after the workshift according to the manufacturer's instructions.

Ventilation

Ventilation air velocity measurements were made in each of the 24 primary inspection booths. The average air flow from the east–side and west–side ceiling vents (5" x 72") was determined by taking five readings at different points along the surface of the vents with a TSI, Inc. VelociCalc® Plus Anemometer (Model 8360) and averaging the measurements. Each damper was checked to determine whether it was opened or closed. Air flow measurements were taken from the ceiling vents without adjusting the dampers. A visual inspection of the air handling units supplying air to the inspection booths was conducted.

The pedestal exhaust system and the pavement exhaust system located in the primary inspection area of four lanes were evaluated in the 1995 survey conducted by NIOSH. NIOSH investigators were informed that although the 1995 report recommended an engineering evaluation of the entire exhaust ventilation system and increased capture velocity at the pavement and pedestal exhausts, these recommendations had not been implemented. A visual inspection of the exhaust ventilation system was performed.

Carbon Monoxide

Carbon monoxide exposures were evaluated using full–shift integrated personal air monitoring and area monitoring. Monitoring was conducted using real–time, data–logging, passive CO monitors. The monitors log the full–shift time–weighted average exposure, the maximum 15–minute short–term exposure, and the maximum peak exposure to CO. The monitors used were Toxilog Personal Portable Gas Detectors manufactured by Biosystems, Inc. (Rockfall, CT), which use an electrochemical cell to detect CO. They were calibrated using a span gas and zeroed in the laboratory prior to their use on–site. A manufacturer representative indicated that a conservative estimate of the accuracy of these instruments is ±5% or ±2 ppm, whichever is greater. The range of these instruments is 0–999 ppm CO. Potential interfering compounds which are found in vehicular exhaust include sulfur dioxide, nitrogen dioxide, nitric oxide, and hydrogen.

Carbon Dioxide And Environmental Conditions

Real–time carbon dioxide (CO_2) concentrations were measured using a GasTech Model R1–411A Portable CO_2 Indicator. The CO_2 monitor was calibrated in the field using an 800 ppm CO_2 span gas. Wind speed, wind direction, temperature, and humidity measurements were taken using an anemometer.

Lead

Full–shift personal air monitoring for lead particulate was conducted. Samples were collected on closed–faced 37–mm mixed cellulose ester (MCE) membrane filters using calibrated sampling pumps at approximately 2 liters per minute (Lpm). Samples were analyzed using NIOSH Method 7105 "Lead by HGAAS."[3]

Soil samples for lead were also collected from the ground in the area of the primary inspection lanes. Samples were collected according to the soil sampling protocol described in the Department of Housing and Urban Development (HUD): *Guidelines for the Evaluation and Control of Lead–Based Paint Hazards in Housing Manual.*[4]

Volatile Organic Compounds

Thermal desorption tubes (both 3–bed and Tenax GR) and XAD–2 tubes were collected for qualitative analysis of volatile organic compounds (VOCs) by gas chromatography–mass spectroscopy (GC–MS). Qualitative analytical results were used to determine the analytes of concern for quantitation.

Personal and area air monitoring for hydrocarbons was conducted. Samples were collected onto SKC charcoal tubes, lot # 226–01, using sampling pumps calibrated to 0.05 Lpm. Samples were analyzed using NIOSH Method 1500 "Hydrocarbons, BP 36–126°C" and NIOSH Method 1501 "Hydrocarbons, Aromatic."[3]

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 criterion. 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 increase 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 recommended exposure limits (RELs),[5] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[6] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs).[7] In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards which are listed as transitional values in the current Code of Federal Regulations; however, some states operating their own OSHA–approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

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 short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short–term.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, tasteless gas which can be a product of the incomplete combustion of organic compounds. CO rapidly diffuses across alveolar, capillary, and placental membranes to bind with heme in the blood. Blood has an estimated 210–250 times greater affinity for CO than oxygen, thereby interfering with oxygen uptake and delivery to the body. Additionally, once absorbed into the bloodstream, the half–life of CO is approximately 5 hours. Overexposure to CO can result in headache, drowsiness, dizziness, nausea, vomiting, collapse, myocardial ischemia, and death.[8]

Many epidemiologic studies have been conducted to evaluate the long term health effects associated with exposures to low concentrations of CO. Of particular concern is the suspected relationship between CO and arteriosclerotic heart disease, cardiovascular disease (CVD), and ischemic heart disease (IHD). Some studies have shown a correlation between occupational exposure to CO and arteriosclerotic heart disease mortality.[9,10] Although there is evidence in the literature of an association between CVD and occupational CO exposure, an epidemiologic review of the literature in 1989 concluded that there is still need for further and better review of this issue before a conclusive statement can be made.[11] A 1994 study of CVD among foundry workers indicated that exposure to CO increased the risk of CVD morbidity and mortality. This was primarily attributed to increases in IHD.[12] Although some studies do show an association between CVD and CO exposure, the scientific community continues to be divided on this issue and further research continues.

The etiology of CVD from occupational exposure to CO is not fully understood; however, some studies have shown that the development of arteriosclerosis and coronary lipid deposition can be enhanced by arterial hypoxia.[13,14] CO exposure does induce partial arterial hypoxia depending upon the level and duration of exposure to CO.

The body compensates for hypoxic stress due to CO exposure by increasing cardiac output, thereby increasing blood flow to specific oxygen–demanding organs (the brain, the heart). This ability may be limited by pre–existing diseases which inhibit increased cardiac output, (i.e., heart and/or respiratory disease). Of particular concern is the case of the pregnant worker, whose endogenous carboxyhemoglobin level can be elevated three fold[15] and whose oxygen consumption is 15–25% higher than normal. Additionally, the mother's blood may have 20–30% reduced oxygen carrying capacity due to lower hemoglobin levels.[16] Exposure to CO can increase the carboxyhemoglobin level in the fetus's blood above the endogenous levels which are already close to critical levels. Additionally, the developing fetus does not have the ability to compensate for hypoxia through increases in cardiac output. Decreased birth weights and fetal death have been documented at moderate CO exposure (30 ppm) in laboratory animals.[15] A well–established relationship exists between smoking and low fetal birth weight; CO is suspected to be one of the primary etiologic agents responsible for this effect.

In 1972, NIOSH published a criteria document recommending that occupational exposures to CO be maintained to a level that will not induce a shift in carboxyhemoglobin level greater than 5%.[17]

NIOSH established an REL for CO of 35 ppm as a TWA for an 8–hour workday and a ceiling concentration of 200 ppm. A ceiling concentration is an exposure concentration which should not be exceeded at any time during the workshift.

In 1971, OSHA adopted a PEL for CO of 50 ppm for an 8–hour TWA.[18] In 1989, OSHA changed its PEL for CO to 35 ppm for an 8–hour TWA with a ceiling of 200 ppm.[7] As previously discussed, the 1989 PELs were vacated in federal court. The San Ysidro POE is a Federal facility and would be subject to Federal OSHA requirements; therefore, the 1971 OSHA PELs would apply.

In 1996, ACGIH revised its recommended occupational exposure criteria for CO.[19] The ACGIH recommends that occupational exposure to CO be based upon exposure levels that will maintain shifts in blood carboxyhemoglobin levels to below 3.5%. This 3.5% caboxyhemoglobin criteria was established "to minimize adverse neurobehavioral changes, and to maintain cardiovascular exercise capacity." The ACGIH recommendation also provides "a margin of safety for individuals particularly susceptible to the adverse effects of CO exposure, including pregnant workers (i.e., the fetus) and those with chronic heart and respiratory disease." The ACGIH TLV for CO is 25 ppm as an 8–hour TWA.

California operates a state OSHA compliance program (CalOSHA). The state program uses the 1989 PELs for their compliance program and updates those PELs every two years (to reflect current occupational health research). The CalOSHA standard for a full–shift exposure to CO is 25 ppm, with a ceiling concentration of 200 ppm.

Lead in Air

Lead is ubiquitous in U.S. urban environments due to the widespread use of lead compounds in industry, gasoline, and paints during the past century. Exposure to lead occurs via inhalation of dust and fume, and ingestion through contact with lead–contaminated hands, food, cigarettes, and clothing. Absorbed lead accumulates in the body in the soft tissues and bones. Lead is stored in bones for decades, and may cause health effects long after exposure, as it is slowly released in the body.

Symptoms of lead exposure include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop."[20,21,22] Overexposure to lead may also result in damage to the kidneys, anemia, high blood pressure, infertility and reduced sex drive in both sexes, and impotence. An individual's blood lead level (BLL) is a good indication of recent exposure to, and current absorption of lead.[23] The frequency and severity of symptoms associated with lead exposure generally increase with the BLL.

Leaded fuel in gasoline was outlawed in the U.S. in 1976; however, leaded gasoline is still used and sold in Mexico. Automobiles currently entering the U.S., if registered in Mexico, do not have to pass U.S. emissions standards to enter the country. Automobiles that burn leaded gasoline cannot use catalytic converters on their exhaust systems as the lead in the gasoline destroys the chemical used in the catalytic process. Therefore, automobiles entering the U.S. that burn leaded fuel not only emit lead particulate into the environment but also emit higher concentrations of exhaust emissions as they do not use catalytic converters.

Under the OSHA general industry lead standard (29 CFR 1910.1025), the PEL for airborne exposure to lead is 50 micrograms per cubic meter ($\mu g/m^3$) (8–hour TWA).[24] The standard requires lowering the PEL for shifts exceeding 8 hours, medical monitoring for employees exposed to airborne lead at or above the action level of 30 $\mu g/m^3$ (8–hour TWA), medical removal of employees whose average BLL is 50 micrograms per deciliter ($\mu g/dL$) or greater, and economic protection for medically removed workers.

Lead in Surface Dust and Soil

Lead–contaminated surface dust and soil represent potential sources of lead exposure, particularly for young children. This may occur either by direct hand–to–mouth contact, or indirectly from hand–to–mouth contact with contaminated clothing, cigarettes, or food. Previous studies have found a significant correlation between resident children's BLLs and house dust lead levels.[25] There is currently no federal standard which provides a permissible limit for lead contamination of surfaces in occupational settings. As required by Section 403 of the Toxic Substances Control Act (TSCA), the Environmental Protection Agency (EPA) is in the process of developing a rule to address hazards from lead–contaminated dust and soil in and around homes.

The EPA currently recommends a strategy of scaled responses to soil lead contamination, depending upon lead concentrations and site–specific factors.[26] When lead concentrations exceed 400 ppm in bare soil, the EPA recommends further evaluation and exposure reduction activities be undertaken, appropriate to the site–specific level of risk. If soil lead concentrations exceed 5000 ppm, the EPA recommends permanent abatement of contaminated soil.

Hydrocarbons

Gasoline is a clear, volatile petroleum fuel used primarily in internal combustion engines. It is a complex mixture of hydrocarbons, with an overall carbon number range of C_4–C_{12}. The chemical composition can vary widely and depends on the production techniques, seasonal variability, and the presence of additives.[27,28] Previous studies have found that the standard gasoline formulation contains 62% alkanes, 7% alkenes, and 31% aromatics.[29] From a health perspective, exposures to benzene and the lighter hydrocarbons (C_6 or lower) are the constituents of most concern. Some of the compounds commonly found in gasoline exhaust include: benzene, toluene, ethyl benzene, xylene, low molecular weight alkanes, nitrogen, CO_2, CO, oxygen, hydrogen, oxides of nitrogen, and oxygenates.[30]

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.[31] 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.[32]

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 100–fold 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)[33] 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. NIOSH, in its Criteria for a Recommended Standard[34] proposed a REL of 85 dB(A) for 8 hours, 5 dB less than the OSHA standard. The NIOSH 1972 criteria document also used a 5 dB time/intensity trading relationship in calculating exposure limits. However, in 1995, NIOSH changed its official recommendation for an exchange rate of 5 dB to 3 dB.[35] The ACGIH also changed its TLV in 1994 to a more protective 85 dB(A) for an 8–hour exposure, with the stipulation that a 3 dB exchange rate be used to calculate time–varying noise exposures.[6] 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.

The duration and sound level intensities can be combined in order to calculate a worker's daily noise dose according to the formula:

$$\text{Dose} = 100 \times (C1/T1 + C2/T2 + ... + Cn/Tn),$$

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.[33] During any 24–hour period, a worker is allowed up to 100% of a 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 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. However, in 1983, a compliance memorandum (CPL 2–2.35) directed OSHA compliance officers not to cite employers for lack of engineering controls until workers' TWA levels exceed 100 dB(A), so long as the company has an effective hearing conservation program in place. Even in TWA levels in excess of 100 dB(A), compliance officers are to use their discretion in issuing fines for lack of engineering controls.

RESULTS

Noise

Six INS inspectors volunteered to wear a noise dosimeter during their workshift. The inspectors rotated every 30 minutes to a different location according to their daily schedule. A portion of the time was spent in one of the primary inspection booths. Because the noise dosimeters were calibrated to the time of day when first turned on in the morning, the noise levels associated with working in the booths can be identified in the data printout. The daily noise levels for five of the inspectors (the data for one of the inspectors was erased before it could be stored) are shown in Figures 1–5. The booth locations are noted on each of the figures by the booth number on the figure above the half–hour time period when the inspector was assigned to it. Generally, the noise appears more steady when the inspector was at a primary inspection location because the major sources of noise are from the vehicles and the ventilation system. Area samples were collected in booths #2 and #24. The daily noise levels in these two booths are shown in Figures 6 and 7, respectively.

The A–weighted average noise levels measured for the five inspectors are summarized in Table 1. The table shows the 8–hour TWA values calculated according to the OSHA regulation (L_{OSHA}) and the NIOSH criterion (L_{EQ}). The inspectors do not routinely work 8–hour days at this location. Therefore, the TWA noise values have been converted to percent of daily allowable dose and interpolated to 9–hour and 10–hour workshifts which is their normal work day. For both evaluation criteria, the daily dose never exceeds 100% which would represent the maximum allowable noise level. Also, a dose of 50%, which is designated as the AL calculated according to the OSHA regulation, is not exceeded for any of the inspectors.

Carbon Monoxide

Four INS inspectors volunteered to wear a passive CO monitor during their workshift. A graphical representation of the monitoring results from INS Inspector #5 is presented as Figure 8. This INS inspector spent four hours of the nine hour workshift in the inspection lanes. The full–shift TWA exposure was 16 ppm CO. The maximum 15–minute short term exposure was 86 ppm CO and the maximum peak reading was 819 ppm, occurring at 7:36 a.m. At two other periods during the day, this CO monitor recorded values in excess of the CalOSHA PEL and NIOSH ceiling concentration of 200 ppm. At 14:24 the CO level was 458 ppm and at 14:46 the CO level was 205 ppm. At the time of the 819 ppm peak exposure to CO, the INS inspector was working on primary inspection line 18. This inspector noticed that his personal monitor was recording 800 ppm CO and stated that he was talking to the car owner through the driver side window when this occurred. The one–minute exposures greater than 200 ppm represent an overexposure to CO, according to the CalOSHA PEL and NIOSH REL. It should be noted that the four areas of CO exposure activity as seen on the graph correspond to the four periods the inspector was working in the primary inspection area. The periods of low exposure correspond to periods of time the inspector was working inside a building.

A graphical representation of the monitoring results from INS Inspector #3 is presented as Figure 9. This inspector spent four hours of the nine hour workshift in the inspection lanes where exposure to CO is a concern. The full–shift TWA exposure was 6 ppm CO, the maximum 15–minute short term exposure was 36 ppm CO, and the maximum peak concentration was 90 ppm. No overexposure to CO was identified in this sample.

A graphical representation of the monitoring results INS Inspector #2 is presented as Figure 10. This inspector spent 3½ hours of an 8–hour workshift in the inspection lanes where exposure to CO is a concern. The CO monitor drifted after nine minutes of recording positive CO exposures to a negative CO reading. This is not uncommon when using electrochemical cells for the determination of real–time CO levels as the monitor may have been jarred after the readings began. The maximum instrument drift recorded a value of –10 ppm CO. For this reason, the TWA exposure calculation is not considered valid. However, this instrument recorded peak CO exposures of 310 ppm at 8:07 and 268 ppm at 8:36. Given that the CO monitors have an accuracy of ±5%, the lower estimate of these peak readings is 279 ppm and 255 ppm respectively. Both these values are well above the CalOSHA PEL and NIOSH recommended ceiling exposure to CO of 200 ppm. Additionally, these CO exposures were recorded from a baseline of approximately –5 ppm CO. These peak exposure levels may be an underestimate of the actual exposure.

A graphical representation of the monitoring results from INS Inspector #4 is presented as Figure 11. This inspector spent 4 hours of a 9–hour workshift in the inspection lanes. The CO monitor drifted after 54 minutes of recording positive CO exposures to a negative CO reading. The maximum instrument drift recorded a value of –12 ppm CO. For this reason, the TWA exposure calculation is not considered valid. However, this instrument recorded a peak CO exposure of 443 ppm at 6:55. At this time, the CO monitor had a positive baseline. The one–minute exposure greater than 200 ppm represents an overexposure to CO, per the CalOSHA

PEL and NIOSH REL. It should be noted that the four areas of CO exposure activity as seen on the graph correspond to the four periods the inspector was working in the primary inspection area.

Twenty–four hour area monitoring for CO was conducted in the primary inspection area of lane 7. INS inspectors identified the area for monitoring as representative of where inspectors stand during a push. The area monitoring identified a TWA concentration of 18 ppm, a maximum 15–minute short term exposure of 108 ppm, and a maximum peak concentration of 355 ppm. A graphical representation of the analytical results from this CO monitoring event is presented as Figure 12. It should be noted that during this 24–hour period, seven peaks were above the CalOSHA PEL and NIOSH ceiling of 200 ppm (228 ppm – 355 ppm).

Twenty–four hour area monitoring for CO was conducted in the pre–primary inspection area of lane 7. INS inspectors identified the area for monitoring as representative of where inspectors stand during a "double push." This area is approximately 21 yards in front of the primary inspection booth of lane 7. The area monitoring identified a TWA concentration of 53 ppm, a maximum 15–minute short term exposure of 169 ppm, and a maximum peak concentration of 852 ppm. A graphical representation of the analytical results from this CO monitoring event is presented as Figure 13. It should be noted that during this 24–hour period, 22 peaks were above the CalOSHA PEL and NIOSH ceiling of 200 ppm (204 ppm – 852 ppm).

Volatile Organic Compounds

Four area thermal tube air samples were collected in the primary inspection area, two were collected in the pre–primary inspection area, and two were collected in the north parking lot to establish background concentrations of VOCs. Samples were collected for approximately 2 hours at a flow rate of 0.05 Lpm. The qualitative analysis for VOCs primarily identified toluene, xylene, benzene, various C_3–C_8 aliphatic hydrocarbons, C_3–C_4 alkyl substituted benzenes, and methyl tert–butyl ether (MTBE).

Analytical results from the qualitative VOC analyses were used to identify compounds of interest for quantitation using charcoal tube samples collected on four INS inspectors. A total of six personal breathing zone (PBZ) air samples were collected for periods of time ranging from 2 hours to 4 hours. Three area samples were collected in the primary and pre–primary inspection areas for periods of time ranging from 1 hour to 2 hours. The charcoal tubes were quantitated for benzene, ethyl benzene, total xylenes, toluene, hexane, pentane, octane, and heptane.

All personal and area charcoal tube air samples were below the limit of detection (LOD) for each evaluated hydrocarbon with the exception of one sample. One sample identified trace amounts of toluene. This sample quantified toluene between the minimum detectable concentration of 0.085 milligrams per cubic meter (mg/m^3) (0.023 ppm) and the minimum quantifiable concentration of 0.34 mg/m^3 (0.088 ppm), assuming a sample volume of 11.8 liters. This is well below all applicable occupational health criteria for toluene: OSHA PEL of 200 ppm, NIOSH REL of 100 ppm, and ACGIH TLV of 50 ppm.

Lead

Four INS inspectors volunteered to wear a sampling pump for the collection of lead air filter samples during their workshift. The analytical results revealed lead concentrations between the LOD and the limit of quantification (LOQ) of the method. The analytical LOD is 0.02 micrograms (µg) of lead/filter, which equates to a minimum detectable concentration of 0.02 µg of lead/m^3, assuming a sample volume of 1,100 liters. The analytical LOQ is 0.07 µg of lead/filter, which equates to a minimum quantifiable concentration of 0.06 µg of lead/m^3, assuming a sample volume of 1,100 liters. All personal samples for lead particulate were between 0.02 µg of lead/m^3 and 0.07 µg of lead/m^3.

This is well below the OSHA action level of 30 µg of lead/m^3.

Soil sampling was conducted at the San Ysidro POE at three locations. Composite soil samples were collected in the following areas: west of the inspection booth in lane 24, south–east of the pre–primary inspection area of lane 1, and on the east side of the secondary vehicle inspection area. The soil west of the lane 24 inspection booth contained 53 micrograms of lead/gram of soil (µg/g). The soil had recently been laid down in this location. The samples collected to the south–east of pre–primary inspection lane 1 and on the east side of the secondary vehicle inspection area contained 15 µg/g and 640 µg/g, respectively. These composite samples are spot samples and should not be considered a characterization of the entire location.

Ventilation

There are 24 inspection booths, with 12 ventilated by systems located in a mechanical room on the east side of the complex and the other 12 ventilated by systems located in a mechanical room on the west side of the complex. The exhaust ventilation system is designed to reduce vehicle emissions and consists of grids in the pavement and pedestal exhausts along the sides of the inspection lanes. The east and west exhaust systems each have 100 horsepower motors with a nominal air flow of 60,000 cubic feet per minute (CFM).

This exhaust system was thoroughly evaluated in the 1995 NIOSH investigation. In four lanes, the pedestal and pavement exhaust capture velocities were calculated. The pavement exhaust capture velocities were between 170–230 feet per minute (fpm) and the pedestal exhaust capture velocities were between 20–30 fpm. Based upon the release of a contaminant at high velocity (from the tail pipe of a car) into a zone of very rapid air motion (windy area), the capture velocities at the pedestal and pavement exhaust should be between 500–2000 fpm.[36] INS officials indicated that there had been no change in the exhaust ventilation system since that evaluation. A limited inspection of this system and qualitative evaluation appeared to support the 1995 study finding that the exhaust system does not operate at a high enough flow rate to effectively capture vehicle emissions.

A second ventilation system supplies air to each of the inspection booths through two ceiling vents. Two supply air motors are located in each of the east and west mechanical rooms. Each supply motor is 25 horsepower with a nominal air flow of 24,000 CFM. Make–up air for the supply is drawn from the outside through a bank of air filters. The supply air is not tempered before it reaches the inspection booths. There are heating coils above each booth but there is no provision for cooling the supply air. The most lateral inspection booths (#1–6 and #19–24) are supplied air directly from the main trunk line by a stationary deflector. The middle booths (#7–12 and #13–18) have air supplied through connector lines from the main trunk line with controllable dampers.

Visual inspections of the ceiling grids in the inspection booths revealed many different configurations of grid closings. Some had been left completely open and others were completely or partially closed. Because of some obvious bending of the grids, it seems as though the employees are attempting to change the grid closures on their own. Also, the east ceiling vent was typically closed to some degree more than the west ceiling vent. This is reflected in the finding that 18 of the 24 booths had more air flow through the west side vent (Table 2). Overall, the air velocities varied greatly between the inspection booths, ranging from 333 fpm to 2,300 fpm. Area noise measurements found that the highest noise levels were in the two booths with the highest air flow, #7 and #20.

DISCUSSION

Carbon Monoxide

Personal CO monitoring for full–shift exposures to CO were below the most stringent occupational health criteria for CO. Job rotation is effectively reducing full–shift exposures to CO to acceptable levels; however, peak exposures to CO still exceed the NIOSH REL and the CalOSHA PEL in both personal and area monitoring. NIOSH recommends that at no time during the day an employee be exposed to concentrations of CO greater than 200 ppm. The CalOSHA standard has a TWA–PEL of 25 ppm and a ceiling concentration of 200 ppm.

It is recommended that the CalOSHA standard be used as guidance for establishing CO exposure criteria for INS inspectors.

Three out of the four personal CO samples identified peak 1–minute exposures to CO that were greater than the NIOSH recommended ceiling concentration of 200 ppm. Area monitoring conducted in the primary inspection area of lane 7 identified seven 1–minute peak measurements that were greater than 200 ppm and area monitoring conducted in the pre–primary inspection area of lane 7 identified 22 1–minute peak measurements greater than 200 ppm. Both the area monitors were positioned to collect data where INS inspectors typically work.

Area monitoring revealed lower CO concentrations in the primary inspection area than in the pre–primary inspection area (see Figures 12 and 13). As the cars passing through the pre–primary and the primary inspection areas of lane 7 were the same and the sampling locations were similar, these differences are likely due to the fact that only one car is idling in the primary inspection area as opposed to multiple cars which can be idling in the pre–primary inspection area. Once cars have passed the primary inspection, they advance across the border and out of the work area of the INS inspector. The use of local exhaust ventilation in the primary inspection area may have some effect on INS inspector exposures; however, the 1995 NIOSH survey found the capture velocity of the exhaust ventilation system to be insufficient.[2]

The practice of "double pushing" inspections to decrease the time spent by motorists waiting to cross the border involves an employee working in the pre–primary position. Working in this area, INS inspectors do not have the benefit of local exhaust ventilation or fresh air from a booth. Additionally, the inspectors are exposed to vehicle exhaust from multiple vehicles. During the 24–hour monitoring period, the NIOSH ceiling of 200 ppm was exceeded approximately once per hour. The maximum 15–minute concentration of CO in the pre–primary inspection area was 169 ppm. Assuming a light workload, an individuals blood carboxyhemoglobin level would reach 3.5% after approximately 16 minutes and 10 seconds of exposure to 169 ppm CO.[17] In 1996, the ACGIH recommended that CO exposures should maintain shifts in blood carboxyhemoglobin levels to below 3.5% for an entire workshift.[19] This recommendation was established to minimize the potential for adverse neurobehavioral changes and to maintain cardiovascular exercise capacity. The recommendation also provides a margin of safety for those particularly susceptible to CO exposure, including pregnant workers (the fetus), and workers with chronic heart or respiratory disease. The CalOSHA standards for CO exposure are also based upon maintaining shifts in carboxyhemoglobin to less than 3.5%.

The earlier NIOSH study (HETA 95–0365) involved the collection of four personal exposure samples for CO. Although the CO concentrations were well below the most stringent occupational health criteria for a full–shift exposure, half of the samples showed peak exposures to CO greater than 200 ppm. The 1995 study recommended an engineering evaluation of the exhaust ventilation systems, including the possible relocation of the pavement exhaust system, and recommended that increased capture velocities were needed for both the pavement and pedestal exhaust. These recommendations have yet to be implemented.

Lead

No INS inspectors were exposed to lead particulate above the OSHA action level of 30 $\mu g/m^3$. Analytical results revealed that airborne concentrations of lead were over 400 times below the most stringent occupational exposure criteria for lead on the day of measurement.

Background soil lead levels in rural areas are typically less than 50 micrograms per gram (µg/g), while urban soil levels are usually in the 400–2000 µg/g range.[26] The EPA, under the Residential Lead–Based Paint Hazard Reduction Act (Title X), recognizes a bare soil lead concentration of 400 µg/g as a concern when in an area where there is high potential for use by children.[26] Where there is unlikely or infrequent child contact, the EPA uses a bare soil lead of 2000 µg/g as a concentration of concern. The concentration of lead in the secondary vehicle inspection area composite sample falls into the concern range for an area where there is high potential use by children. However, the area sampled is not likely to be used by children.

Volatile Organic Compounds

This study found that the following qualitatively identified hydrocarbons were all well below their respective occupational exposure criteria: toluene, benzene, ethyl benzene, total xylene, hexane, pentane, octane, and heptane.

Noise

The INS inspectors are not exposed to noise levels that are hazardous to their hearing. In no case did the noise dosimeters exceed 50% of the OSHA PEL for an extended workshift. The more stringent NIOSH REL was also not exceeded for any of the measurements.

Ventilation

The supply air flow in the inspection booths varies greatly across the 24 booths. Comparisons of air flows through ceiling diffusers that have been left open exhibit variations from 333 fpm to 2,300 fpm, indicating a system that is out of balance. The partial and complete closure of the other ceiling vents adds even more variability to the air flow reaching the inspection booths. It is interesting to note that the ceiling vent on the east side of the booth was more likely to be closed. It is the east side of the booth where the INS inspector talks to the vehicle occupants. Higher air flows from the ceiling vents were correlated with higher noise levels in the booths. These higher noise levels can mask conversation with vehicle occupants.

CONCLUSIONS

The reported health effects among INS inspectors identified in the request for HHE were headaches, dizziness, breathing problems, and difficulty hearing. The NIOSH evaluation has shown that INS inspectors are exposed to CO in excess of the CalOSHA PEL and NIOSH recommended ceiling concentration of 200 ppm. This overexposure occurs in the primary and pre–primary inspection areas. The likelihood of overexposure to CO is greater in the pre–primary inspection area than the primary inspection area. CO exposure has been shown to be associated with headaches, dizziness, and problems breathing.

The noise survey concludes that INS inspectors are not overexposed to noise when inspecting vehicles crossing the border. However, many of the INS inspectors do qualify their weapons on a firing range where overexposure to noise is likely if proper hearing protection is not used correctly. The reported difficulty hearing among INS inspectors may be due to continuous low level background noise on the inspection line, possibly due in part to the imbalanced supply ventilation system. This background noise may cause interferences, making communication difficult, but is not anticipated to cause occupation hearing loss.

RECOMMENDATIONS

NIOSH recommends that steps be taken to reduce INS inspector exposures to CO, that an audiometric testing program be implemented for officers who must shoot on a firing range, and that a formal exposure assessment program be implemented to routinely evaluate personal CO exposures and the effectiveness of any changes to the work environment.

Carbon Monoxide

There are several methods that can be used to reduce exposures to workplace contaminants. The preferred control method for CO at this work site is to add new ventilation systems and improve the existing ventilation systems. The second preferred control method is the addition of new administrative controls. The third preferred control method is to use respiratory protection. It may be necessary to use respiratory protection until suitable engineering and/or administrative controls can be implemented.

- **Local exhaust ventilation and booths should be provided for employees working in the pre–primary inspection area.** The local exhaust ventilation system and booths currently located in the primary inspection area should be duplicated in the pre–primary inspection area. The exhaust ventilation should be installed in a location that is consistent with the area of vehicle exhaust from most automobiles.

- **The capture velocity of the pavement and pedestal exhaust ventilation system in the primary inspection area should be adjusted and balanced to between 500 and 2000 fpm.** It may also be necessary to relocate the pavement exhaust ventilation opening. The current location of the pavement exhaust inlet is beneath the center of the car, rather than the rear of the car where most automobiles exhaust emissions.

- **The set point on the dilution ventilation fans mounted into the canopy should be lowered to 25 ppm.** These fans are currently set to turn on when CO concentrations of 35 ppm are detected at one of 16 sample ports in the canopy roof. The most current occupational health criteria suggests that exposures should be maintained below 25 ppm as a TWA.

- **The supply ventilation system should be evaluated and balanced by a qualified mechanical contractor.** This will eliminate the variations in air flow in the inspection booths so that the employees may be less likely to attempt to change the ceiling dampers on their own. Additionally, this should reduce noise levels in some of the noisier booths enabling INS inspectors to spend more time in the booths away from vehicle emissions.
- **INS inspectors should be limited to 15 minute shifts in the pre–primary location, with the following restrictions: (1) employees should only do so once per workshift, and (2) employees should not work in the primary vehicle inspection area for any other rotation during that workshift.** This is due to the 3.5% shift in carboxyhemoglobin level which may occur in just over 16 minutes (approximately 16 minutes and 10 seconds) when working in the pre–primary vehicle inspection area. This is currently the maximum recommended shift in blood carboxyhemoglobin levels for a full workshift. Any exposure to CO from working in the primary vehicle inspection area either prior to or following working a "double push" in the pre–primary vehicle inspection area could produce cumulative CO exposures which would yield shifts in blood carboxyhemoglobin levels well in excess of 3.5%. As previously discussed, human blood has a 210–250 times greater affinity for CO than it does oxygen. Once CO has entered the bloodstream of an employee, forming carboxyhemoglobin, that employee requires 5–hours of CO–free air to breath before half of the CO in that employees bloodstream is removed from the body. Any employee working in the pre–primary inspection area for 15 minutes without respiratory protection should not spend any other part of the day working in an area of CO exposure, i.e. the primary vehicle inspection area.

- **Until effective engineering or administrative controls can be implemented, INS inspectors should avoid working in the pre–primary inspection area.** If inspectors must work in the pre–primary inspection area without engineering or administrative controls, inspectors should use respiratory protection. This is due to the frequency of peak exposures greater than 200 ppm and the 15–minute STEL exposure of 169 ppm recorded by the area monitor in this location. The only available forms of air purifying respiratory protection for CO exposure are full–facepiece, air purifying respirators that use a canister for filtering CO (NIOSH approval # TC–14G–0096 and TC–14G–0233). The difference in the two respirators is that the canister of one is mounted to the front of the facepiece and the canister of the other is chest or back mounted. It should be recognized by management that the use of a full–facepiece respirator may cause heat stress problems among INS inspectors due to the climate in San Ysidro, California. Additionally, communication using a full–facepiece respirator may be more difficult for INS inspectors working in the pre–primary area.

- **Pregnant workers, and workers with heart disease or respiratory disease are more susceptible to the adverse effects of carbon monoxide exposure.** Individuals with these conditions should consult their physician about their personal situation.

Noise

The INS inspectors are not exposed to hazardous noise in the inspection area of the port. However, the officers are exposed to potentially damaging noise whenever they qualify their weapons on the firing range. For this reason, an audiometric testing program for officers who must shoot on a firing range should be implemented to track the hearing of the officers to assure that damaging noise is not reaching their ears. The OSHA standard 1910.95 should be used to establish a hearing conservation program.

Exposure Assessment Program

Any ventilation changes to the pre–primary or primary inspection areas should be followed by personal CO exposure assessments using real–time, integrated CO monitors that log data every minute. Controls should be implemented or modified until employees no longer experience personal exposures to CO greater than the CalOSHA PEL and NIOSH recommended ceiling concentration of 200 ppm. The program should provide for annual personal CO monitoring.

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Table 1
Noise Dosimeter Data

INS
San Ysidro, California
September 18, 1997
HETA 97–0291

Sample Location	Sampling Time [hh:mm]	L_{OSHA} [dBA]	8–hr. Dose [%]	9–hr. Dose [%]	10–hr. Dose [%]	L_{EQ} [dBA]	8–hr. Dose [%]	9–hr. Dose [%]	10–hr. Dose [%]
Inspector #1	08:28	69.6	5.9	6.7	7.4	77.6	18.2	20.4	22.9
Inspector #2	07:32	69.1	5.5	6.2	6.9	80.0	31.6	36.3	39.8
Inspector #3	08:12	76.6	15.6	17.5	19.5	81.8	47.9	53.7	58.9
Inspector #4	08:15	77.2	17.0	19.2	21.3	82.2	52.5	58.9	66.1
Inspector #5	07:57	74.4	11.5	12.9	14.4	82.3	53.7	61.6	67.6

Noise dosimeter data for the surveyed INS inspectors. The $\mathbf{L_{OSHA}}$ noise levels are based on a 5–dB exchange rate and an 80 dB(A) threshold as regulated by OSHA. The $\mathbf{L_{EQ}}$ levels are based on a 3–dB exchange rate and no threshold according to the NIOSH criterion. The various dose percentages are the amounts of noise accumulated during different shifts with 100% representing the maximum allowable daily dose.

Table 2
Noise and Air Flow Data
from the Primary Inspection Booths

INS
San Ysidro, California
September 18, 1997
HETA 97–0291

Booth No.	Noise Level [dB(SPL)]	Air Flow Velocity [feet/minute]		Notes
		East Vent	West Vent	
1	93.8	630	740	Both dampers partially closed
2	92.5	970	1310	Both dampers closed except 6" of east side
3	89.7	725	630	Both dampers open except 12" of west side
4	NM	1130	1190	Both dampers open
5	NM	1100	1190	Both dampers open
6	96.9	725	700	Both dampers partially open
7	100.5	1620	2100	Both dampers open
8	89.5	1180	1640	West damper open; east only 1/3 open
9	NM	487	1480	West damper open; east mostly closed
10	NM	785	1230	West damper open; east mostly closed
11	NM	1340	1480	Both dampers open
12	NM	530	1060	West damper open; east damper closed

NM – *no measurement*

**Table 2 (Continued)
Noise and Air Flow Data
from the Primary Inspection Booths**

**INS
San Ysidro, California
September 18, 1997
HETA 97–0291**

Booth No.	Noise Level dB(SPL)	Air Flow Velocity feet/minute		Notes
		East Vent	West Vent	
13	NM	1370	1400	Both dampers open
14	NM	1940	960	West damper open; east only 1/3 open
15	88.5	1610	363	West damper closed; east only 1/3 open
16	94.5	1380	835	West damper closed; east mostly closed
17	NM	333	655	West damper open; east only 1/3 open
18	90.5	459	740	West damper open; east only 1/3 open
19	91.6	1010	1210	West damper open; east only 1/3 closed
20	113.9	2330	1370	Both dampers closed except 6" of east side
21	91.9	520	1360	West damper open; east damper closed
22	92.5	620	710	Both dampers partially closed
23	NM	341	1140	West damper open; east damper closed
24	NM	980	1140	Both dampers open

NM – *no measurement*

HHE Supplement

INS Inspections at the San Ysidro POE

In August of 1997, NIOSH representatives conducted a health hazard evaluation at the San Ysidro Port of Entry (POE). We looked into employee and management concerns about exposure to vehicle exhaust and noise. This sheet summarizes our evaluation and findings.

What NIOSH Did

We focused on worker exposures in the primary and pre-primary inspection areas of lanes 1-24.

We tested the air for vehicle exhaust emissions. The specific chemicals we tested for were carbon monoxide, carbon dioxide, lead, and hydrocarbons (benzene, ethyl benzene, total xylenes, toluene, hexane, pentane, octane, and heptane).

We measured noise levels inspectors encounter during the day. We measured noise levels in each inspection booth.

We looked at the ventilation systems providing air to the 24 inspection booths.

We looked at the ventilation systems removing air from the 24 inspection lanes.

What NIOSH Found

(The full report lists the actual chemical levels NIOSH found and explains how those chemicals may affect the health of the exposed employees.)

Inspectors were exposed to one-minute peaks of carbon monoxide that are above NIOSH criteria.

Job rotation reduced carbon monoxide exposures to acceptable levels for the whole work day.

The levels of carbon monoxide were higher in the pre-primary inspection area than they were in the primary inspection area.

Lead, carbon dioxide, noise, and hydrocarbon levels were below all exposure criteria.

The supply air to booths 1-24 is not balanced. Some booths get too much air, others don't get enough.

The exhaust air vents in lanes 1-24 is not strong enough to remove vehicle exhaust emissions.

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 1–800–35–NIOSH and ask for HETA report # 97–0291–2681.

What INS Managers Can Do

Local exhaust ventilation and booths should be built in the pre-primary inspection area.

INS inspectors should be limited to one 15-minute shift per day in the pre-primary inspection area until appropriate exhaust ventilation and booths can be built.

Any INS inspector who works for 15-minutes in the pre-primary inspection area should not work around automobile exhaust for any other part of the work shift.

The exhaust ventilation in lanes 1-24 should be increased to capture more vehicle exhausts.

The supply ventilation to the booths should be balanced so that air flow is equal in each booth. This should help reduce noise levels in some booths.

The set point on the canopy dilution fans should be lowered from 35 ppm to 25 ppm of carbon monoxide.

A hearing conservation program should be started for officers who qualify their weapons on a firing range.

An ongoing program of evaluating personal carbon monoxide exposures should be started.

What INS Employees Can Do

Don't work for more than 15-minutes in the pre-primary inspection area, until local exhaust ventilation and booths can be built.

If you work in the pre-primary inspection area for 15-minutes, don't work in any other area of vehicle exhaust exposure for your entire work shift.

Spend as much time as possible in the booths when conducting inspections.

Pregnant workers, and workers with heart disease or respiratory disease are more susceptible to carbon monoxide. Consult your doctor about your personal situation.

Inspectors should avoid changing ceiling dampers in the booths.

National Institute for Occupational Safety and Health

NIOSH

Delivering on the Nation's promise:
Safety and health at work for all people
through research and prevention