



SURVEY REPORT

OPTIONS FOR THE CONTROL OF BORDER AGENTS EXPOSURE TO VEHICLE EMISSIONS: RECOMMENDATIONS FOR A PILOT STUDY

AT

**United States Port of Entry
Calexico, California**

**REPORT WRITTEN BY:
Kevin Dunn, M.S.E.E.
G. Scott Earnest, Ph.D.**

**REPORT DATE:
March 30, 2001**

**REPORT NO.:
EPHB 010-04a**

**U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Division of Applied Research and Technology
4676 Columbia Parkway, Mailstop R-5
Cincinnati, OH 45226**

STUDY SITE:

Calexico Port of Entry
Calexico, California

SIC CODE:

9721

STUDY DATES:

November 15-17, 2000

STUDY CONDUCTED BY:

Kevin H. Dunn, NIOSH
G. Scott Earnest, NIOSH

**EMPLOYER REPRESENTATIVES
CONTACTED:**

Alan Belauskas
Immigration & Naturalization Service

Gerald Stachowitz
United States Customs Service

Wendy Phelps
General Services Administration (GSA)

**Reproduced from
best available copy.**



**EMPLOYEE REPRESENTATIVES
CONTACTED:**

Bob Barron
Local 2805
American Federation of Government
Employees (AFGE)

**PROTECTED UNDER INTERNATIONAL COPYRIGHT
ALL RIGHTS RESERVED
NATIONAL TECHNICAL INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE**

DISCLAIMER

Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention.

INTRODUCTION

The Calexico Port of Entry (P.O.E.) serves as the gateway between Mexicali, Mexico and the United States. Over 20,000 vehicles enter the U.S. through the Calexico Port of Entry every 24 hours¹. The border vehicle inspection area consists of 11 primary inspection lanes and a vehicle secondary inspection area. All traffic enters the Calexico Port of Entry through one of the primary inspection lanes. If a more thorough inspection is necessary, cars are directed to the secondary inspection area and the engines are shutdown during vehicle searches. Each primary inspection lane has one agent which may be employed by the U.S. Customs Service or the U.S. Immigration and Naturalization Service (INS). Each federal agency typically provides half of the inspectors during each shift.

Inspectors for both agencies are rotated among primary inspection lanes, vehicle secondary, pedestrian lane, pedestrian secondary, and operations². The 9 hour work shift is divided into 30 minute intervals. Inspectors do not stay in the primary inspection lane for more than two 30-minute periods before they are assigned to another location which is either inside of the office building or out of the lane area. They have to spend at least one hour away from the lanes before starting another assignment in the primary inspection area. Each inspector can spend a maximum time of 3.5 hours in primary inspection lanes per shift.

Primary Inspection Area Ventilation

A site plan for the Calexico facility is shown in Figure 1. A large canopy roof extends over lanes 4-8 with smaller canopy roofs over lanes 1-3 (see Figure 2) and lanes 9-11. The area directly above the large canopy over inspection lanes 4-8 includes offices and meeting rooms utilized by both Customs and the INS. The site has a solid brick wall on the North and a wall, fencing and buildings on the East and West.

There are several ventilation systems which provide air for each of the lanes. Table 1 shows a list of the primary blowers and the areas that they service. The intakes for most of these fans are located at various locations on the roof of the main facility. HP-1 and EC-1 are located adjacent to each other on the canopy over lanes 1-3 (see Figure 3). The intake for S-2 is located in the penthouse mechanical room which pulls air in from the roof over the main building. The inlet for SF-1 is located at ground level in an area adjacent to lanes 1-3.

Tempered air is supplied to each booth through a group of four supply registers. Directly outside of the booth, air is supplied from overhead to the lanes where the agents perform most of their duties. The booth outer air supply has been re-worked over the years and varies from lane to lane. In lanes 1-3, the outside air supply is directly above the booth and is louvered such that the air is directed towards the vehicle. In lane 4, the supply is configured as an air shower approximately 10 feet above ground and provides air outside of the booth between the car and booth (see Figure 4). In lanes 5-11, the supply register has been moved to the top of the canopy above the booth at a height of 15-20 feet (see Figure 5). The air shower supply registers were

originally installed at a height of approximately 10 feet at all booths but were raised at lanes 5-11 due to vehicle clearance problems. The air showers in lanes 5-11 consist of a register measuring 72 inches in length by 10 inches in width. Also, a series of registers are installed in the canopy roof and are connected to exhaust fan, S-3. The soffit fans exhaust the contaminated air under the canopy to a stack on the roof over the main building (see Figure 6).

A pedestal supply air blower installed at the front of each lane originally directed air towards the vehicle tailpipe to dilute and disperse the exhaust gases (See Figure 7). The pedestal supply blowers were in operation during the site visit but have not been in operation consistently throughout the years. A damper on the pedestal allows the agents to reduce or shutoff airflow from the pedestal supply register. A central supply fan, SF-1, provides the airflow to all of the pedestals with ducts running underground to each lane. This fan is housed in a brick building at the North end of the primary inspection area (next to lane 1). The inlet to SF-1 is located at ground level and faces the area around lanes 1-3.

METHODS

Data was collected to evaluate worker exposures to CO and to assess the performance of the ventilation systems for controlling the CO exposures.

Personal and Area Air Sampling

Personal air samples for CO exposure were collected in the breathing zone of the workers using ToxiUltra atmospheric monitors (Biosystems, Inc) with CO sensors. PHD Ultra multi-gas monitors (Biosystems, Inc) were used to collect area samples from the roof over the main building. Air sampling was performed for CO and used as a surrogate for the many other air contaminants generated by automobile exhaust such as nitric oxides, hydrocarbons, and particulates.

All ToxiUltra and PHD Ultra CO monitors were calibrated before and after use. These monitors are direct-reading instruments with data logging capabilities. The instruments were operated in the passive diffusion mode, with sampling intervals ranging from 1 to 60 seconds. The instruments have a nominal range from 0 to 999 parts per million (ppm) The CO monitors collect data over the entire sampling period and report a peak concentration, a 15-minute peak Short Term Exposure Limit (STEL), and an average over the entire sampling period.

Personal and area samples were collected in the primary inspection lanes. These CO concentrations were measured at a frequency of 1 sample/second to provide data for video exposure monitoring. The ToxiUltra CO monitor was attached to the shoulder epaulet of the volunteer agent. This placed the monitor within 12 inches of the agent's mouth and nose. Data was typically logged for a period of less than 30 minutes. The ToxiUltra monitors are capable of storing up to 50 minutes of data and were downloaded frequently to ensure that data was not lost

or overwritten during operation. A separate ToxiUltra monitor was placed inside the inspection booth to compare CO concentrations within the booth to those experienced by the agent.

Area samples were collected using both ToxiUltra and PHD Ultra CO monitors inside and outside of several booths, and near the air supply for several different blowers, including those on the roof to determine if the intake provided clean or contaminated air. Rooftop area CO concentrations were measured over 3 primary areas, specifically:

- 1) Over lanes 1-3 where the supply air for booths 1-3 and 8-10 is drawn by heat pump, HP-1 and evaporative cooler, EC-1, respectively;
- 2) Over the penthouse area above the Main Building where air for booths 4-7 is drawn by supply fan, S-2; and
- 3) Over the vehicle secondary inspection area.

Real-time Video Exposure Monitoring

Real-time video exposure monitoring was performed, and data was gathered and downloaded to a laptop computer. A video camera was used to record worker activities while real-time exposure data was collected. This videotape was later used to analyze tasks and to determine which work activities resulted in the highest exposures.

Ventilation Evaluation

The ventilation system was evaluated by visual inspection and through the use of a VelociCalc Plus Model 8360 air velocity meter (TSI Inc.). Air velocity readings were taken inside of the booths, at the face of the pedestal blowers, and near the inlet of fans providing air near the primary lanes. The total flow rate was obtained by averaging the air velocity measurements and determining the cross-sectional area of the ventilation system where the air velocity measurements were made.

The air velocity from the pedestal blowers in primary inspection lanes 7 and 8 was measured using the VelociCalc. Nine measurements were taken over the 27" x 29.5" pedestal face. Air velocity measurements were taken at the inlet to supply fan, SF-1, which provides air for all pedestal supply registers. Twelve measurements were taken in a grid pattern across the 160" x 138" inlet. Each booth is configured with 4 air supply registers measuring 15.5" x 5.375". Two registers are positioned to blow vertically down (towards the booth floor) while two registers deliver air at an angle to 45 degrees (towards the booth door). Three measurements were taken across the face of each register, averaged and multiplied by open area to yield airflow rate.

RESULTS/FINDINGS

CO Measurements

Table 2 lists all CO measurements taken during the two day survey. Personal and area samples were collected. Personal samples on the agents in the primary inspection area were collected with matching samples collected inside of the respective inspection booth. These samples were collected to give an indication of the protective nature of the booth and to provide data for video exposure monitoring. Roof top samples were collected to provide information on the level of CO contamination in the supply air for the inside and outside of the booths. There were three area samples and 4 matched area/personal samples taken on November 15. There were 3 area samples and 3 matched area/personal samples taken on November 16. Roof top CO levels are also included in the table.

Figures 8 through 13 show area CO measurements taken from inside booths and around the primary inspection area. Where possible, the CO concentration scale on these graphs has been kept constant to allow for better comparison from agent to agent and booth to booth. Figure 10 shows the CO concentration at the inlet to the fan which provides air to the pedestal supply blowers. Area concentrations were logged at a rate between 1/ 10 seconds or 1/minute using the ToxiUltra CO monitors. Figures 14-20 show paired CO measurements which were taken for comparison between agent and booth interior concentrations. The paired samples were collected for a duration between 10-50 minutes. The ToxiUltra was set to log data at a rate of 1/second during these measurements. This high rate was necessary to capture the temporal CO variations necessary for video exposure monitoring.

Rooftop area CO concentrations are shown in Figures 21-23. These measurements were made at a sample rate of 1/minute or 1/10 seconds using the PHD Ultra Multi-gas monitor. These areas were monitored at a frequency of 1 sample/minute in the afternoon of November 15 and overnight and at a rate of 1 sample/10 seconds on the morning of November 16. Figure 21 shows the result of CO sampling from 12:00 p.m. until 3:30 p.m. on the afternoon of November 15. Figure 22 shows the results of CO sampling 4:35 p.m. to 12:25 a.m. on November 15-16. And Figure 23 shows the results of CO sampling from 8:56 a.m. until 9:50 a.m. on the morning of November 16.

Ventilation System Measurements

The average pedestal face velocity was 1990 feet per minute (fpm) for lane 7 and 1810 fpm for lane 8 with dampers in the fully open position. These face velocities translate into calculated air flow rates of approximately 11,000 and 10,000 cubic feet per minute (cfm) for lanes 7 and 8 respectively. The average velocity at the inlet of the pedestal supply fan, SF-1, was 540 fpm which corresponds to an overall air flow rate of 83,300 cfm for all pedestal blowers. This overall flow rate would be affected by the damper configuration of the pedestal registers.

Three measurements were taken across the face of each register inside of the booths with the overall velocity averaging 560 fpm. This corresponds to an average flow rate of 1300 cfm (320 cfm per register). This measurement was taken with the local booth fan turned on but when the supply fan EC-1, was not operational. When EC-1 was set at the low flow rate which is typically used during the winter, the overall face velocity average increased to 750 fpm (1740 cfm total). The evaporative cooler, EC-1 also has a high flow setting which is typically used only in the summer. The low flow setting is used in the winter to decrease impingement velocities thereby minimizing cold drafts.

DISCUSSION/OBSERVATIONS

CO Measurements in the Primary Inspection Area

During the monitoring period, there were three peaks above the NIOSH ceiling of 200 ppm with one peak exceeding the upper limit of the instrument (1000 ppm). Although this concentration was transient, it should not be encountered within the occupational environment. All of these high readings were measured inside the booth at primary inspection lane 8 (see Figure 9).

The matched area/personal samples were collected for two primary reasons: 1) to evaluate the protective nature of the booth ventilation and 2) to provide data for video exposure monitoring. The key findings were that the booths seemed to provide good protection when the ventilation systems were operating properly. Figures 14, 15 and 16 show the effectiveness of the booth in controlling CO concentrations in lanes 4 and 1. The average CO concentrations in Lane 4 during the time period from 2:46 p.m.-3:01 p.m. (see Table 2 and Figure 15) was 15 ppm for the personal sample on the agent while the average inside the booth was 1 ppm showing a reduction of 93% over a 15 minute time period. Also the peak exposure was 95 ppm on the agent versus 11 ppm inside the booth resulting in a reduction of greater than 88%. In Figure 14, the peak CO concentration reaches 35 ppm while the corresponding peak in the booth is approximately 3 ppm. These examples indicate the exposure reduction potential of adequate ventilation.

Figures 17, 19 and 20, however, tell a different story. One can see from these figures that the concentrations in booths 8 and 9 provide minimal protection. This may be due to several different factors: 1) the agents may have turned off the booth ventilation; 2) Booth ventilation may be inadequate in these booths; 3) the supply fan, EC-1, may have been turned off for maintenance during the evaluation period; or 4) the intake to the pedestal blower, SF-1, may have been contaminated with CO from the primary inspection lane area. The representative from One Source, the facility maintenance contractor, indicated that the supply fan to booths 8-10 was turned off for part of the day for service. However, the exact source of the poor ventilation performance is not known and should be evaluated further to identify the cause. It was also noted that booth ventilation is turned off regularly by the agents due to high impingement velocities generated by the supply. A number of agents complained of draftiness inside the inspection booths.

Agent's exposures were evaluated using video exposure monitoring during inspection of cars with visible emissions, AKA "smokers." After identifying smoking cars, CO monitors were placed on the inspectors during routine checks. During the evaluation period, fewer "smokers" than typical were encountered. Those which were identified and evaluated are shown in Figures 19 and 20.

Rooftop CO Measurements

The roof top CO measurements showed low CO concentrations during the day and much higher concentrations during the evening period. For November 16, from 8:56 a.m. to 9:50 a.m., the three rooftop area CO concentrations were low with averages of 0 ppm. The afternoon time frame on November 15, from 12:02 p.m.- 3:32 p.m. showed averages of 1 ppm or less. The evening time period, from 4:35 p.m. to 12:35 a.m. showed averages of around 7 ppm for all sensors. The CO concentration trace shown in Figure 22 shows all sensors tracking together during this time period. This indicates that the concentration of CO was fairly homogeneous throughout the roof area. It also indicates that CO concentration increases during the period when car traffic increases and as winds subside consistent with evening atmospheric inversion. This phenomenon is important in that a source of fresh air may not be available during the evening hours at the roof top level. It may be necessary to build a stack or research pollutant removal options for the fresh air supply to reduce CO concentrations in the primary inspection area. It would also be prudent to evaluate the exposure of office workers during the swing (4 p.m.- 12 a.m.) and graveyard shifts (12 a.m.-8 a.m.). The source of fresh air for those areas is also on the rooftop and may be contaminated during periods of inversion, high traffic, or if the exhaust from the soffit fan stack is re-entrained.

Facility Observations

Several concerns with the facility were noted during the survey. No current facility drawings were available on site. We were told that one set of as-built drawings were on file at the GSA office in San Francisco but several modifications to the facility have been made since the facility opened. The ventilation system appears to have been modified and the facility upgraded to accommodate additional traffic over the years but the effects of these changes on the overall ventilation system performance is not known. The lack of current facility drawings not only affects the ability to best utilize existing resources but it also hinders the proper maintenance of the facility. General information on the performance of the system is also not available. A test and balance report had been completed of the heating, ventilating, and air conditioning (HVAC) system for the general office area but not for the ventilation to the primary inspection area. This report would provide important information such as air flow rates for each booth, pedestal and air shower. Also, the inlet to EC-1 was blocked by HP-1 which was unfortunately placed directly in front of the intake for EC-1 (see Figure 3). This degrades fan performance by restricting airflow and causing lower overall flow to the booths served by EC-1.

The design and operation of the pedestal blowers is also a concern. The current system is not located or directed properly, has not been well maintained, and the inlet is located in an area that is easily contaminated with vehicle exhaust. The primary problem with the current system is the placement of the pedestal with respect to the tailpipe. This current system is ineffective at blowing the vehicle exhaust away from the inspection stations and diluting the contaminants. The louvers on all of the pedestal blowers were damaged and the airflow dampers were not labeled as to which position was open and which was closed. Further, the supply for these blowers is taken from supply fan, SF-1, which is located at ground level in the primary inspection area near lanes 1-3 (see Figure 1). The inlet location is in an area that is easily contaminated with vehicle exhausts. The CO monitor which was placed at the inlet to SF-1 showed a peak concentration of 86 ppm with a 3 hour average of 5 ppm. Each of these problems must be addressed in order to improve the performance of the current system.

Other general facility observations include layout, and operational issues. The facility is located in an enclosed, congested area-the primary inspection booths are located under a large canopy which serves to trap vehicle emissions. Also there are buildings, walls and fencing on all sides of the complex which inhibit flow of winds which would help dilute and remove vehicle exhaust. The large volume of cars awaiting inspection serve as active sources of contaminants near the workers. During the evening (especially in Winter), some agents close the booth air supply due to cold drafts. Draftiness is due to the high impingement velocities from the booth air supply. This minimizes booth ventilation effectiveness. Use of lower velocity, laminar supply registers could help improve air circulation while improving comfort.

The U.S. Customs Service operates a continuous real time monitoring system designed to measure CO concentration in the primary inspection area. The system consists of a Bruel and Kjaer (B&K) multi-gas monitor with a B&K multi-point sampler (California Analytics, Orange CA). The CO monitoring system is designed to sequentially sample and record CO concentrations from multiple locations within the primary inspection area. During the visit, the unit was not functional. This system could provide a good tool to track overall CO concentrations in the primary inspection and help evaluate the long-term effect of any intervention.

There are a great number of poorly maintained vehicles (AKA "smoker" vehicles) which cross the border daily. On a normal, well maintained vehicle, most of the emissions come from the tailpipe of the automobile; however, a significant number of vehicles crossing through the Calexico POE were observed to be emitting air contaminants from the engine and the sides of the vehicle in addition to the tailpipe. These vehicles, that are in obvious need of maintenance, are a significant source of vehicle emissions that agents are exposed to. Because the emissions are coming from sources other than the tailpipe, it is likely that the pedestal blowers will be ineffective at diluting much of air contaminants. The method for handling these cars needs to be reviewed.

RECOMMENDATIONS

Based upon the findings of this study, several recommendations can be made to reduce CO exposures to customs and INS agents at the Calexico, California Port of Entry (POE). Our recommendations are primarily based upon the need to reduce carbon monoxide exposures for officers performing inspections. In that regard, the NIOSH recommendations should be evaluated by experts within the Customs and Immigration departments for their potential impact upon officer safety. They should also be evaluated by each agency for operational and cost feasibility prior to implementation. The recommendations that follow are based on data and observations gathered during the NIOSH visit.

Facility Maintenance

- Update all mechanical drawings of the ventilation system to “as built” and ensure copies of these diagrams are available to the maintenance supervisor on site.
- Service and balance all ventilation systems that provide air to the vehicle inspection lanes. Also, ensure that all control panels for these HVAC systems are fully operational.
- Repair and service all CO monitoring equipment and ensure that the instrumentation is regularly calibrated in accordance with manufacturer’s recommendations.

Facility Modifications

- Install air showers outside of the inspection booths. The air shower should be implemented as an air supply register that extends outside of the booth where agents spend much of their time. An air shower ventilation system will provide an envelope of clean air around the agent and reduce CO concentration in the primary work area.
- Modify pedestal blowers near the vehicle tailpipe locations to evacuate/dilute vehicle exhausts. Pedestals 7 through 10 should all be positioned to blow in a southwest direction, and air flow should be directed towards the rear of the vehicles. This could be accomplished by reconfiguring the existing system. All louvers on the pedestal blowers should be replaced with louver made of durable heavy gauge material and the system serviced. Manual dampers on the pedestals should be clearly labeled “on/off.”
- Replace the solid brick wall on the northeast side of the vehicle lanes (near the inlet for the pedestal fans) with an air permeable fence made of metal bars to permit ambient air movement to and from the vehicle lanes to aid in CO dilution.
- Reverse the flow of the soffit fans to provide fresh dilution air under the canopy area. A central fan, S-3, exhausts air from the canopy area above the inspection booths. A substantial increase of fresh air supply could be delivered under the canopy simply by

reversing the soffit fans flow direction. This reversal would have the added benefit of helping to isolate the air supplies on the roof from the source of CO.

- Reconfigure the inspection booths by installing laminar flow elements on the supply air and adding vents to the floor of the booths. The volume of air supplied to the booths should be increased to ensure that a positive pressure is maintained between the booths and the ambient environment. These changes would minimize turbulence and increase the effectiveness of supply air in providing a clean air shower to the booth.
- Modify the intake for the pedestal fan to provide a clean air source. Modifications are required near the inlet for the pedestal fan because it is drawing in contaminated air from the vehicles that pass near lane 1.
- Remove the blockage of the HVAC unit located on the roof above lanes 1-3 and the pedestal fan inlet near lane 1. Changes should be made to eliminate any blockage in front of the intake for the HVAC unit (EC-1 and HP-1) located on the roof above lanes 1-3. Both of the units have an intake that is partially blocked which can adversely effect fan performance.
- The height of the roof exhaust stack for soffit fan, S-3, should be thoroughly evaluated to prevent cross-contamination of nearby air supply inlets. The effective stack height is the portion of the exhaust stack that extends above local recirculation zones on the top of the building and upwind and downwind of obstacles. Stacks should not only be located on the highest roof of a building, but should also extend above the height of the flow recirculation zone to prevent contamination of inlet air supplies that may be located on the roof. Exhaust gases exiting the stack within the flow recirculation zone will rapidly diffuse and may be drawn into air intakes.

Operations Modifications

- Establish a vehicle-free buffer zone to increase the distance between the sources of CO (vehicles) and the inspection booths. This increased distance will enhance the opportunity for ambient winds to dilute and evacuate the contaminated air.
- Establish a standard operating procedure (SOP) to handle “smoker” vehicles which cause elevated exposures to CO and other air contaminants. This SOP should involve channeling smoker vehicles to an outside lane (such as lane 10) so that these vehicles can be more effectively isolated from other agents by not passing directly through the center lanes. Additionally, the pedestal blower on this lane would be designed to cover a wider area than each of the other lanes in order to more effectively dilute emissions coming from the vehicle.

NIOSH recommends that a pilot study be performed to evaluate these recommendations in a step-wise manner. This study will include only those options that are determined to be feasible for implementation by the GSA, INS, and Customs Service at the Calexico POE. Engineering controls for the pilot study could be manufactured and implemented on a single lane and evaluated using qualitative and semi-quantitative techniques. Those controls that are deemed successful could then be implemented on a larger scale at Calexico POE. Following a broad implementation at Calexico POE, similar controls could potentially be installed at other POEs on the Southern U.S. border. It is recommended that NIOSH engineers provide technical assistance and evaluation for installation of controls at other border crossing sites.

PLAN OF ACTION

A variety of options have been introduced in the previous sections. As discussed, NIOSH recommends a phased approach to evaluate these control options. The following section outlines a strategy to evaluate selected options on a pilot scale. Other options not included here should also be considered for implementation. Some require only a moderate change to facility or operations but may yield measurable benefits. The initial phase requires that INS and Customs adopt a change in operation for a short period of evaluation (1 week) and would require a rework to the pedestal blower configuration for a few lanes. The planning for the second phase should be scheduled to overlap with phase one. Once GSA has a contractor on contract, NIOSH engineers could meet and plan the second phase during the initial phase site visit. More information is required before a design can be completed for the air shower.

Phase 1

Evaluate the vehicle free buffer zone. NIOSH recommends that temporary traffic control measures be implemented at a distance of 100 yards from primary inspection lane 11. The evaluation will be carried out to evaluate the effect of traffic distance on agent exposure to CO. The overall evaluation will be conducted on a 3 shift/24 hour basis with personal CO monitors placed on selected agents in the primary inspection area. Meteorological conditions such as wind direction and speed will be logged to assist in determining the effect of atmospheric conditions on test results. This evaluation requires minimal facility modifications (addition of stop signs etc.) and moderate operational changes. Therefore, we recommend that this option be evaluated in the first phase. This option, if successful, would also provide the minimal cost solution to reduce vehicle exhaust exposure. While we understand that the buffer zone distance may be restricted by U.S.-Mexico physical border, the potential effectiveness of this option may be greatly reduced by a limited separation distance.

Evaluate modification of pedestal blowers in lanes 7-10. NIOSH recommends that the pedestal blowers in lanes 7-10 be reworked to better direct airflow towards the vehicle tailpipe to increase the effectiveness of these blowers. An evaluation would include evaluating the effect of the blowers on agent exposure to CO. Also flow visualization might be utilized to provide qualitative data on the effect of redirecting these blowers.

Phase 2

Evaluate the effect of ventilation system changes. NIOSH recommends that modifications be made to primary inspection lane 8 for the pilot study. This lane is located towards the center of the primary inspection area and underneath the main canopy and should represent a worst case scenario. The highest CO concentrations recorded during the initial visit were in this lane. The addition of an overhead air shower should be evaluated. This requires that a blower, ducts, and a laminar flow diffuser be procured and installed to provide low velocity uni-directional airflow to the primary inspection lane area. The "fresh" air will be drawn from the roof top and supplied outside of the primary inspection booth over the head of the agent. To successfully evaluate this option, a meeting with a GSA contractor would need to be scheduled so that the tasks required and design data could be gathered. NIOSH engineers will perform the system design and provide information on blower, diffuser, and duct size selection.

Evaluation of Booth and Soffit Fan Effectiveness. NIOSH recommends that the effectiveness of the booth ventilation be further evaluated. The data from this initial survey showed major differences between the protective effect of the booth ventilation. This may be due to operator preference (turning of booth ventilation) or a poor booth ventilation. A more thorough evaluation of the effectiveness needs to be conducted to better understand these results.

The Soffit fan exhaust registers are located throughout the canopy region and their effect on ground level CO concentrations is unknown. These fans may not have a beneficial impact on air quality or they draw contaminated air into the primary inspection area from the cars awaiting inspection resulting in a negative impact on agent exposure. An evaluation on the effect of this system could be easily performed by evaluating ground level CO with the fan, S-3, turned on and off.

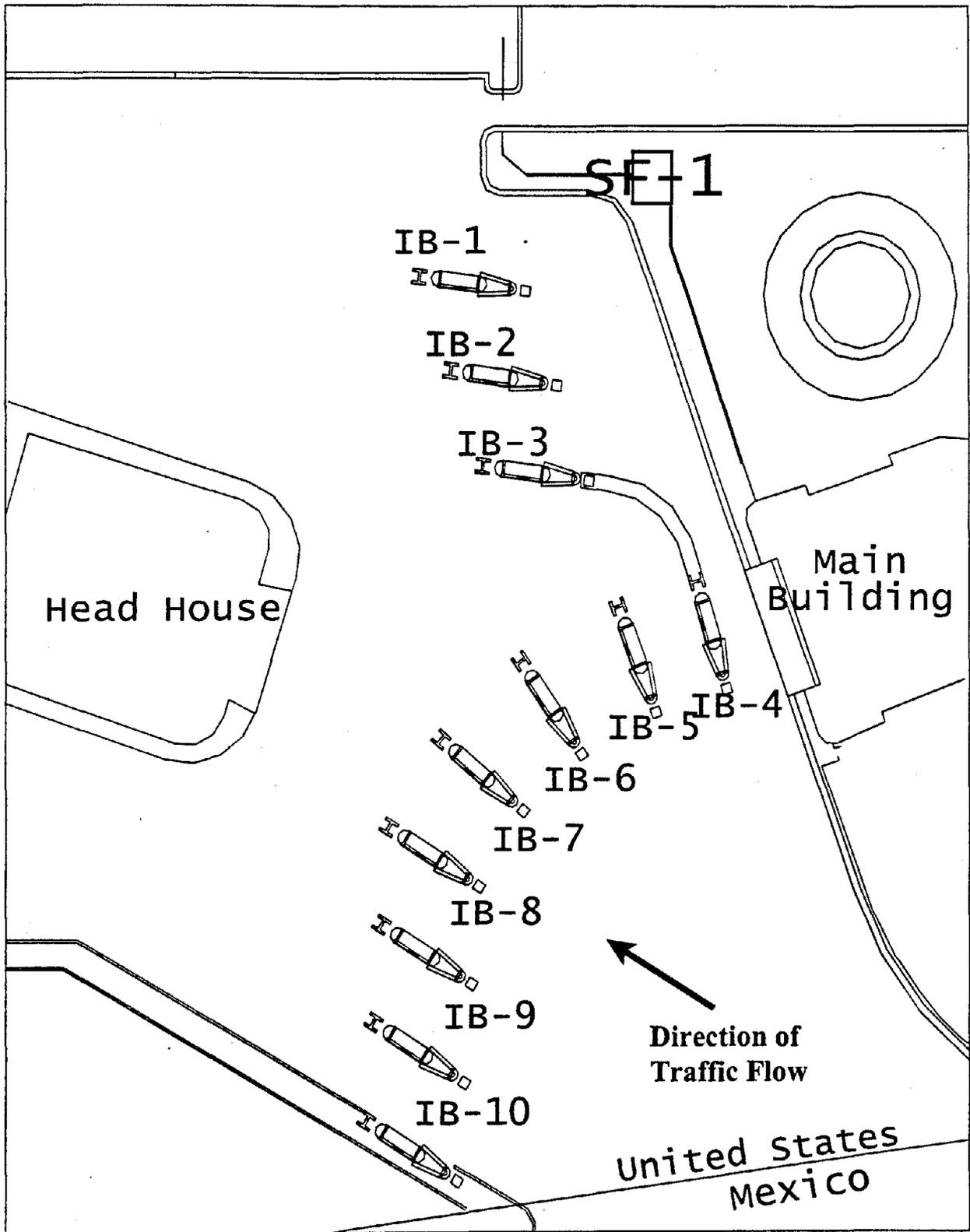
References

1. U.S. Customs Service [1999]. Customs Processing More People Entering State From Mexico. Press Release dated March 16, 1999. San Diego, CA.
2. DHHS [1999]. Evaluation of Carbon Monoxide Exposures of U.S. Immigration and Naturalization Service Inspectors for Calexico Port of Entry. San Francisco, CA: U.S. Department of Health and Human Services, Public Health Service, Division of Federal Occupational Health, San Francisco Field Office, DHHS (FOH).

Table I. Ventilation Blower Configuration

Ventilation Unit	Supplies Air to	Comments
Heat Pump, HP-1	Booths 1,2,3	Conditioned air for inside of booth. 20 ton unit with non-contact evaporative cooling.
Supply Fan, S-2	Booths 4,5,6,7	Provides air from air handler in the penthouse with heating/cooling provided to each booth.
Evaporative Cooler, EC-1	Booths 8,9,10 and overhead air supplied above all primary inspection booths	Provides air to inside of booths 8-10 and outside air for all booths with evap and furnace sections for heating/cooling.
Supply Fan, SF-1	Pedestal supply registers for all lanes	Located in brick building at ground level with intake near lanes 1,2,3.
Supply Fan, S-3	Soffit Fan Exhaust	Provides exhaust from top of canopy through distributed supply registers.

Figure 1. Calexico Facility Layout



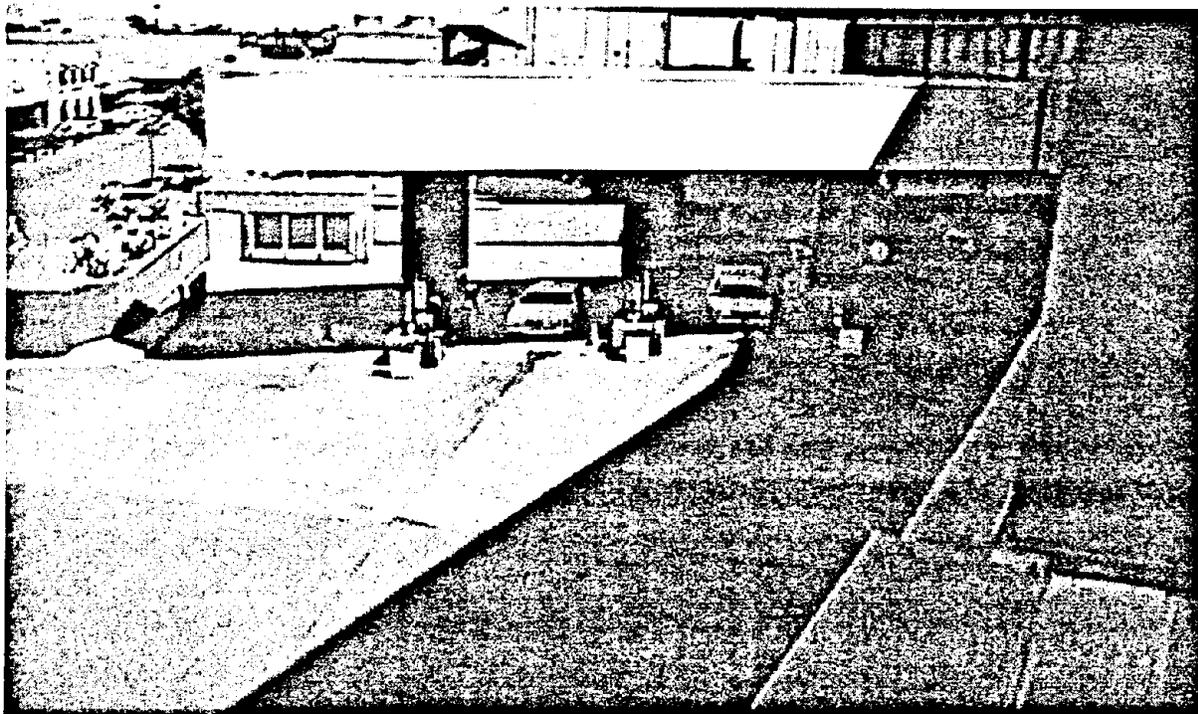


Figure 2. Canopy Roof over Lanes 1-3.



Figure 3. HP-1 and EC-1 Blower Intake Configuration.

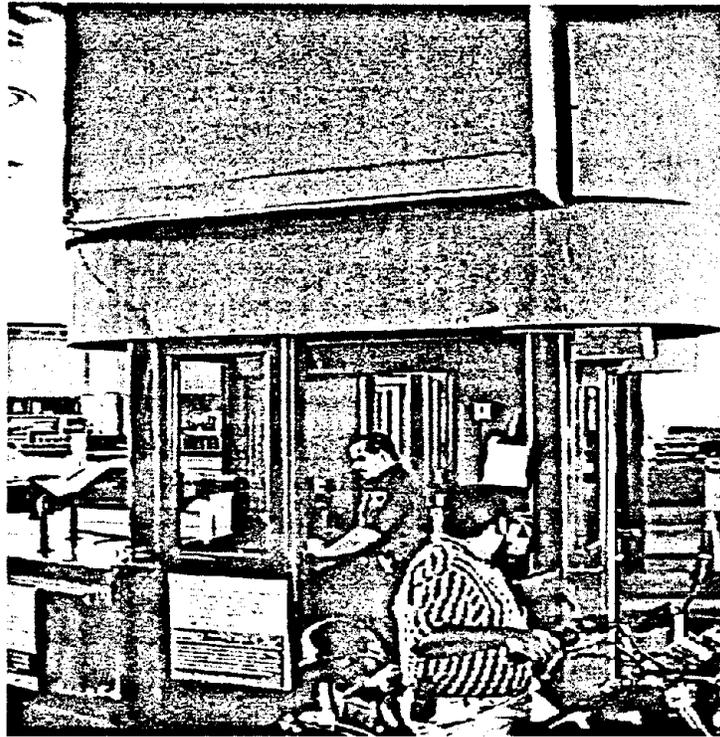


Figure 4. Air Shower Over Lane 4.

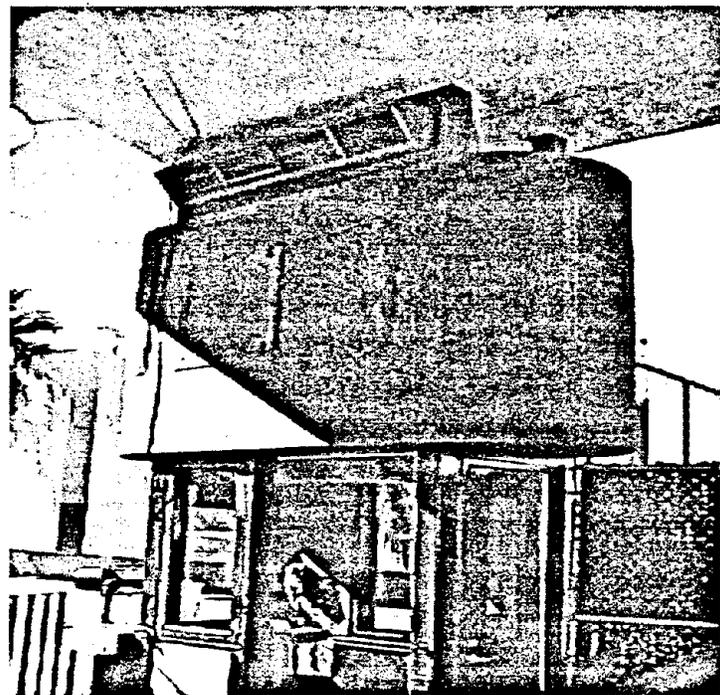


Figure 5. Raised Air Showers over Lanes 5-11.

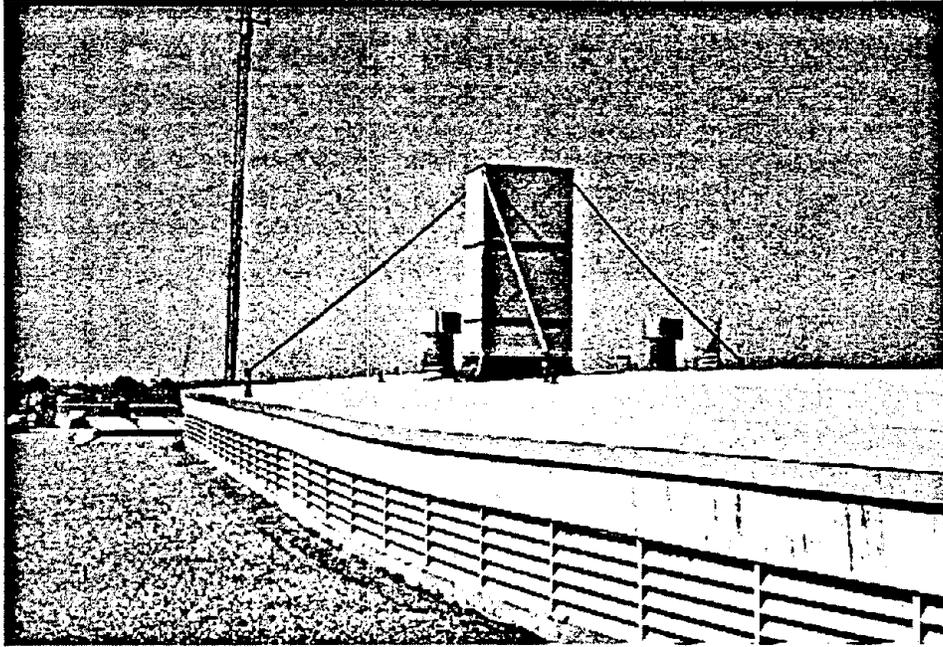


Figure 6. Soffit Fan Exhaust Stack.

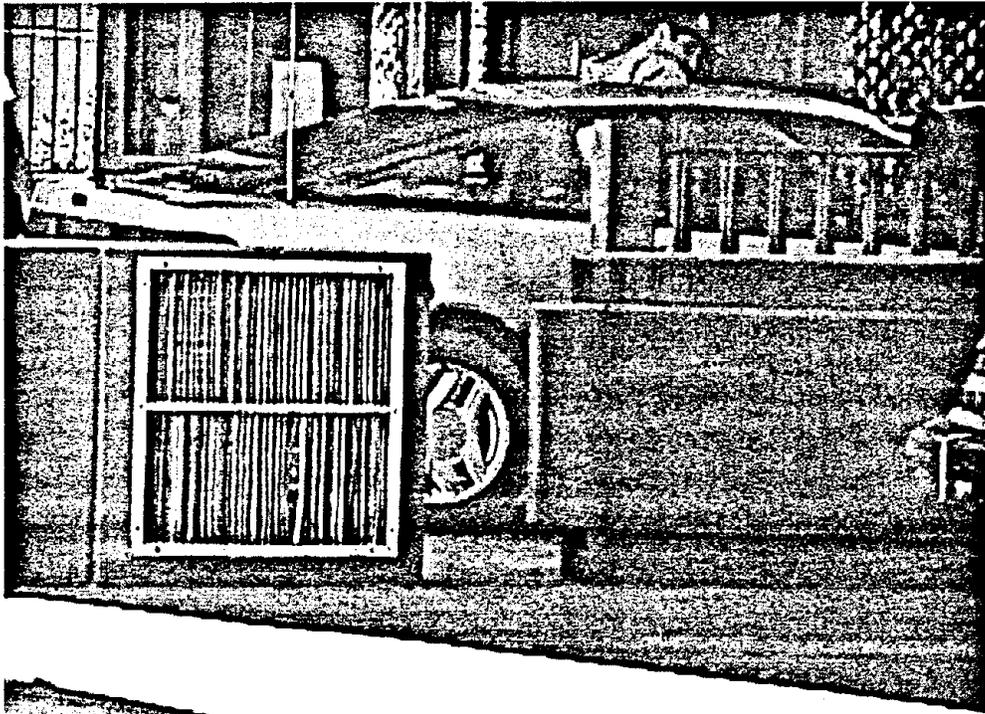


Figure 7. Pedestal Exhaust Blower.

Figure 8
CO Concentration-Area Sample
Primary Inspection Lane 3
November 15, 2000

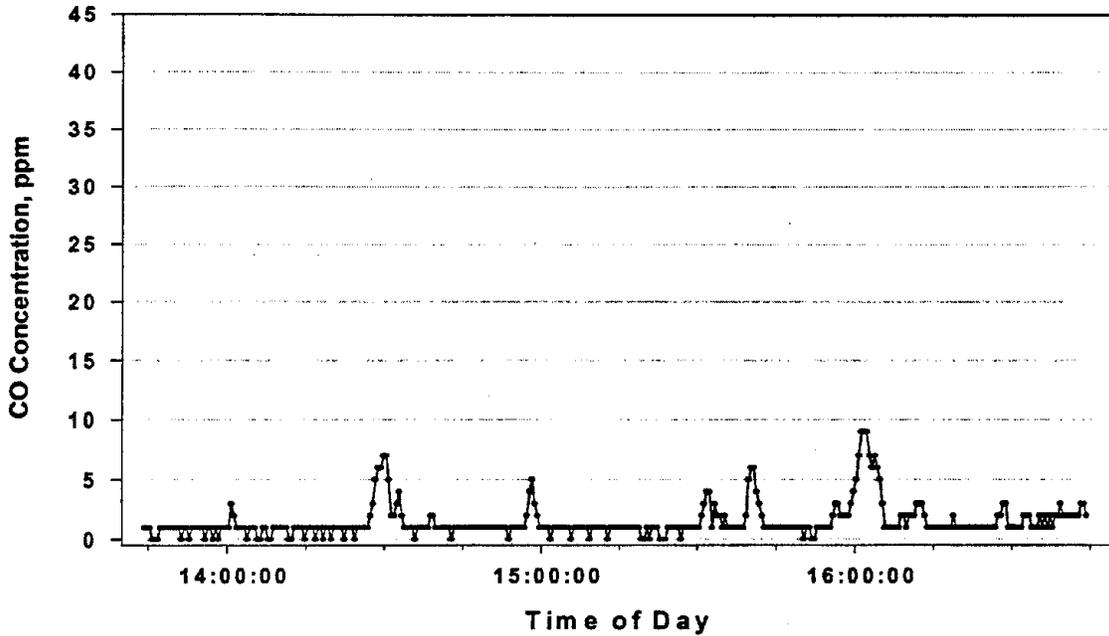


Figure 9
CO Concentrations-Area Sample
Primary Inspection Lane 8-Inside Booth
November 15, 2000

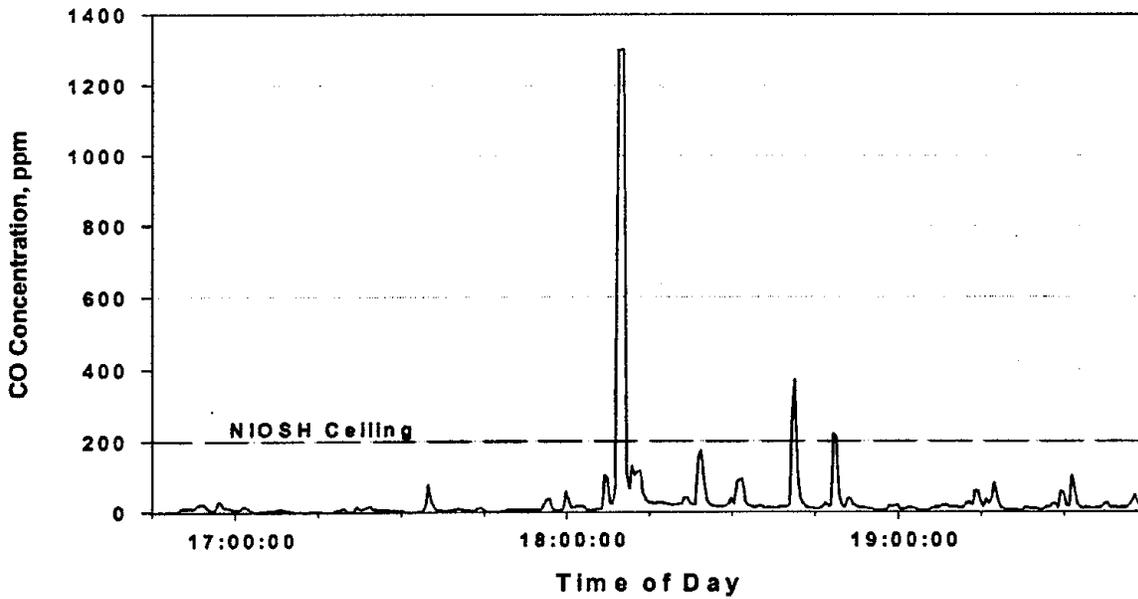


Figure 10
CO Concentration-Area Sample
Inlet to Pedestal Supply Fan, SF-1
November 16, 2000

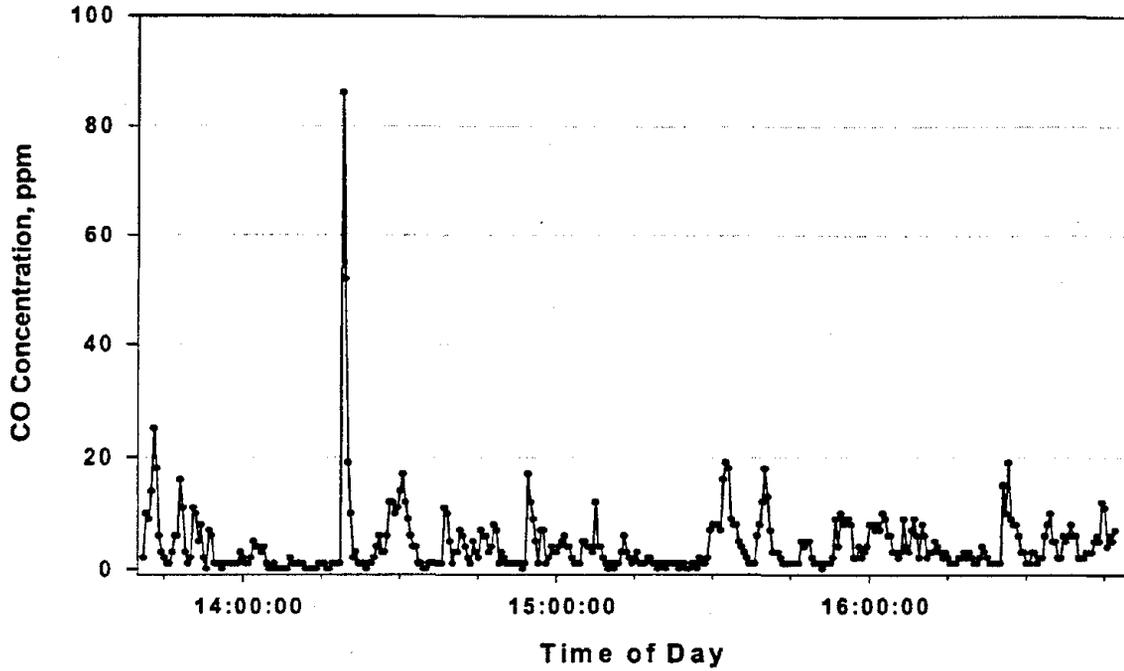


Figure 11
CO Concentration-Area Sample
Primary Inspection Lane 8--Behind Booth
November 16, 2000

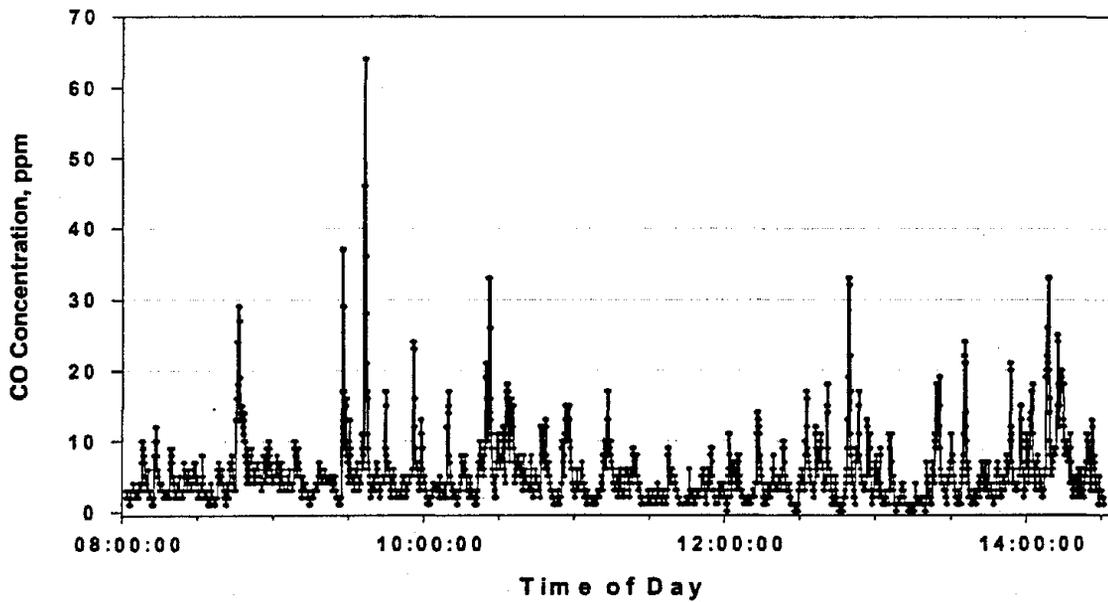


Figure 12
Co Concentration-Area Sample
Primary Inspection Lane 2--Inside Booth
November 16, 2000

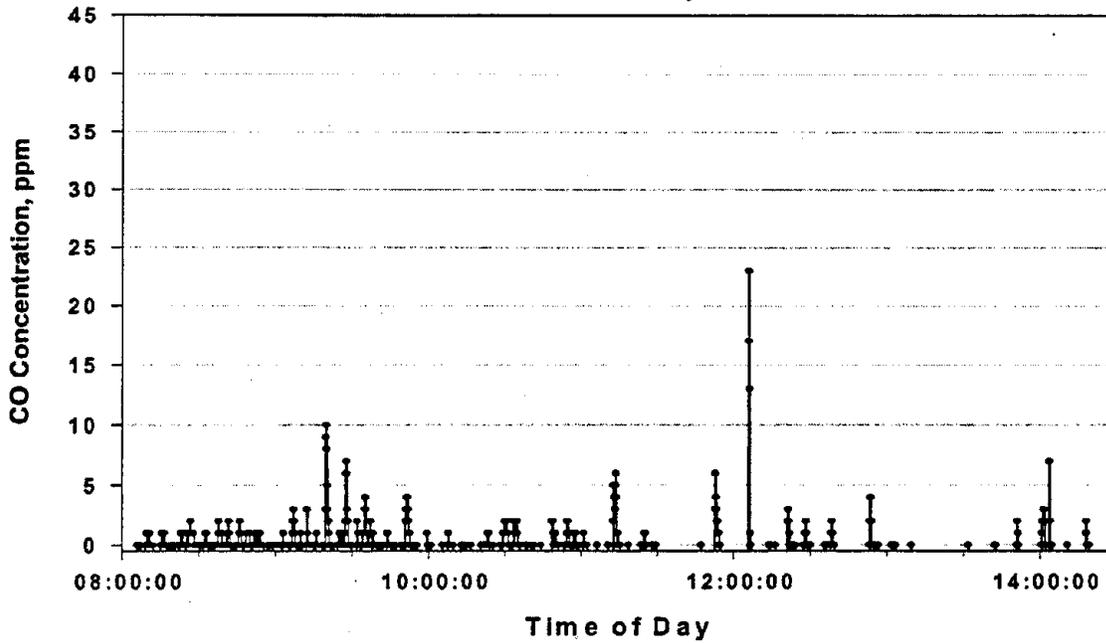


Figure 13
CO Concentration-Area Sample
Primary Inspection Lane 9--Inside Booth
November 16, 2000

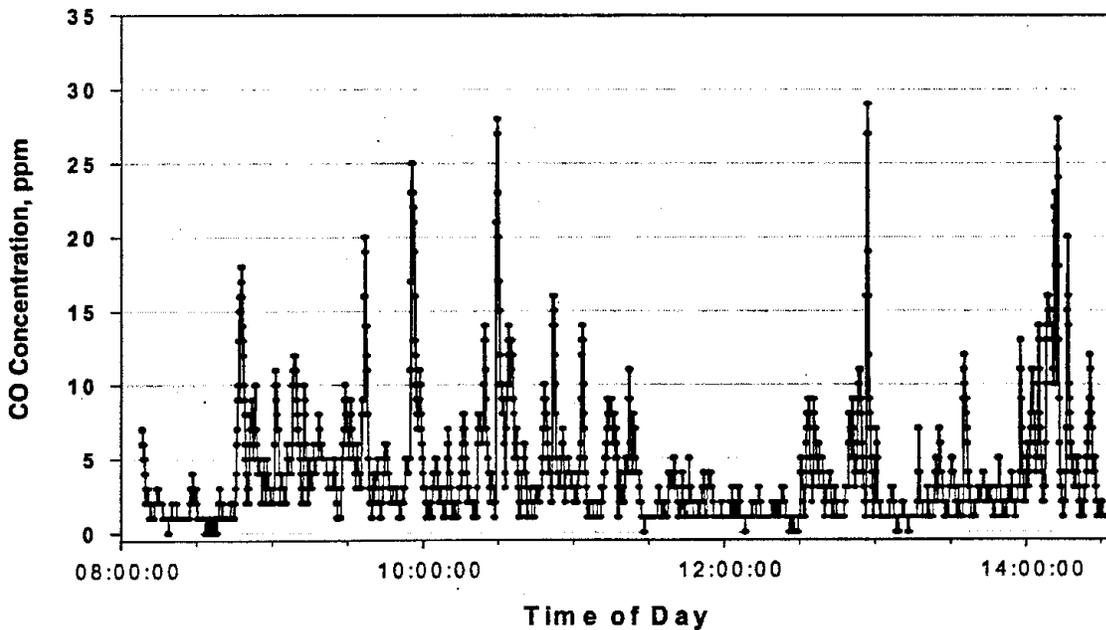


Figure 14
CO Concentration-Area and Personal
Primary Inspection Lane 4
November 15, 2000

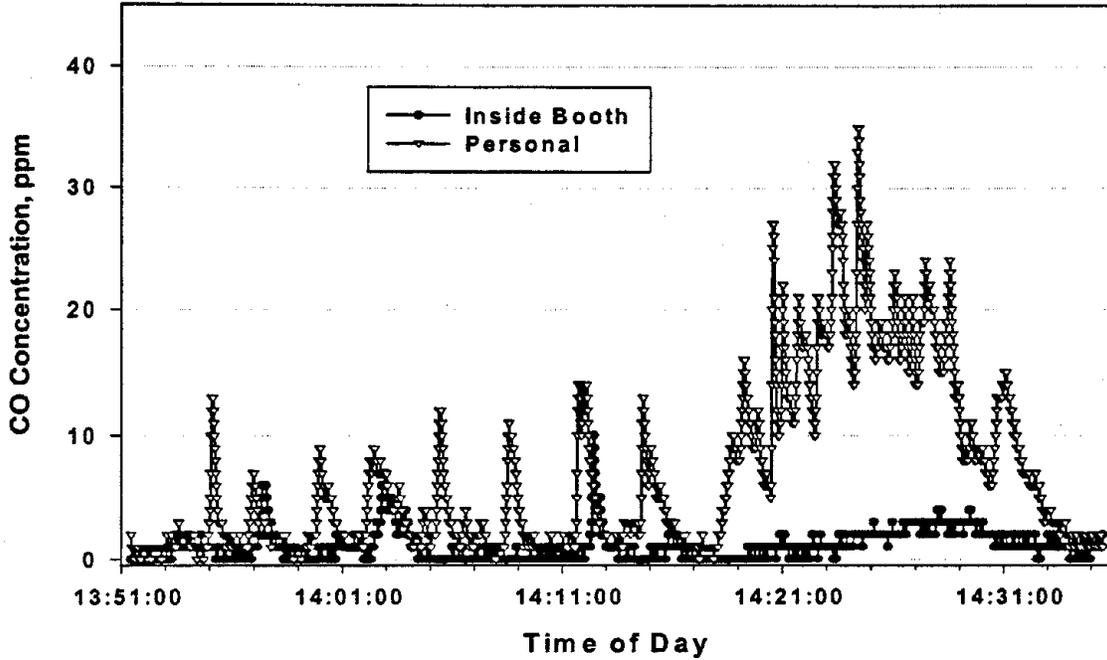


Figure 15
Co Concentration-Area and Personal
Primary Inspection Lane 4
November 15, 2000

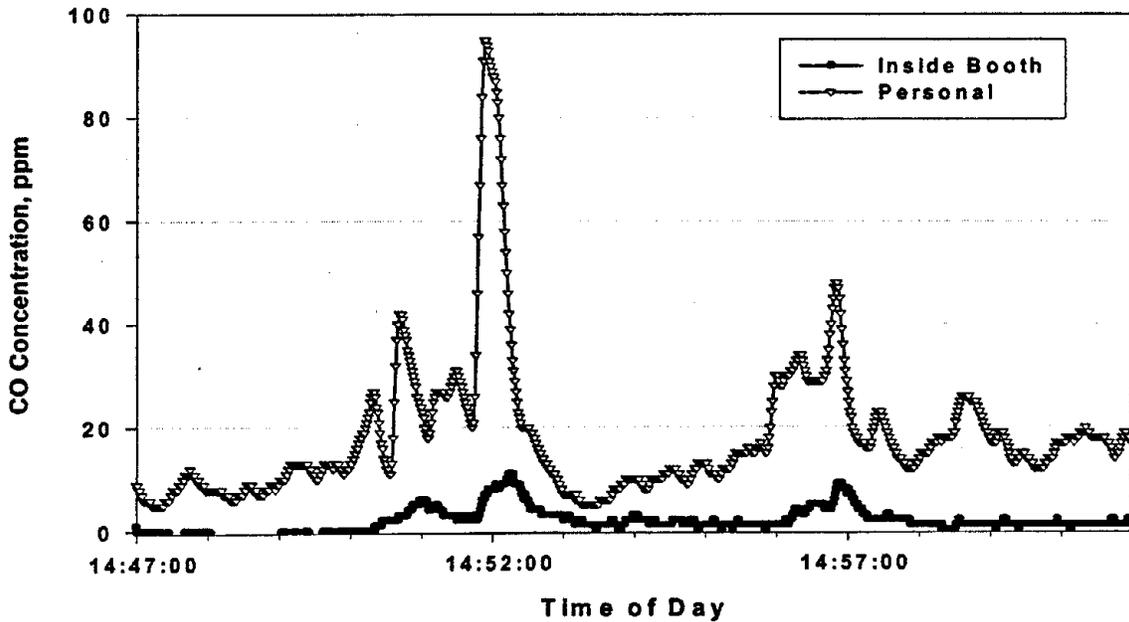


Figure 16
CO Concentration-Area and Personal
Primary Inspection Lane 1
November 15, 2000

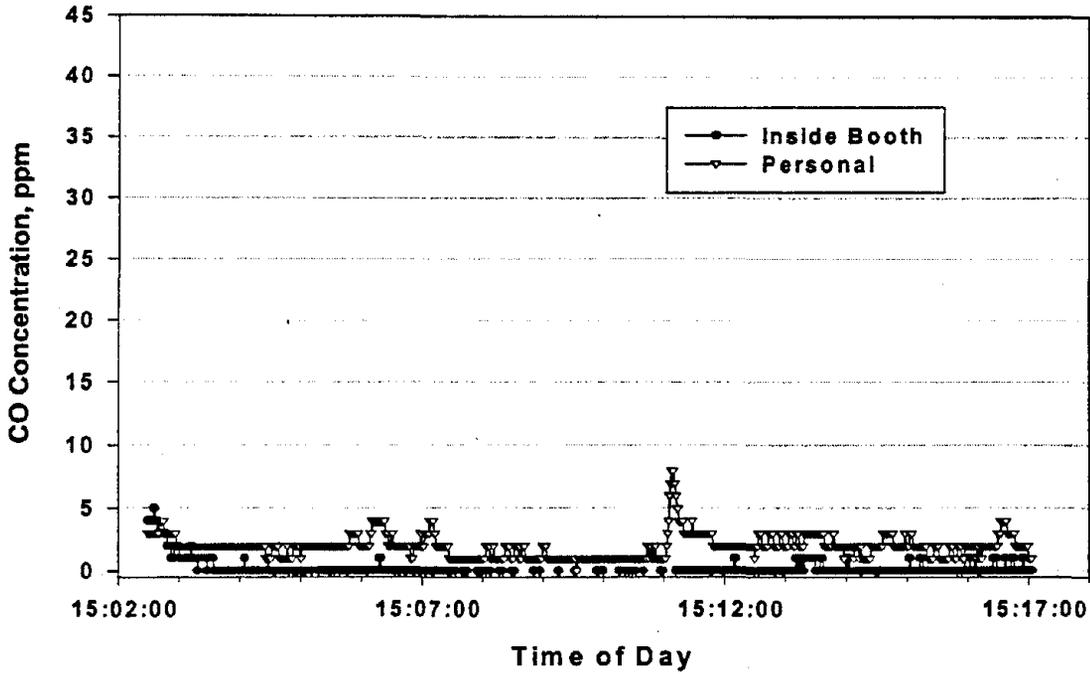


Figure 17
CO Concentration-Area and Personal
Primary Inspection Lane 9
November 16, 2000

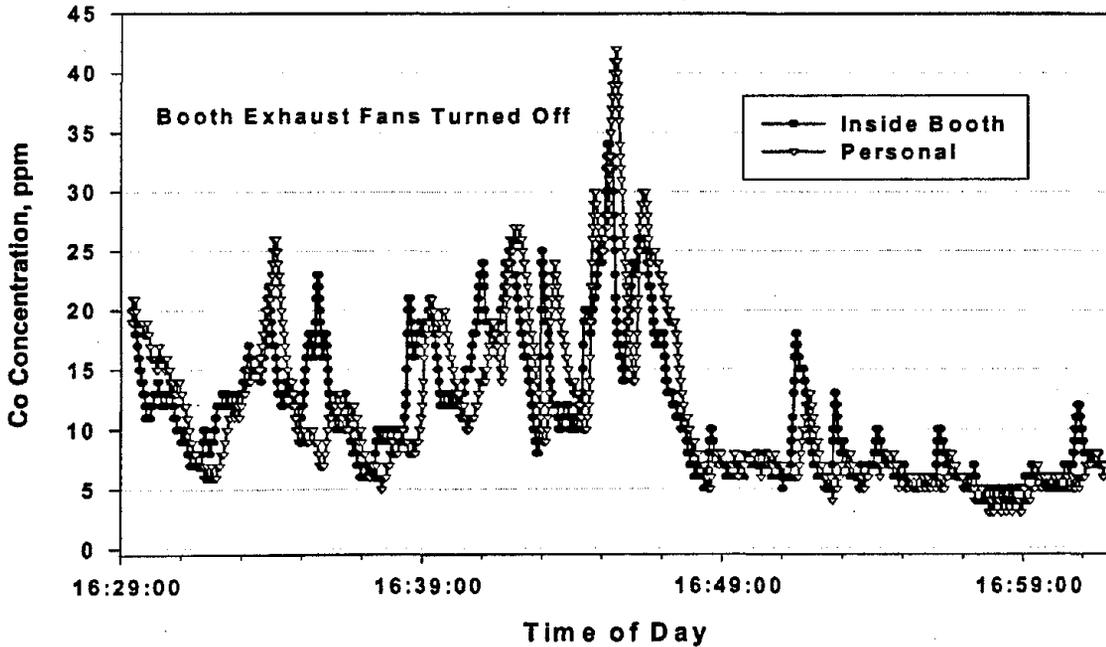


Figure 18
Co Concentrations-Area and Personal
Primary Inspection Lane 8
November 16, 2000

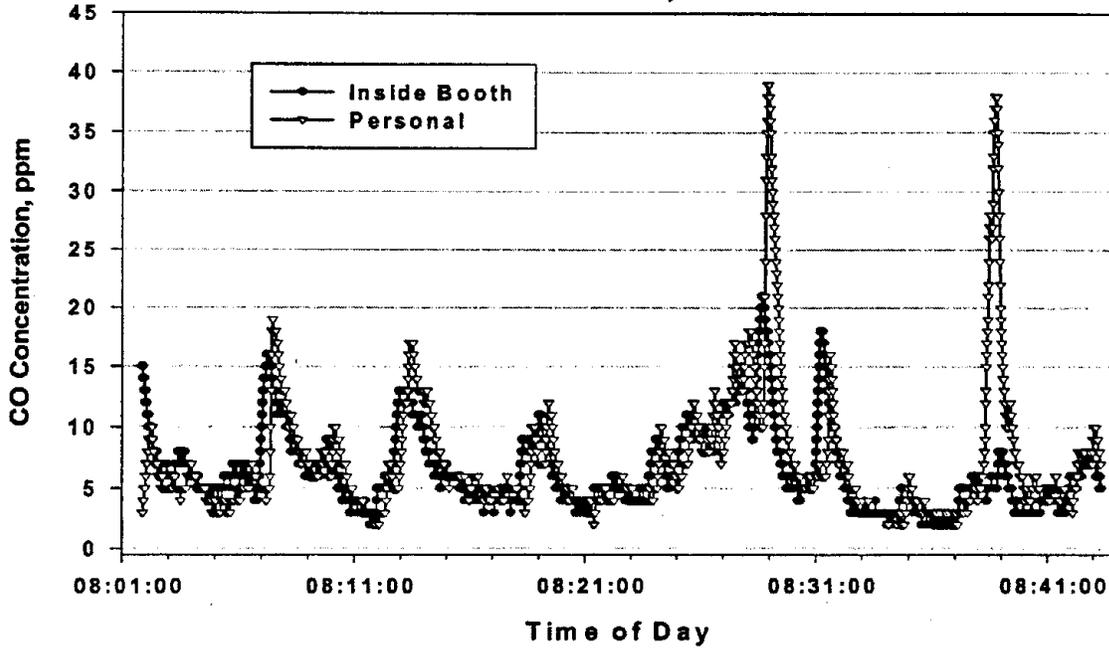


Figure 19
CO Concentration-Area and Personal
Primary Inspection Lanes 8 and 6
November 16, 2000

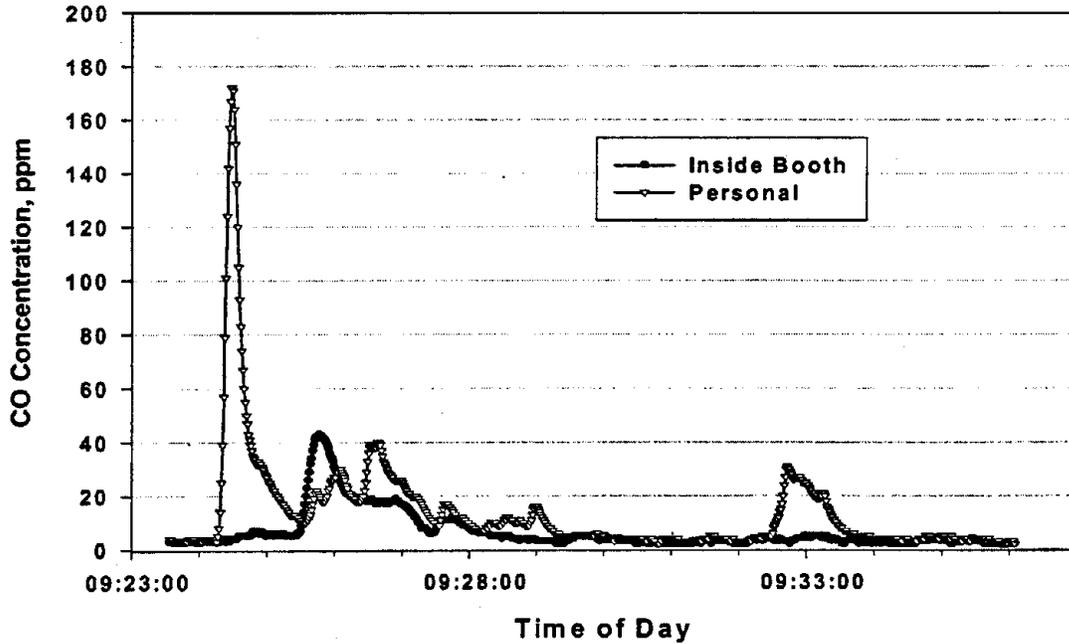


Figure 20
CO Concentration-Area and Personal
Primary Inspection Lane 9
November 16, 2000

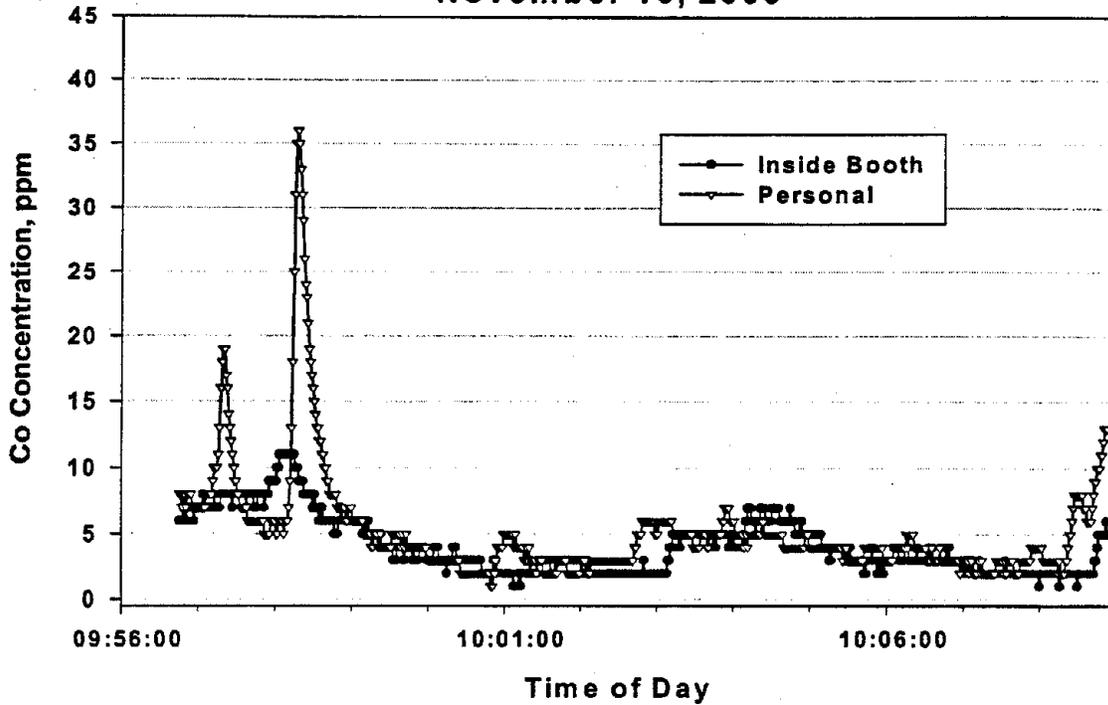


Figure 21
CO Concentration-Area Sample
Roof Top Area
November 15, 2000

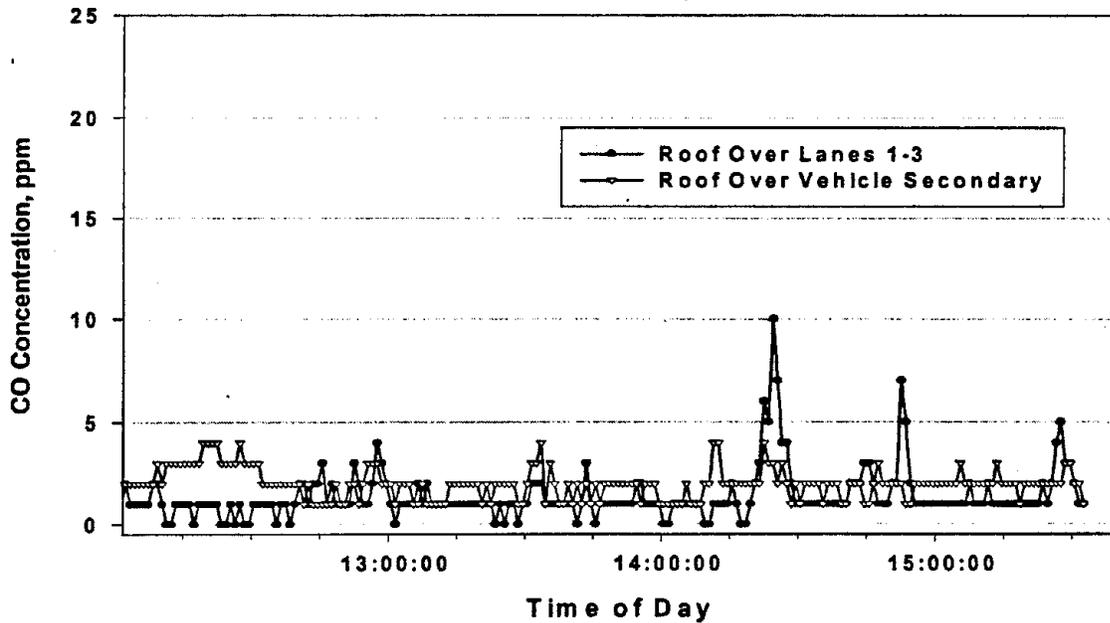


Figure 22
CO Concentration-Area Sample
Roof Top Area
November 15, 2000

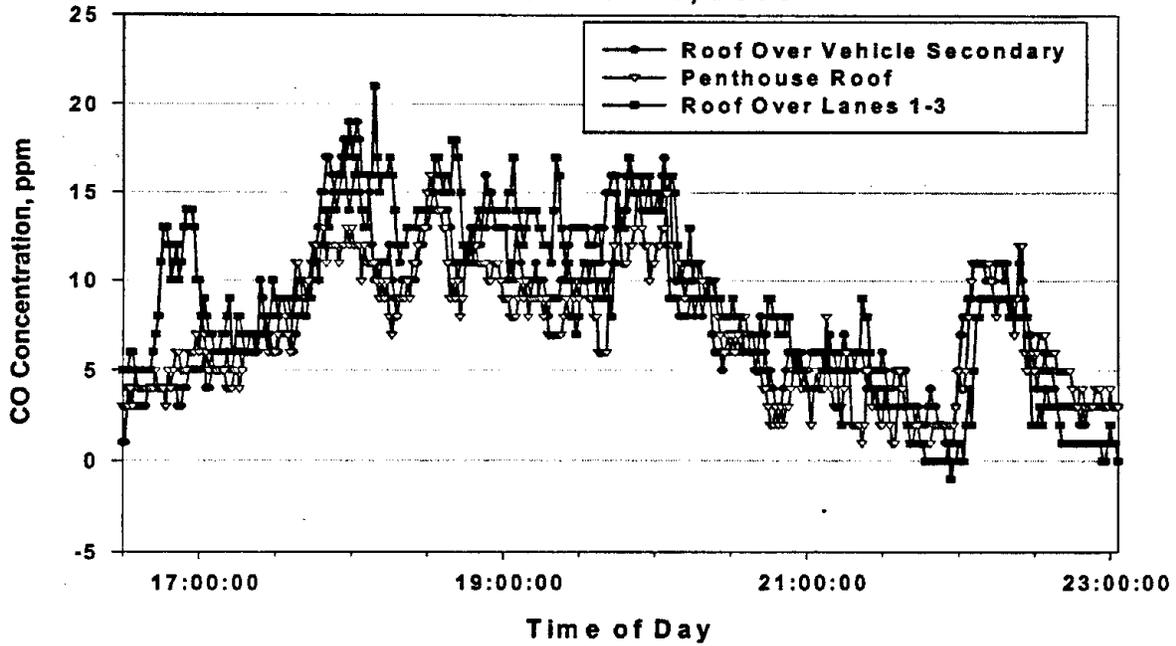


Figure 23
CO Concentration-Area Sample
Roof Top Area
November 16, 2000

