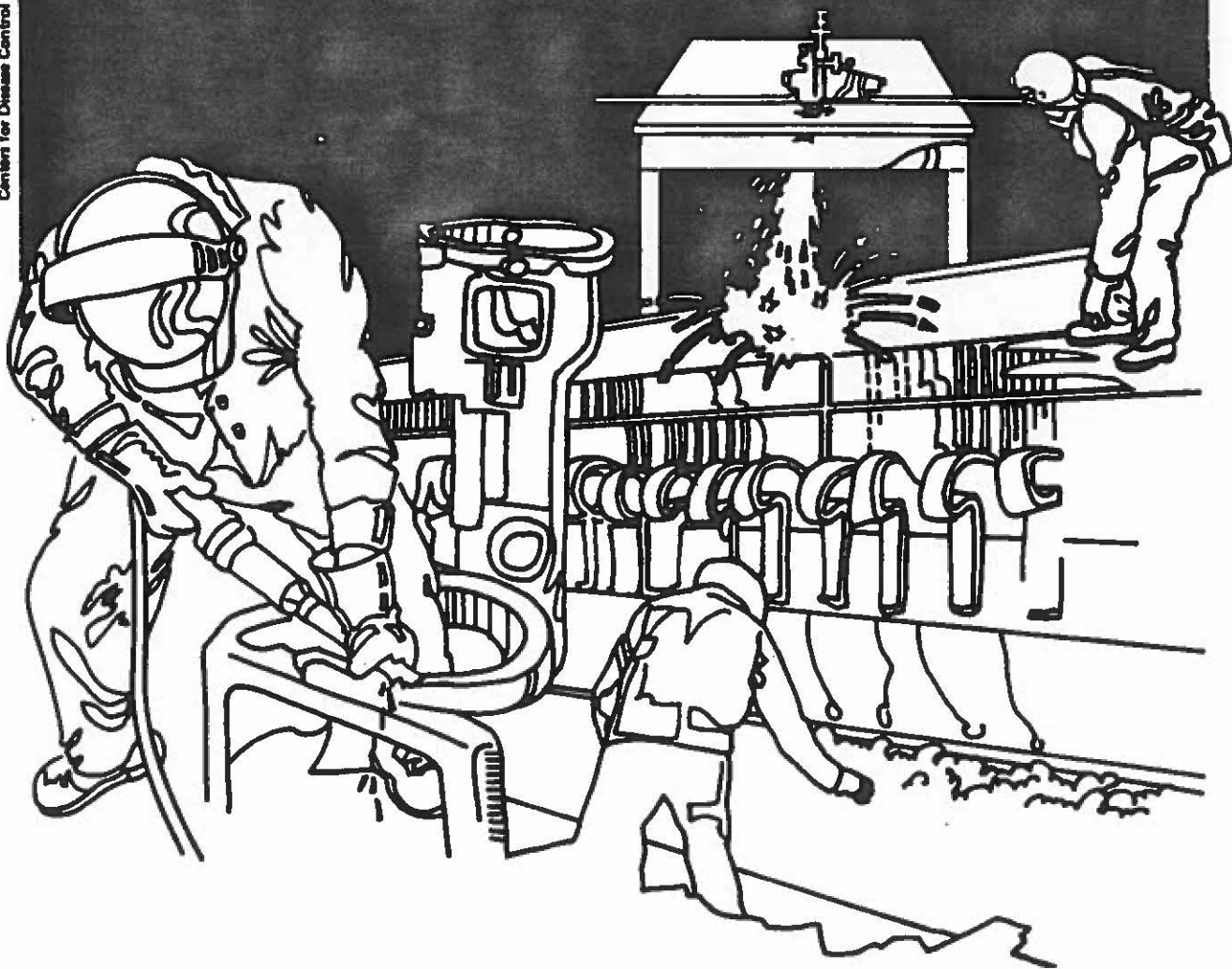


NIOSH



Health Hazard Evaluation Report

HETA 82-135-1205
ST. BERNARD FIRE DEPARTMENT
ST. BERNARD, OHIO

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, medical, nursing, and industrial hygiene technical and consultative assistance (TA) 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.

HETA 81-135-1205
OCTOBER 1982
ST. BERNARD FIRE DEPARTMENT
ST. BERNARD, OHIO

NIOSH INVESTIGATOR:
Cheryl Lucas

I. SUMMARY

On February 25, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for assistance from the City of St. Bernard to evaluate respiratory problems among firefighters at the City's new firehouse. Several employees had complained of respiratory problems after the Fire Department had moved into the new fire house about 4 years ago.

On March 4 and 5, 1982, 27 employees were interviewed, the ventilation systems were evaluated and air samples for carbon monoxide, oxides of nitrogen and organic vapors were obtained.

Fifty-two percent of the workers complained of dry nose and throat problems which they associated with their work place. Humidity levels averaged 27% in the living quarters which is below the ASHRAE recommended comfort range of 30-60%. Although blueprints called for 20% fresh air, there was no fresh air intake duct on the air handling unit that services the living quarters.

Carbon monoxide (CO) and oxides of nitrogen (NO_x) which includes nitric oxide (NO) plus nitrogen dioxide (NO₂) concentrations were at background levels in the living quarters, but 300 parts per million (ppm) CO and 8 ppm NO_x levels were measured in the apparatus floor area during morning startup procedures. The NIOSH recommended standards for CO is 35 ppm for an 8-hour time weighted average (TWA), and a 200 ppm for a ceiling; for NO is 25 ppm for a 10-hour TWA; and for NO₂, 1 ppm 15-minute ceiling limit. However since the NO_x 8 ppm level is a measure of both NO and NO₂, and exactly how much of each is not known, it cannot be directly compared to the NO or the NO₂ criteria.

Two charcoal tube air samples for organic vapors detected trace concentrations of toluene and xylene, but levels were too low to be quantified.

Low humidity and an apparent lack of fresh air in the living quarters may be responsible for the dry nose and throat problems. Potentially harmful levels of CO and NO_x are generated during those occasions when the engines are run with the doors closed. Recommendations are provided in Section VII that will increase worker comfort and minimize exposure to engine emissions.

KEYWORDS: SIC 9224 (Fire Protection), fire station, carbon monoxide, oxides of nitrogen, firemen

II. INTRODUCTION STATEMENT OF REQUEST

On February 15, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for assistance from the City of St. Bernard to evaluate respiratory problems among firefighters at the City's new firehouse. Several employees had complained of respiratory problems after the Fire Department had moved into the new fire house about 4 years ago.

On March 4 and 5, 1982, a NIOSH Industrial Hygienist conducted a survey at the fire house.

A summary of the survey including interim results and recommendations was submitted to the City of St. Bernard in a letter dated April 16, 1982.

III. BACKGROUND

The City of St. Bernard Fire Department responds to fire and other emergency situations throughout the city. The 4 year old fire house consists of a garage or apparatus floor, firemen sleeping quarters, officers sleeping quarters, a lobby, two offices, a living room, a locker room, and a kitchen. The apparatus floor houses the 4 fire trucks (2 diesel and 2 gasoline powered), 2 ambulances, and 2 service cars owned by the fire department. All vehicles are started each morning as a routine check procedure. The fire department employs 29 workers to cover 3 shifts (9 per shift including fire men, paramedics, and one captain and the fire chief who works during the day). Officials indicated that firemen respond to an average of 2 fires and 10 emergency calls per week.

IV. EVALUATION DESIGN AND METHODS

The following items were covered during the survey:

1. Twenty seven employee interviews (93% of work force) via non-directed medical questionnaires for characterization of health problems were administered.
2. A brief evaluation of the ventilation system, including inspection of the design blue prints, air handling unit, humidifier, air supply ducts, and smoke tube tests was conducted.
3. Temperature and humidity measurements were taken.
4. Monitoring of carbon monoxide (CO) and nitrogen oxides (NO_x) which includes nitrogen oxide (NO) plus nitrogen dioxide (NO₂), (primary contaminants in diesel exhaust) in the apparatus floor area and sleeping quarters, was conducted with colorimetric detector tubes which give a direct reading of contaminant levels.

5. Collection of two area air samples for organic vapors; these samples were collected on charcoal tubes using personnel sampling pumps operating at 0.5 liters of air per minute (Lpm) in the sleeping quarters of the fire house. The tubes were analyzed by desorbing with carbon disulfide, and analyzed by gas chromatography using a 10% SP-1000 column and a flame ionization detector (FID) in accordance with NIOSH Method P&CAM No. 127.

V. EVALUATION CRITERIA

OSHA standards and recommended criteria, used to make health hazard assessments in this report, are levels of toxic substances which it is believed that nearly all workers may be repeatedly exposed to without adverse effects for a 40-hour work week in an occupational lifetime. Some substances such as CO and NO₂ also have short term (i.e., 15 minute) exposure criteria due to their potential for causing serious short term health effects.

Carbon Monoxide

Carbon monoxide (C)) exposure can, depending on exposure concentrations, cause headache, nausea, dizziness, rapid breathing, unconsciousness, and death. Long term chronic effects from low level unconsciousness, and death. Long term chronic effects from low level CO exposure include behavioral changes, central nervous system damage, and cardiovascular problems. The current OSHA standard is 50 parts of CO per million parts of air (ppm) average over a 10-hour workshift. NIOSH has recommended that the permissible exposure limit reduced to 35 ppm averaged over a 10-hour workshift, with a ceiling of 200 ppm.²

Nitrogen Oxides (NO_x)

Inhalation of oxides of nitrogen (NO_x) can cause irritation to the eyes, nose, throat, and severe respiratory pulmonary edema when in high enough concentrations. Chronic pulmonary changes, hematologic changes, and chronic obstructive pulmonary diseases have been documented in workers exposed to low concentrations of oxides of nitrogen, but further epidemiologic studies are needed in this area. The current OSHA standard for nitrogen dioxide (NO_x) is a ceiling of 5 ppm. NIOSH has recommended an exposure limit of 1 ppm averaged over a 15-minute period³ for NO₂, and 25 ppm, 10-hour TWA for NO.

VI. RESULTS AND DISCUSSION

A. Employee Interviews

Analysis of the employee interviews showed that 14 of the 27 interviewed (52%) indicated that they experienced dry nasal passages during their tour of duty in the fire house.

Other health problems reported included: 1 deviated septum with congestion; 2 cases of eye irritation with congestion; 1 light headedness; 1 irregular heart beat; 2 chest pains; 1 feeling tired; 1 nose bleed with chest pain; and 1 nose bleed alone.

B. Ventilation

The ventilation system consisted of one air conditioning/heating unit which serviced the living quarters of the fire house and 3 separate heating units for the apparatus floor.

The air handling unit serving the living quarters is located on the roof and was designed to deliver 20% fresh air. However, upon inspection of the unit, NIOSH officials and a heating system service representative could not locate the fresh air intake. Therefore, apparently the fire house was undergoing 100% recirculation, or infiltrated air from doors and windows accounts for the 20% fresh air design requirement. Excessive air infiltration is probably causing increased air particulate concentrations in the fire house because the infiltrated air is not filtered through the systems air-handling unit. In addition, infiltrating air from the apparatus floor through the loosely fitting doors could carry in exhaust fumes during morning start checks. Smoke tests indicated that infiltration from the apparatus floor was significant.

The primary problem noted on the apparatus floor was the fact that engine apparatus exhaust hoses were not used to remove fumes during morning start checks which could result in extremely high exposures to firemen in the winter months when apparatus floor garage doors remain closed due to cold weather.

C. Temperature and Humidity

Relative humidity and temperature levels averaged 27% and 75°F respectively. Temperature levels are adequate, but the humidity reading is slightly below the 30-60% ASHRAE recommended comfort range.

D. Carbon Monoxide (CO) and Nitrous Oxide Fumes (NO_x)

Results of CO and NO_x detector tube measurements are shown in Table I. During the morning start on the apparatus floor CO levels were 250-300 ppm which exceeded the NIOSH recommended ceiling level of 200 ppm, 15-minute ceiling. NO_x levels were 8 ppm. This NO_x level cannot be directly compared to the NIOSH recommended criteria for NO₂, (1 ppm 15-minute ceiling) or NO, (25 ppm 10-hour TWA). However, since NO₂ and NO produce similar health effects, the 8 ppm exposure is not desirable.

E. Organic Vapors

Analysis of the charcoal tube air samples taken in the sleeping quarters show trace levels of toluene, xylenes, and other hydrocarbons but all levels were too low for quantitation, and can be considered as background concentrations.

VII. CONCLUSION

It appears that the problems associated with the ventilation system and the relatively low humidity levels in the fire may be responsible for the dry nose and throat complaints from fire house employees. Environmental sampling results indicate that no significant health hazard exists at the St. Bernard fire house due to chemical contamination with the exception that potential harmful concentrations of CO and NO_x are generated if the diesel and gas engines are run on the apparatus floor with the fire house garage doors closed.

VIII. RECOMMENDATIONS

The following recommendations should increase worker comfort and minimize exposure to diesel and gas engine emissions:

1. Increase humidity levels especially in the sleeping quarters. If the current system cannot handle the increase, use a portable humidifier as a temporary or supplemental source of humidity.
2. Have the air handling system checked to see if it is operating in accordance with design specifications and local code requirements. High efficiency filters should be used in the air handling unit and checked regularly to cut down on infiltration of particulate matter produced from nearby industries and roadway traffic.
3. Maintain the living quarters at positive pressure with respect to the outside and apparatus floor.
4. During weather conditions where the doors cannot be left open on the apparatus floor, exhaust hoses should be purchased so that the exhaust from each vehicle can be directed outside.

IX. REFERENCES

1. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.1000. Occupational Safety and Health Administration, revised 1980.
2. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to carbon monoxide. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW publication no. (NIOSH) 73-11000).

3. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to oxides of nitrogen. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. (DHEW publication no. (NIOSH) 76-149).
4. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to toluene. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW publication no. (NIOSH), U.S. Gov. Printing Office: 1977-757-009/40).
5. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to xylene. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1975. (DHEW publication no. (NIOSH) 75-168).

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Mayor, St. Bernard
2. Fire Chief, St. Bernard Fire Department
3. Safety Director, St. Bernard

4. NIOSH, Region V
5. OSHA, Region V

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

TABLE I
DETECTOR TUBE AIR SAMPLES FOR
CARBON MONOXIDE (CO), AND NITROGEN OXIDES (NO_x)

St. Bernard Fire Department
HETA 82-135
March 5, 1982

LOCATION	TIME	CONTAMINANTS	CONCENTRATION
Apparatus floor (before morning start check)	9:40am	NO _x = NO ₂ + NO CO	Trace 5 ppm
Apparatus floor (during morning start check)	9:45am	NO _x = NO ₂ + NO CO	8 ppm 250-300ppm
Sleeping quarters (after morning start check)	10:00am	NO _x CO	trace 5ppm
OSHA Standard		NO ₂ CO	5ppm 8 hr. TWA 50ppm 8 hr. TWA
NIOSH Criteria		NO ₂ NO CO	1ppm-Ceil 25ppm-10 hr. TWA 35ppm-10 hr. TWA 200 ppm-Ceil

ppm = Parts of contaminant per million parts of air.

TWA = Time weighted average concentration limit.

Ceil = Ceiling limit not to be exceeded in any 15 minute time period.