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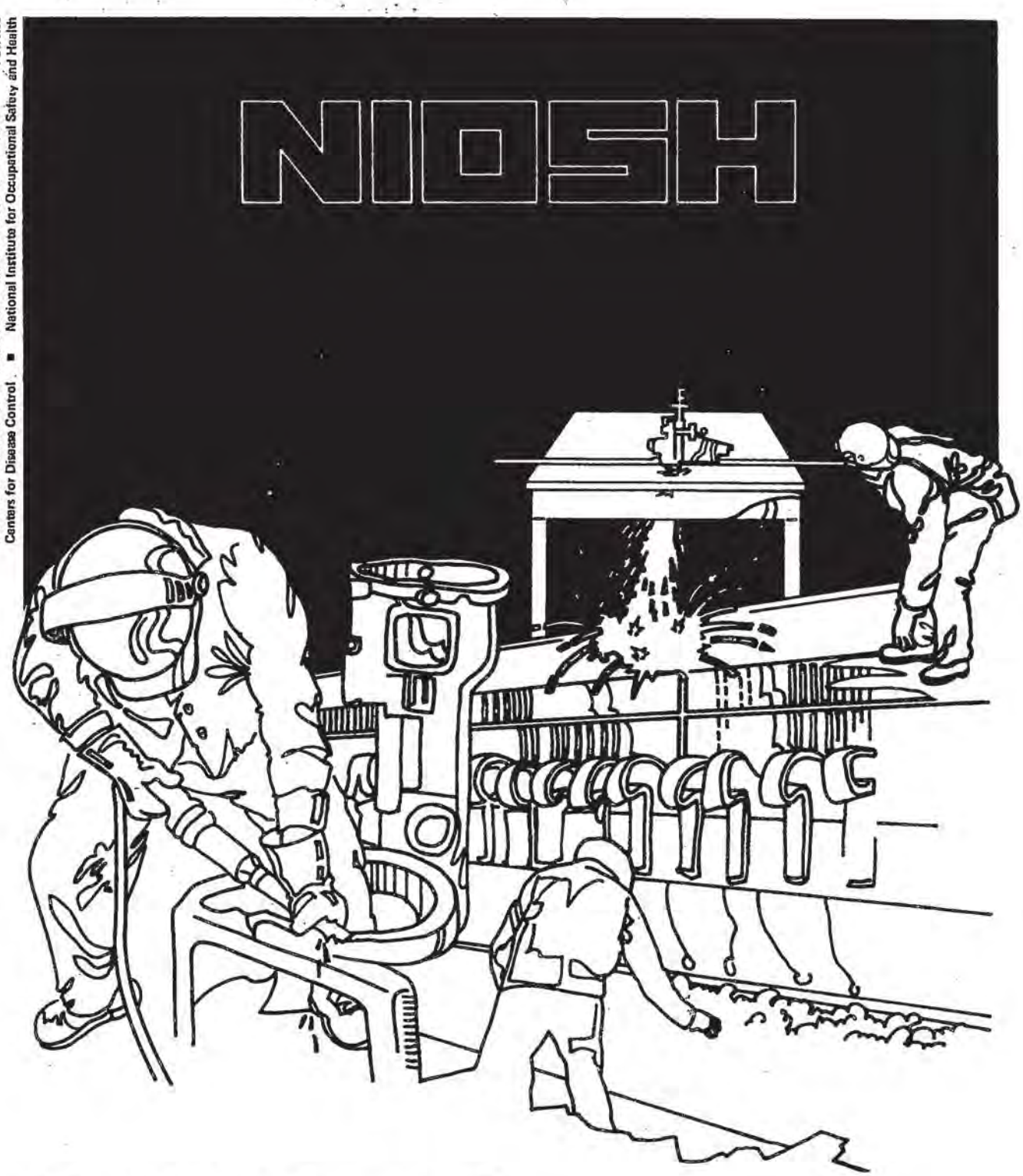

Health Hazard Evaluation Report

HETA 82-316-1230
TEXAS INTERNATIONAL AIRLINES
DENVER, COLORADO

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 nygiene 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.

HETA 82-316-1230
TEXAS INTERNATIONAL AIRLINES
DENVER, COLORADO
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I. SUMMARY

In June, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate occupational exposures to noise and diesel exhaust to the ground crew operators at Texas International Airlines' Stapleton International Airport operation, Denver, Colorado.

On August 26, 1982, NIOSH performed an environmental investigation which consisted of direct reading and 8-hour time-weighted average (TWA) noise measurements, as well as octave band analysis from 31.5 Hertz (Hz) to 31,500 Hz. Breathing zone and general area air samples were collected for determining cyclohexane soluble fraction of total airborne particulates. General area air samples were collected for carbon monoxide, nitrogen oxide, nitrogen dioxide, and sulfur dioxide. All levels for these compounds were far below the evaluation criteria. Nitrogen dioxide sample levels were less than 0.002 milligrams per sample (mg/sample). Nitrogen oxide levels ranged from less than 0.002 mg/sample to 0.33 mg/M^3. Sulfur dioxide sample levels ranged from 0.01 to 0.02 mg/M^3. Carbon monoxide direct reading samples showed levels that ranged from one to two parts per million (1 to 2 ppm) up to a high of 8 ppm. None of the air contaminants exceeded levels that would cause health effects.

Cyclohexane solubles were taken in the breathing zone on four workers. These samples were analyzed and concentrations found were too low for individual polynuclear aromatics analysis. If excessive levels of cyclohexane solubles had been found, individual polynuclear aromatics would have been determined on each individual filter.

Eight-hour TWA noise levels on five workers at Gates 10 and 12 were 88, 84, 81, 91, and 91 decibels (dBA). When measuring intense noise, the A-weighting feature (referred to as dBA) is used since it simulates the response of the human ear. Three of the five levels exceeded the NIOSH evaluation criteria of 85 dBA for an 8-hour TWA. All of these workers were wearing hearing protection.

On the basis of the environmental data collected, NIOSH determined that a potential health hazard from excessive noise levels did exist to workers evaluated during this survey at Texas International Airlines' operation at Gates 10 and 12 at Stapleton International Airport, Denver, Colorado. All other environmental samples for nitrogen oxide, nitrogen dioxide, carbon monoxide, and cyclohexane solubles did not pose any health hazard. Recommendations that can further assist in preventing hearing loss are included in this report.

KEYWORDS: SIC 4511 (Air Transportation, Certificated Carriers), noise, nitrogen oxide, nitrogen dioxide, carbon monoxide, cyclohexane solubles, ground crew personnel, mechanics, baggage handlers, ramp operations agents, power backing.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in June 1982 from Teamsters Local 2707, Oakland, California, to evaluate exposures to noise and diesel exhaust to Texas International Airlines' ground crew personnel at Stapleton International Airport, Denver, Colorado. An environmental evaluation was conducted on August 26, 1982. The results of the survey were discussed with union and management officials during the survey and after receipt of laboratory results in September 1982.

III. BACKGROUND

Union representatives were concerned about possible overexposures to the ground crew to diesel exhaust fumes during the practice of reversing airplane engine thrust to exit the gate areas. They were also concerned about increases in carbon monoxide and oxides of nitrogen levels, as well as excessive noise exposures. This study was performed at Gates 10 and 12 at Concourse C at Stapleton International Airport. Individual workers representing the entire ground crew at these gates were monitored under the observation of Texas International and union officials.

IV. ENVIRONMENTAL DESIGN AND METHODS

Three breathing zone samples and one general area air sample for cyclohexane solubles were collected on 37 mm silver membrane filters and analyzed according to NIOSH P&CAM Method No. 217. These samples were collected to determine if any carcinogens were present.

Five nitrogen oxide and nitrogen dioxide general area air samples were collected on solid sorbent sampling tubes using vacuum pumps operated at 100 cubic centimeters per minute. Samples were analyzed according to NIOSH P&CAM Method No. 231.

Three sulfur dioxide general area air samples were collected on 37mm filters and analyzed according to NIOSH P&CAM Method No. 268.

Carbon monoxide measurements were obtained with a precalibrated portable direct-reading carbon monoxide instrument.

Five personal TWA noise measurements were taken using Metrosonic® noise dosimeters which register on a memory cell the dose or noise level received during the exposure period. The results for each minute of exposure can then be displayed as a read-out (hard copy) at the end of the exposure period. The read-out also describes the accumulated exposure for each hour and is described as the average noise exposure for each hour evaluated.

Various noise levels and sound pressure levels were also evaluated around the work sites using a Bruel & Ajar® (B&K) Precision Sound Level Meter equipped with an octave band analyzer.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Environmental

The three sources of criteria used to assess the workplace concentrations of air contaminants were (1) the Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1000); (2) the NIOSH criteria for a recommended standard; and (3) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances in the Workroom Environment (TLV).

	Permissible Exposure Limits 8-hour Time-Weighted Exposure Basis
Carbon monoxide.....	35 ppm (NIOSH) 50 ppm (OSHA)
Cyclohexane solubles.....	*
Nitrogen Oxide, Nitrogen Dioxide....	1.8 mg/M^3 (C) (NIOSH) 9.0 mg/M^3 (C) (OSHA)
Sulfur Dioxide.....	1.5 mg/M^3 (NIOSH) 5.0 mg/M^3 (ACGIH) 13.0 mg/M^3 (OSHA)

ppm = parts per million
mg/M^3 = milligrams of substance per cubic meter of air
* = no standard or criteria has been established
C = ceiling concentration which should never be exceeded

Exposure to high levels of noise may cause temporary and/or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 decibels (dBA) causes hearing loss in a portion of the exposed population.

OSHA's existing standard for occupational exposure to noise (29 CFR 1910.95) specifies a maximum permissible noise exposure level of 90 dBA for a duration of 8 hours, with higher levels allowed for shorter durations. NIOSH, in its Criteria for a Recommended Standard, proposed a limit of 5 dB less than the OSHA standard.

Time-weighted average noise limits as a function of exposure duration are shown below:

Duration of Exposure (hours/day)	Sound Level, dBA NIOSH	OSHA
16	80	---
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115*
1/8	115*	---
	---	140 dB**

* No exposure to continuous noise above 115 dBA.

** No exposure to impact or impulse noise above 140 dB peak sound pressure level (SPL).

When workers are exposed to sound levels exceeding the OSHA standard, feasible engineering or administrative controls must be implemented to reduce levels to permissible limits. OSHA has recently issued a hearing conservation amendment to its noise standard. For workers exposed at or above a TWA of 85 dB, the amendment will require noise exposure monitoring, employee education, and audiometric testing. Review of audiograms have to be made by an audiologist or otolaryngologist or a qualified physician in their absence. Employees also must be notified of monitoring results within 21 days. Employee records must be kept by the employer for up to five years after termination of employment.

B. Toxicological

1. Nitrogen Oxide, Nitrogen Dioxide

Exposures that are at the evaluation criteria of 1.8 mg/M^3 (Ceiling) or above may cause pulmonary distress. The most immediate and hazardous symptom to observe with an overexposed individual is the development of pulmonary edema and pneumonia. An overexposed worker should be given immediate and complete rest. Recommended medication includes hydrocortisone and antibiotics to prevent bacterial infection.[1]

2. Carbon Monoxide

The signs and symptoms of carbon monoxide poisoning may include headache, nausea, vomiting, dizziness, drowsiness, and collapse. In the bloodstream, carbon monoxide rapidly binds to the oxygen-carrying molecule hemoglobin, forming "carboxyhemoglobin" (COHb). When carbon monoxide binds with hemoglobin to form COHb, it reduces the oxygen-carrying capacity of the blood. The more COHb is formed, the more significant the symptoms are. Heart disease may be made worse in workers who have coronary heart disease and are exposed to carbon monoxide concentrations high enough to produce a COHb level greater than 5%. There is also important evidence that exposure to lower carbon monoxide concentrations, producing COHb levels below 5%, affects the nervous system and causes changes in visual alertness, response time, and fine judgment.

Non-smoking, non-exposed persons have an average COHb level of 1%. Cigarette smokers usually have an average COHb level of 2 to 10%. Non-smokers exposed to 50 ppm (50 parts per million of carbon monoxide, the OSHA standard) for six to eight hours have COHb levels of 8 to 10%. Symptoms such as headache and nausea may be seen above 15%, but usually not at lower levels. At 25% there may be electrocardiographic evidence of heart effects, and 40% usually results in collapse.

The current OSHA standard for carbon monoxide is 50 ppm. Exposure at this level for 90 minutes may cause chest pain for persons with angina (chest pain related to heart disease); exposure for 2 hours may make leg cramps worse for persons who have leg cramping associated with vascular disease. The effects of carbon monoxide exposure, including the more common symptoms of headache, dizziness, and nausea, are made worse by heavy labor and a high temperature in the work area.

In 1972, after considering all of these factors, NIOSH recommended an exposure limit of 35 ppm for an 8-hour time-weighted average, and a ceiling limit of 200 ppm. This recommendation is based on the concentration necessary to produce a COHb level of not more than 5%. The recommendation does not consider the smoking habits of workers since the COHb levels in smokers has generally been found to be in the 4 to 5% range, but may run as high as 10 to 15% in heavy smokers. Therefore, smokers who already have a blood level of 5%, and then are exposed in a work place with an average concentration of 35 ppm will have a total COHb of about 10%.

3. Sulfur Dioxide

Sulfur dioxide, a colorless gas, is a severe irritant of the eyes, upper respiratory tract, and skin. The irritant effects of sulfur dioxide are caused by the rapidity with which it forms sulfurous acid on contact with moist membranes. Approximately 90% of all sulfur dioxide inhaled is absorbed in the upper respiratory passages, where most effects occur; however, it may cause pulmonary edema on severe exposure.

Workers repeatedly exposed to 10 parts per million (ppm) experienced upper respiratory tract irritation, and some nose-bleeds, but the symptoms did not occur at 5 ppm.[2]

There does not appear to be any long-term effects upon pulmonary function.[3]

4. Noise[4]

Noise, commonly defined as unwanted sound, covers the range of sound which is implicated in harmful effects. Noise can be classified into many different types, including wide-band noise, narrowband noise, and impulse noise. To describe the spectrum of a noise the audible frequency range is usually divided into eight frequency bands, each one-octave wide, and sound pressure level (SPL) measurements are made in each band using a special sound level meter. A wide-band noise is one where the acoustical energy is distributed over a large range of frequencies. Examples of wide-band noise can be found in the weaving room of a textile mill and in jet aircraft operations.

Exposure to intense noise causes hearing losses which may be temporary, permanent, or a combination of the two. These impairments are reflected by elevated thresholds of audibility for discrete frequency sounds, with the increase in dB required to hear such sounds being used as a measure of the loss. Temporary hearing losses, also called auditory fatigue, represent threshold losses which are recoverable after a period of time away from the noise. Such losses may occur after only a few minutes of exposure to intense noise. With prolonged and repeated exposures (months or years) to the same noise level, there may be only partial recovery of the threshold losses, the residual loss being indicative of a developing permanent hearing impairment.

Temporary hearing impairment has been extensively studied in relation to various conditions of noise exposure. Typical industrial noise exposures produce the largest temporary hearing losses at test frequencies of 4,000 and 6,000 Hertz (Hz).

The actual pattern of loss depends upon the spectrum of the noise itself. The greatest portion of the loss occurs within the first two hours of exposure. Recovery from such losses is greatest within one or two hours after exposure.

The amount of temporary hearing loss from a given amount of noise varies considerably from individual to individual. For example, losses at a given frequency due to noise intensities of 100 dBA may range from 0 to more than 30 dB.

Low frequency noise, below 300 Hz, must be considerably more intense than middle or high frequency noise to produce significant threshold losses.

Considerably fewer temporary hearing losses result from intermittent than from continuous noise exposure, even though the total amount of noise exposure is the same in both instances.

Physiologic reactions to a noise of sudden onset represent a typical startle pattern. There is a rise in blood pressure, an increase in sweating, an increase in heart rate, changes in breathing, and sharp contractions of the muscles over the whole body. These changes are often regarded as an emergency reaction of the body, increasing the effectiveness of any muscular exertion which may be required. However desirable in emergencies, these changes are not desirable for long periods since they could interfere with other necessary activities. Fortunately, these physiologic reactions subside with repeated presentations of the noise.

For performance on a task to remain unimpaired by noise, man must exert greater effort than would be necessary under quiet conditions. When measures of energy expenditure--for example, oxygen consumption and heart rate--are made during the early stages of work under noisy conditions they show variations which are indicative of increased effort. Measurements in later stages under continued exposure, however, show responses return to their normal level.

VI. ENVIRONMENTAL RESULTS AND DISCUSSION

On August 26, 1982, NIOSH performed an environmental investigation which consisted of direct reading and 8-hour time-weighted average (TWA) noise measurements, as well as octave band analysis from 31.5 Hertz (Hz) to 31,500 Hz. Breathing zone and general area air samples were collected for determining cyclohexane soluble fraction of total airborne particulates. General area air samples were collected for carbon monoxide, nitrogen oxide, nitrogen dioxide, and sulfur dioxide. All levels for these compounds were far below the evaluation criteria. Nitrogen dioxide sample levels were less than 0.002 milligrams per sample (mg/sample); nitrogen oxide levels ranged from less than 0.002 mg/sample to 0.33 mg/M^3. (Refer to Table 1.) Sulfur dioxide sample levels ranged from 0.01 to 0.02 mg/M^3 (refer to Table 2). Carbon monoxide direct reading samples showed levels that ranged from one to two parts per million (1 to 2 ppm) up to a high of 8 ppm. None of the air contaminants exceeded levels that would cause health effects.

Cyclohexane solubles were taken in the breathing zone on four workers. These samples were analyzed and concentrations found were too low for individual polynuclear aromatics analysis (refer to Table 3). If excessive levels of cyclohexane solubles had been found, individual polynuclear aromatics would have been determined on each individual filter.

A total of five personal noise samples and numerous area noise level measurements were taken during the survey period. Eight-hour TWA noise levels on five workers at Gates 10 and 12 were 88, 84, 81, 91, and 91. Three of the five levels exceeded the NIOSH evaluation criteria of 85 dBA for an 8-hour TWA. Refer to Tables 4 and 5. All of these workers were wearing hearing protection.

VII. CONCLUSIONS

A health hazard existed to excessive noise levels at Texas International Airlines' Gates 10 and 12, Concourse C, at Stapleton International Airport during NIOSH's evaluation. Ground crews were provided hearing protection which does reduce the noise exposure. How well the exposures are reduced can only be determined by periodic audiometric testing of exposed employees.

Samples taken for nitrogen oxide, nitrogen dioxide, carbon dioxide, and cyclohexane solubles did not pose any health hazard. Most were below laboratory limits of detection.

VIII. RECOMMENDATIONS

1. The hearing protection program should be continued and rigidly enforced. Ground crew members should wear ear protection when aircraft on adjacent gates are power backing or taxiing.

2. Audiometric testing should be performed at least yearly.

3. Noise monitoring should be performed routinely to help supplement the hearing protection program.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standard Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. 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. Teamsters Local 2707.
2. Teamsters Union.
3. Texas International Airlines.
4. U.S. Department of Labor/OSHA - Region VIII.
5. NIOSH - Region VIII.
6. Colorado Department of Health.
7. State Designated Agency.

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

TABLE 1

General Area Air Concentrations of Nitrogen Oxide (NO) and Nitrogen Dioxide (NO_2)
in the Vicinity of Gates 10 and 12, "C" Concourse
Stapleton International Airport

Texas International Airlines
Denver, Colorado

August 26, 1982

Sample Number	Gate	Location	Sampling Time	mg/M^3 NO	mg/M^3 NO_2
N1	C-10	Top of Auto-Guide in System	7:53 AM - 12:12 PM	*	*
N2	C-10	Post by Power Plug	7:53 AM - 12:13 PM	0.33	*
N3	C-9	Top of Power Shut Off	7:55 AM - 12:14 PM	0.10	*
N4	C-10	Fuel Cut Off Sign	7:54 AM - 12:13 PM	0.12	*
N5	C-10	Cabinet Top	7:52 AM - 12:10 PM	0.01	*
EVALUATION CRITERIA				1.8 (C)**	1.8 (C)
LABORATORY LIMIT OF DETECTION mg/tube				0.002	0.002

mg/m^3 = milligrams of substance per cubic meter of air
* = below laboratory limit of detection
** = converts to NO_2 fast thus use same evaluation criteria

TABLE 2

General Room Air Concentrations of Sulfur Dioxide
Gates 10 and 12, Concourse C

Texas International Airlines
Denver, Colorado

August 26, 1982

Sample Number	Location	Sampling Time	mg/M^3 Sulfur Dioxide
01	Gate 10	8:15 AM - 1:30 PM	0.02
02	Top of Cabinet, Gate 10	8:15 AM - 1:28 PM	0.02
03	Between Gates 10 & 12	8:16 AM - 1:29 PM	0.01
EVALUATION CRITERIA			1.5
LABORATORY LIMIT OF DETECTION mg/sample			0.004

mg/m^3 = milligrams of substance per cubic meter of air

TABLE 3

Breathing Zone and General Area Air Concentrations of Cyclohexane Solubles
in the Vicinity of Gates 10 and 12, "C" Concourse
Stapleton International Airport

Texas International Airlines
Denver, Colorado

August 26, 1982

Sample Number	Location	Sampling Time	mg/M^3 Cyclohexane Solubles
AG1	Ramp 10 & 12 (breathing zone)	8:46 AM - 1:58 PM	0.73
AG2	On Tractor, Gates 10 & 12	8:42 AM - 1:10 PM	0.80
AG3	Off Load Delivery (breathing zone)	8:41 AM - 1:56 PM	0.64
AG5	Cleaner (breathing zone)	8:29 AM - 1:41 PM	0.68
EVALUATION CRITERIA			*
LABORATORY LIMIT OF DETECTION mg/sample			0.02

mg/m^3 = milligrams of substance per cubic meter of air

* = No evaluation criteria for cyclohexane solubles. This test is performed to see if there are excessive levels; if so, individual polynuclear aromatics are analyzed for in the individual samples.

TABLE 4

Noise Dosimeter Levels
C Concourse, Gates 10 and 12
Stapleton International Airport

Texas International Airlines
Denver, Colorado

August 26, 1982

Job/Task Description	Sampling Time (hours)	8-Hour TWA Noise (dBA)
Superintendent of Ramp (Gates 10, 12)	7	88.2*
Commissary on Ramp	7	83.7
Baggage Handler (Bag Room)	7	80.7
Aircraft Technician (Gates 10, 12)	7	91.3*
Aircraft Technician (Gates 10, 12)	7	90.9*
EVALUATION CRITERIA	NIOSH 8-hour TWA	85 dBA
	OSHA 8-hour TWA	90 dBA

* Noise Levels which exceeded NIOSH criteria or OSHA standard.

TABLE 5

Octave Band Sound-Pressure Levels

Texas International Airlines
Denver, Colorado

August 26, 1982

Hertz (cycles per second)	Noise Level dBA
31.5	84
63	89
125	88
250	85
500	82
1000	79
2000	82
4000	80
8000	69
16000	--
31500	--

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