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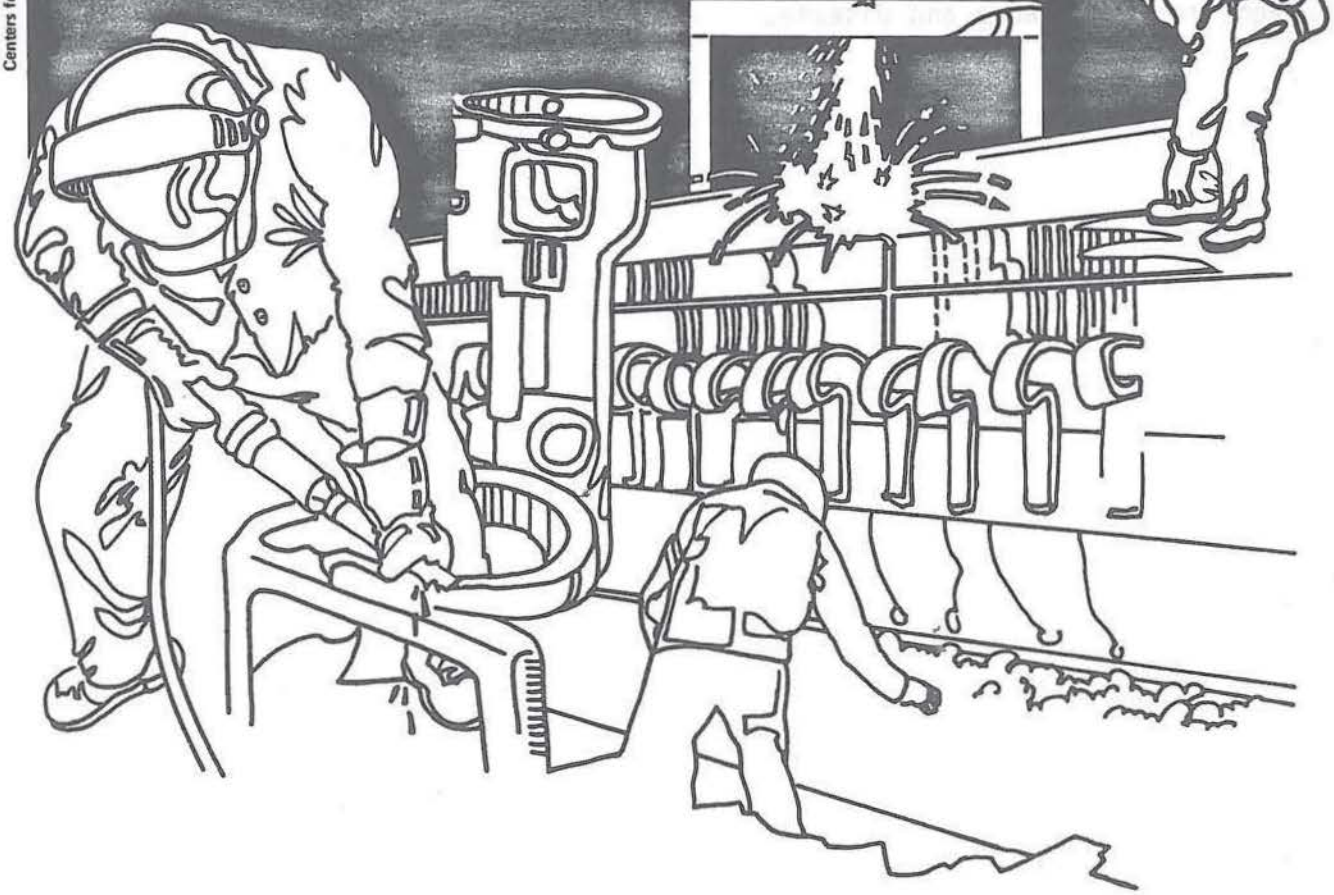

Health Hazard Evaluation Report

HETA 81-197-995
FRONTIER AIRLINES, INC.
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 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.

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FRONTIER AIRLINES, INC.
DENVER, COLORADO

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I. SUMMARY

In February 1981 the National Institute for Occupational Safety and Health (NIOSH) received a request from a representative of Frontier Airlines, Inc. in Denver, Colorado, to evaluate occupational exposures to noise to the ground crew operators at their Denver operation.

An environmental investigation was performed in July 1981 and consisted of direct reading and 8 hour Time-Weighted Average (TWA) noise measurements. When measuring intense noise, the A-weighting feature (referred to as dBA) is used since it simulates the response to the human ear. Measurements were made at the worker's hearing zone (close to the ear). Noise-frequency distribution (octave band analyses) and peak noise levels were also measured at those areas where the highest exposures were thought to exist, that is, directing planes into and away from the terminal, unloading and loading baggage, etc.

At the time of the July survey noise levels exceeding the NIOSH recommended limit of 85 dBA, 8-hour TWA were found at the various ground crew jobs evaluated. Eight-hour averages ranged from 83 to 86 dBA for ramp operations agents; 84-97 dBA for baggage handlers; and 83 to 89 dBA for mechanics.

Peak noise levels for the various locations and jobs performed around the aircraft ranged from 93 to 110 dBA for Frontier's Convair 580 turbo prop aircraft and 92 to 98 dBA for Frontier's Boeing 737 aircraft. Excessive noise was found to be distributed over a wide frequency range with the highest levels between 250 to 4000 Hertz (Hz) for both types of aircraft evaluated.

All workers were wearing either ear plugs or muffs which are rated to reduce noise levels below 85 dBA and this hearing protection program is rigidly enforced by management. Since 1973 audiometric testing is mandatory for all employees on an annual basis.

On the basis of the environmental data collected, NIOSH determined that a potential health hazard from excessive noise levels existed to a number of the workers evaluated at Frontier Airlines' Denver, Colorado, operations. Frontier's management has, however, developed an adequate hearing conservation program and it would be impossible to engineer out the noise to an acceptable level without isolation of the workers. Frontier is presently in the process of eliminating all of its Convair 580 aircraft which, based on NIOSH's investigation, contributed to the majority of higher noise exposures evaluated during this survey. Recommendations that can further assist in preventing hearing loss are included in this report.

KEYWORDS: SIC 4511 (Air Transportation, Certificated Carriers), noise, ground crew personnel, machanics, baggage handlers, ramp operations agents.

II. INTRODUCTION

NIOSH received a request in February 1981 from a representative of Frontier Airlines, Inc., Denver, Colorado, to determine if there was a health hazard to ground crew employees from high noise levels from the Frontier aircraft arriving and departing at the Denver facility. An environmental survey was conducted July 15, 1981. Environmental data was discussed with the workers and management at the close of the survey.

III. BACKGROUND

Frontier Airlines' Denver, Colorado, operation runs 24 hours a day, seven days a week, and can be considered one of Frontier's busiest operations. Frontier uses between 16-18 gates at their Denver operation and the heaviest passenger loads are between 9:00 a.m. to 3:45 p.m. The major peak traffic is at 9:10 - 9:50 a.m.; 11:45 a.m. - 1:00 p.m.; and 3:00 - 3:45 p.m. with approximately 85 departures and arrivals during this time.

Each gate has five ground crew personnel: one senior, three permanent, and one runner. There are also two mechanics at each of these stations. Between these crews a number of duties are performed from directing the aircraft into and out of the terminal, loading and unloading baggage, general maintenance on the plane, etc. The specific jobs and duties are:

Local Bag Runner - This person is responsible for Denver bound baggage and transfer baggage to other airlines, e.g., United, Continental, etc. Once this baggage is delivered he will return and assist in final baggage loading at his assigned gate.

On-line Runner - This person is responsible for transferring all baggage that is destine for only Frontier flights, and he is also required to return and assist in final baggage loading.

Ramp Operations Agent - This person is responsible for establishing weights for cargo, e.g., baggage, mail, freight, etc., and determining the most effective way to put this into the cargo area. He also helps to load and unload the baggage.

The average noise exposure time for the ground crews vary depending on how long the plane is on the ground; however, the normal time for the Boeing 737 is 40 minutes and 30 minutes for the Convair 580 turbo jets. The Convair 580 was determined to be the louder of the two planes used by Frontier. Other factors contributing to the noise exposure to Frontier ground crews include: other types of aircraft servicing other airlines around Frontier gates; electrical and air power units used to maintain the planes' equipment while on the ground; push tugs; sanitary trucks, etc. Finally, gates 14 and 34 were said to be the noisiest gates at the Denver operations and was due primarily to the Convair 580 aircraft which uses these gates most often.

Frontier Airlines requires its ground crew personnel to wear hearing protection (ear muffs and/or plugs) as well as to participate in its

annual audiometric testing program. Frontier also performs noise surveys throughout the year at different gates and locations. These noise surveys are performed on both types of aircraft used by Frontier.

IV. ENVIRONMENTAL DESIGN AND METHODS

Fourteen personal TWA noise levels were taken using Metrosonic noise dosimeters which register on a memory cell the dose or noise level received during the exposure period. The data can then be displayed on a read-out (hard copy) for each minute at the end of the exposure period. The read-out 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 & Kjar (B&K) Precision Sound Level Meter equipped with an octave band analyzer.

V. EVALUATION CRITERIA

A. Environmental

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. Finally, for those employees exposed to noise levels exceeding 90 dBA for eight hours and/or where audiometric testing results indicate a hearing loss, ear protection must be worn.

B. Toxicological

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

A total of fourteen personal noise samples (four mechanics, four agents, and six baggage handlers) and numerous area noise level measurements were taken during the survey period. Only one of the agents TWA noise levels exceeded the NIOSH criteria of 85 dBA and this person was working at gate 14 during the survey period. Five of the six baggage handlers evaluated during our survey had TWA noise levels which exceeded the NIOSH standard and four of the five who exceeded the criteria were working at gates 14 or 34. Of the mechanics evaluated, again, all but one had TWA noise exposures exceeding the criteria; however, none of the ground crew employees were working at either gates 14 or 34 (refer to Table 1 for the above results).

The peak area noise level measurements taken ranged from 93 to 110 dBA and this was found at each of the gates where Convair 580 aircraft were located. Area noise levels for the Boeing 737 aircraft ranged from 90-98 dBA at each of the locations evaluated for this aircraft. Based on this survey, the Convair 580 aircraft were consistently noisier at each location evaluated versus the Boeing 737 aircraft evaluated.

VII. CONCLUSIONS

A potential health hazard did exist at this work place during NIOSH's evaluation. This conclusion is based on the excessive TWA noise levels found, as well as the noise data obtained from the dosimeter readings and the octave band evaluation. Ground crews were provided hearing protection which will reduce the actual exposure below that measured by

the personal noise measurements used in this study. It was also determined that Frontier does provide annual audiometric testing and that since 1975 when this program began only two percent of the employees screened per year have developed hearing loss. This 2% loss has been evaluated by Frontier, in each case, as non-occupational, e.g. presbycusis, non-occupational injuries.

Finally, it was determined that the Convair 580 aircraft were consistently noisier at each location evaluated versus the Boeing 737 aircraft evaluated.

It can be concluded, based on the data obtained during NIOSH's survey, that operations at gates 14 and 34 had greater noise exposures than the other operations and/or gates surveyed. However, these consistently high noise levels were determined to be due to the excessive air traffic in and around these gates.

VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental study, as well as personal communications with individuals at Frontier Airlines' Denver operation, the following recommendations are made to provide a better work environment for the concerned employees:

1. The hearing protection program should be continued and rigidly enforced.

2. Audiometric testing should be performed yearly. If the worker has any significant threshold shifts, the hearing protection program should be re-evaluated.

3. Noise monitoring should be performed routinely to help supplement Frontier's hearing protection program. This information will then identify for management and the employees which work areas are the most hazardous. Also, those areas which are considered high noise areas should be posted accordingly.

4. To insure that full personal protection is being provided during those periods of exposure the Environmental Protection Agency's Noise Reduction Ratings (NRR) should be consulted amd understood when selecting hearing protection in order to provide the most effective device. Each protective device (ear plugs or muffs) has a NRR rating which, for that particular type and model, describes what percent of noise attenuation may be obtained when using a particular device. However, these ratings can be misunderstood, i.e., suppose a muff (X) has good attenuation at all frequencies except at 4000 Hertz where it has excellent attenuation and its overall NRR rating is 23. Another muff (Y) has great attenuation at all frequencies except 4000 where its attenuation is poor and its overall NRR rating is 26. Therefore, if one only knew that the higher the NRR the better the protection, it would be misleading if the greatest intensity noise in their workplace was at 4000 Hertz and they were using muff Y rather than muff X.

5. An educational program to instruct new employees on the hazards of noise exposures should be implemented, as well as an annual review of noise hazards for all concerned employees should also be implemented if it has not been already.

IX. REFERENCES

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4. Handbook of Noise Measurement, seventh edition, Arnold Peterson and Ervin Gross, 1974.

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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. Frontier Airlines, Inc.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health.
5. 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

NOISE DOSIMETER LEVELS

Frontier Airlines, Inc.
Denver, Colorado

July 15, 1981

Job/Task Description	Sample Number	Sampling Time (hours)	Noise Level dBA
Mechanic/Gate 6	56	6.5	82.5
Mechanic/Gate 4	59	6.5	88.8
Mechanic/Gate 4	63	6.5	87.0
Mechanic/Gate 6	74	6.5	85.0
Agent/Gate 14	73	7.0	84.0
Agent/Gate 34	64	7.0	83.0
Agent/Gate 16	81	7.0	84.0
Agent/Gate 14-A	60	7.0	86.0
Baggage/Gate 22-24	80	7.0	85.0
Baggage/Gate 14A	78	7.0	97.0
Baggage/Gate 22-24	82	7.0	84.0
Baggage/Gage 34	57	7.0	90.0
Baggage/Gate 14	55	7.0	88.0
Baggage/Gate 16	78	7.0	90.0

EVALUATION CRITERIA:			
	NIOSH	8-hour TWA	85 dBA
	OSHA	8-hour TWA	90 dBA