LOG OF MEETING

SUBJECT: Technical Advisory Panel Meeting or UL for single and multiple station smoke alarms, UL 217.

DATE OF MEETING: February 4, 1997

PLACE: Hyatt Regency Hotel, Bethesda, Maryland

NON-COMMISSION ATTENDEES:

Fabio Ameida	American Sensors	Paul Llorett	UL - Santa Clara
Tom Barakat	Coleman Safety	Larry Maruski	US Fire Admin
Ron Baugh	Sentrol, Inc./ESL	Rick Mendlen	HUD
Emil Braun	NIST	Jim Milke	University of MD
Dick Bukowski	NIST	Bob Miller	UL - Northbrook
Maureen Cislo	Product Safety Letter	Isaac Papier	UL - Northbrook
Mark Earley	NFPA	John Parssinen	UL - Northbrook
Scott Edwards	Gentex Corp.	Paul Patty	UL - Northbrook
Bob Fischette	Sentrol	Doug Peabody	State of Conneticut
Dave Haatja	UL - Washington, DC	Larry Ratzlaff	Fymetics
Matthew Hamm	BRK Brands, Inc.	Sara Yerkes	NFPA
Rick Huey	COMSIS Corp.	Craig Zajac	Motorola
Adam Kozlowski	System Sensor		

COMMISSION ATTENDES:

Julie Ayres — Office of Hazard Identification and Reduction
James Hoebel — Directorate of Engineering Sciences

LOG ENTRY SOURCE: Julie Ayres

SUMMARY OF MEETING:

See attached minutes dated March 5, 1997

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Subject 217

1655 Scott Blvd.
Santa Clara, CA 95050
March 5, 1997

TO:

Julie Ayres)
Thomas Barakat)
Ron Baugh)
Tom Brace)
Richard Bukowski)
Merton W. Bunker, Jr.)
Mark Devine)
Val DiGiovanni)
Scott R. Edwards)
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Leon Harper)
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Ron Mengel)
James Milke)
Larry Ratzlaff)
Mickey Reiss)

Industry Representatives on the Technical Advisory Panel for UL for Single and Multiple Station Smoke Alarms, UL 217

SUBJECT: Report of the Technical Advisory Panel Meeting of UL for Single and Multiple Station Smoke Alarms, UL 217.

SUMMARY OF TOPICS

The following topics were discussed at the meeting:

1. Alarm Silencing Means
2. Standardized Alarm Signal
3. Dust Test
4. Corrosion Test
5. Audibility Test

(Continued)

SUMMARY OF TOPICS (continued)

6. Smoldering Smoke Test
7. Escape Time
8. Standardized Mounting, Brackets, and Wire Harnesses

A meeting of the Technical Advisory Panel (TAP) for Subject 217 was held at the Hyatt Regency in Bethesda, Maryland on February 4, 1997. The purpose of this meeting was to discuss the "summary of topics" previously noted in addition to other technical issues submitted by industry and the Consumer Product Safety Commission (CPSC).

Attached as Appendix A is a list of the persons who attended the meeting. Attached as Appendix B is a copy of the Hearing Conversation Program from California State Polytechnic University, Pomona submitted by Scott Edwards of Gentex Corporation (see item 5, Audibility Test for details). Attached as Appendix C is supplementary information from UL regarding the Norwegian Fire Research Report (see item 6, Smoldering Smoke Test for details).

Comments regarding this meeting report or any of the topics previously discussed are welcome. Written suggestions should be sent to the attention of Kristin Andrews at UL's Santa Clara office, 1655 Scott Blvd., Santa Clara, CA 95050-4169. Suggestions may be faxed to (408) 556-6045.

It is suggested that the agenda for this meeting, dated December 20, 1996, be referenced for proposals, industry comments, and additional technical material.

* * * * *

The following report is not intended to be a verbatim transcript of the discussions at the meeting, but is intended to record the significant features of those discussions.

INTRODUCTION

Chairman Isaac Papier from UL's Northbrook office opened the meeting and welcomed all the attendees. He advised all participants of the content and format of the meeting. TAP members were granted exclusive privilege to comment on discussion items. Observers were given permission to comment after TAP members were finished with their respective comments. It was emphasized that this meeting was strictly advisory and related to the printed subject matter. UL's goal is to enhance the development of its standards, in this case UL 217.

A reference was made to the December 20, 1996 agenda which anonymously highlighted industry comments regarding proposals made in the Subject 217 bulletin dated April 5, 1996. It was noted that many proposals were not incorporated into the February 21, 1997 new edition of the standard and were reserved for future discussion. Among those subjects were proposals regarding corrosion, dust, audibility, smoldering smoke, and escape times which were items to be discussed at this meeting.

1. ALARM SILENCING MEANS

Discussion on this topic centered on the feasibility of requiring an alarm silencing means (ASM) to disable nuisance tripping of alarms (as a result of smoke from cooking, steam from a shower, and other instances that were not related to an emergency). The disabling of smoke detectors has been verified as a leading cause of injuries and deaths related to fires.

Paul Patty from UL's Northbrook office presented technical data regarding the products of combustion and the "development" of a fire and smoke, which is typically the first hazard that confronts an individual. He also presented detailed information concerning the five components of an alarm and how the alarm functions.

John Parssinen from UL's Northbrook office continued the presentation regarding the function and possible suitability of an ASM. Four available options were offered to help prevent the disassembly of a standard alarm in the event of nuisance tripping:

- Move the alarm away from problem sources to more suitable locations;
- Change the "principle" of the alarm's function (for instance from an ionization type to a photoelectric type)
- Select an alarm with an ASM
- Design and manufacture a "smarter" alarm

Representatives of manufacturers noted that alarms are often misplaced in residential dwellings (considered 1-to-2 units as in a small home or apartment). They also noted there is far less of a problem in commercial dwellings (a hotel or hospital) where stricter guidelines are enforced. Regardless, it was mentioned that the national codes and standards advise of the proper placement and installation of smoke alarms in the home. However, it was implied that many owners and residents of dwellings are misinformed or simply not knowledgeable regarding the use or maintenance of a detector.

Other TAP members noted that an ASM would not necessarily solve the problem of alarm disablements. If misplaced, the ASM would still trip and become a nuisance to the resident. The alarm would eventually be disabled. Other members noted differences between photoelectric and ionization types and the issue that ionization types are primarily affected by nuisance tripping. However, all manufacturers admitted that cost becomes an issue (since ion-types are generally much cheaper to buy).

It was asked if an ASM was a band aid for a more inherent problem. The majority of the group believed that if the correct alarm were properly designed and installed per the applicable codes, it would operate properly with minimal nuisance tripping. However, it was noted that proper public education would not guarantee the correct use of an alarm, unless owners responsibly installed and maintained alarms.

The last issue that industry submitted was the cost associated with an ASM, since the device is patented. Manufacturers thought it would be extremely unfair to impose regulations and noted that typical costs associated with an ASM would raise detector costs, making them less affordable to low-income families. This would be particularly true of photo types which are already more expensive to buy.

After additional discussion the group acknowledged that the universal mandating of an ASM was not the proper route. Both types of alarms are useful and work if properly used. The potential exists to modify the installation and operating instructions that are provided with these alarms. It was mentioned that an ASM may even be desirable in some functions.

As a result of this discussion, the following ideas emerged:

- An ASM could make the situation worse (allowing for a false sense of security);
- There appeared to be two specific categories which dictated the use and application of alarms – commercial residential and "conventional" residential environments which may require different forms of protection;

• There are concerns with patenting;

• The TAP cannot realistically rely on an occupant to protect himself.

Therefore it was concluded that an ASM will remain as an option and changes to Chapter 2 of the National Fire Protection Association (NFPA) will be suggested to establish two categories of smoke alarms/protection: commercial residential and conventional residential. These changes could also be made to UL 217. Additional comments are welcome from industry.

2. STANDARDIZED ALARM SIGNAL

This requirement has been adopted as originally proposed in the April 5, 1996 bulletin for UL 217. Organizations such as the NFPA and International Standards Organization (ISO) in Europe have adopted this standard evacuation signal that is intended to convey the message to immediately leave a commercial establishment. Unfortunately, while many organizations are consistent, Canadian authorities do not want to adopt this "three pulse" temporal pattern for residential smoke alarms. This has made it difficult for UL to harmonize its requirements with Canada.

Most members of the TAP concurred with the requirement. The trouble lies with Canadian authorities which will force manufacturers to produce two types of alarms to satisfy both U.S. and Canadian requirements.

It was noted that the effective date for this requirement in UL 217 is 18 months. It was recommended that manufacturers and officials work with the National Building Code of Canada to resolve differences and perhaps adopt this signal.

A TAP member briefly asked how UL would test this signal (and how compliance with tolerances would be determined). UL staff answered that devices would be measured at room temperature and technicians would listen to signals at various temperature ranges. It was acknowledged that keeping a 10 percent tolerance over different temperatures may not be easy, but as a matter of practicality a perceivable difference in sound would determine if the device complied.

3. DUST TEST

Discussion was referenced to UL's proposal bulletin referenced in item 2. UL staff noted the revised requirement (the change from 1 percent per foot obscuration to 50 percent) simply allowed alarms to become more sensitive after this test. However, UL staff mentioned that another type of dust, ASHRAE dust, is being considered for testing. Some manufacturers believe that the current dust, cement dust, is not appropriate since it is very easy to clean. However, ASHRAE dust is darker and stickier and is normally found in air handling systems. UL feels that this is not representative of a household environment.

Manufacturing representatives mentioned that many of the alarms returned for servicing or replacement are filthy. It is believed that grease is a major contributor to the dirt that collects on the alarm screens. There were two lines of thought regarding this build up.

First, members conceded that commercial alarms were generally not affected by this build up since they are frequently serviced. It was acknowledged that the accumulated build up of grease generally occurred in residential dwellings. The group was reminded about item 1 and the ASM discussion. It appeared that there were significant differences in the dirtiness of commercial versus residential alarms. It was suggested if two categories were established, perhaps an additional test could be conceived to address the effect of grime on household detectors.

Second, some manufacturers noted that a homeowner is not in the position to effectively clean a detector. He typically would do more harm than good, and the alarm would normally be returned to the factory for servicing or replacement. Or, as another possibility, a consumer would simply buy a new alarm. In either case, the amount of dirt build up correlated with the life of a detector. Although there was some disagreement concerning the actual "life" of a detector in years (10 seemed the most agreeable figure), most manufacturers believe that most alarms are replaced well before they are ineffective. In fact, UL staff noted that most samples with dust contamination (due to residue, grease, etc.) were typically more sensitive; therefore, safety does not appear to be an issue.

From this discussion, the TAP accepts the current test protocol and the idea that accumulation of dirt on a detector is an indication that it is nearing the end of its life.

4. CORROSION TEST

UL has determined that equivalent test methods should be devised as alternatives to this test. UL mentioned that the current test evolved from other fire alarm standards where this test was devised some 40 years ago.

Although UL wants manufacturers to have options, many of the manufacturing representatives see no need for optional tests. However, the CPSC noted that after an analysis of alarm samples in the field, one of the residues that was found was chlorine. The CPSC is concerned that chlorine or chlorides could be present in alarms and attack internal components. Since UL does not have a test to examine samples for chlorine it was suggested that one be studied and possibly developed.

A survey of various corrosion tests from UL and ISO (including a mixed flow test) showed similarities among the tests that were described. The only differences were the traces of chlorine that were found, and there was no indication to verify how those traces were measured. Without an electron microscope to examine samples (to check if chlorine had additionally damaged the samples) results would be inconclusive. Additionally, since corrosion was a problem with the field samples that the CPSC collected, there was no evidence to determine that the residues were chlorides or chlorine. There was also no data to determine the age of the field samples.

Although the mixed flow test was the only one to show traces of chlorine and nitrogen dioxide, UL staff noted that this test is typically performed on carbon monoxide alarms due to their similarity to smoke alarms. UL mentioned it would welcome any information that would help modify its current corrosion tests. In the meantime, manufacturers were wondering if chlorine would be a problem in residential areas (members noted homes with pools) and why any newly designed alarm would be affected. It was generally agreed that older alarms with piezo discs housing spring contacts would be at risk; however, this design is old and fewer are made each year. UL staff briefly mentioned that it intends to add a failure rate figure for horn contacts since MIL Standard 217 F has been revised to include this figure.

The conclusion was that there was no real firm evidence that chlorine or chlorides were attacking components. There is a question that there could be sources of chlorine before and after a fire, but the amount of "free" chlorine or chloride remains to be seen. The current corrosion test is viable and will continue to be used until a better test can be developed if appropriate.

As a result of this discussion, Dick Bukowski and Jim Milke will try and gather information (within 60 days) regarding the effect on chlorides on alarms. Julie Ayres volunteered to review the CPSC information to determine if chlorine or chlorides were the chemicals that were found on alarms.

5. AUDIBILITY TEST

There had been no peak frequency range specified for alarms subjected to the Audibility Test in Section 65 of UL 217. Since lower frequencies carry through the structure of a house better than higher frequencies, UL proposed to revise the requirements specify a 500 to 1000 Hz range for the primary peak frequency. However, most manufacturers that use piezo discs are disturbed by this proposal since these discs generate frequencies hovering around 3300 Hz.

Many of the manufacturing representatives argued that the proposed change was unreasonable since it was geared to a selected group, the hearing impaired. They were concerned that it was not reasonable to mandate such a requirement for a selected small group. Additionally, representatives referred to UL 1971, Signaling Devices for the Hearing Impaired as a viable alternative for the hearing impaired. It was also mentioned that the same proposal was defeated in NFPA 72 Chapter 2 primarily because of the advent of UL 1971, which provides an alternative. Another opinion noted there was no substantial data to support the 500 to 1000 Hz requirement.

There were comments on both sides of the issue. Some TAP members noted that the lower frequency would be better distributed around a building or home and would be better able to alert members in the case of an emergency. However, that opinion was countered with research provided by Scott Edwards. The Hearing Conversation Program, California State Polytechnic University, Pomona (see Appendix B) stated 1000 to 5000 Hz is the most common audibility range for humans. It also cites studies showing noises at 3000 Hz start causing damage to ears and that ears are most sensitive to sounds at 4000 Hz.

The group also addressed the costs involved with the revised frequency and the potential problems such a frequency would have on batteries (drain). It was mentioned that the increased battery drain and resulting reduction in battery life could cause more alarms to fail with the potential for more injuries.

One TAP member claimed other studies report that larger factions of the population are beginning to lose their hearing capabilities at 1500 Hz. The group concluded that a significant portion of the population may be hard of hearing and require an alternative to a standard alarm. However, it appears there are alarms available for the hearing impaired, and although more expensive, they are proven and work for those who need them. Therefore, the standard will not be revised at this time.

6. SMOLDERING SMOKE TEST

Comments previously received from industry voiced concern that the smoke produced by this test does not accurately represent the smoke produced in a residential smoldering fire. Some industry members are concerned with ionization type alarms and their smoke detection performance. UL staff demonstrated tenability limits and smoke detection statistics by comparing research from the Norwegian Fire Research Report (see Appendix C), Dunes Tests, and UL's current tests referenced in UL 217 and UL 268. UL uses the approach that a "fire is a fire" and does not test for a specific "type" of smoldering fire. Paul Patty additionally noted that there are too many variables to determine sources of fires. To develop a test with the most "accurate" smoldering particles would be extremely difficult if not impractical based on all the variables.

UL explained the current test process specified in the standard. UL found a substitute material to simulate a burning mattress and paper. This substitute is ponderosa pine which is used for the smoldering smoke test. After research and test experience, UL is confident that the current test is a consistent, representative test for smoldering smoke.

Additionally, UL emphasized that all detectors must still comply with the 10 percent per foot smoke criteria specified in the standard. This requirement is more severe than the 15 percent specification required by the Dunes test.

Discussions reverted to differences between ionization and photoelectric detectors and which ones worked better in a smoldering fire condition. It was noted that in Europe ISO has 7 tests from which an organization chooses the tests relative to the type of detector used. However, UL emphasized that in the U.S. a detector has to pass *all* tests. UL also explained that while ISO criteria is scientific, it is less practical than UL criteria when related to overall testing. ISO charts categorize the detectors which in turn allows for fewer variables

UL explained that it worked with the National Electrical Manufacturers Association (NEMA) on a study that profiled known false alarm scenarios. The results of that study show that fire profiles for contained and uncontained fires are very similar. However, for most fire scenarios, such as burning toast and broiler cooking, the predominant smoke characteristic is small particles which are more easily sensed by an ionization type smoke alarm versus a photoelectric type smoke alarm. Accordingly, it may not be desirable to place an ionization type smoke alarm too close to these known sources of contained fires. In this situation, the study showed that by moving an alarm or replacing an ionization type with a photoelectric type, fewer nuisance alarms would occur.

UL also confirmed that its test programs for both photo- and ion- type smoke alarms are identical and that one type of alarm does not typically perform appreciably better than the other to mixed fuel fire situations.

However, one TAP member voiced concern about results from the Norwegian tests involving the time in seconds where smoke reached "critical values." These charts are attached as Appendix C. The critical value/time figures noted in this appendix correlate with recent changes to NFPA Chapter 2 which require detectors in every bedroom of a residence. However other members expressed concerns about smoldering smoke and the reality that detection times are longer than detection times in typical flaming smoke fires.

Another member voiced concern about the accumulation of carbon monoxide that is noted in Figure 4 of the Norwegian tests (reference the same appendix). The concern was that the data appeared to show that ionization type detectors do not respond to smoke until the carbon monoxide is at a critical level.

UL noted that Figures 3 and 4 are characteristics of a fire in the room of origin. Figure 6 shows characteristics of smoke in the hallway outside the room of origin. It was emphasized that one would have to look at various types of tests to see how this information was validated. Also, the location of the test measuring equipment would play a factor in some of the values indicated in the submitted charts. A member noted that the charts really didn't indicate what type of fire was involved, since the fuel of a fire and the associated gases involved typically determine what a "survivable" fire is. Poisonous gases would differ based on the location of a fire and its fuel source.

To conclude discussions, Julie Ayres was asked to provide information regarding research of carbon monoxide levels in smoldering smoke tests. When this information is provided, UL will review it and determine if further discussion is required regarding carbon monoxide levels and their relation to smoldering smoke.

7. ESCAPE TIME

A manufacturer previously commented that UL 217 should require instructions that explicitly inform the consumer of the escape time a detector provides to flee a burning dwelling. UL noted that there are too many variables to specify a particular escape time. The location of the fire, the type of fire, alarm, paths for evacuation, and physical ability of the occupants are a few of the many variables that determine an escape time. UL emphasized that time should not be an issue – the public should realize that there is no time to spare in the event of a fire.

TAP members agreed that escape times are not practical. Instead, continuing public education is the key to help prevent injuries and fatalities. Although information exists and has been published, members acknowledged that more efforts have to be made to inform more segments of the population. The group suggested that the CPSC, NEMA, NFPA, and UL work together to gather all relevant information and publish a document that can be used for public education.

It was noted that NEMA and associated manufacturers have developed a task force regarding smoke detector applications and public guidelines. It was concluded that all the participating organizations would help to maintain public awareness and notify the public that the following fire safety precautions need to be met:

- Reduction of fire risk by the practice of good safety habits (unplugging of appliances, proper use of alarms, etc.)

- Regular cleaning of smoke alarms

- Evacuation plans, and routine practice of these plans

- The immediate initiation of an evacuation plan when a smoke alarm sounds.

8. STANDARDIZED MOUNTING, BRACKETS, WIRE HARNESSES

This topic was introduced by a member of industry who had concerns about the standardization of connections and mounting of multiple station alarms. There are too many variations between alarms. Tandem line voltages and connection means vary from manufacturer to manufacturer making the replacement of older alarms expensive and, at times, infeasible.

Most members acknowledged there are problems, but there appears little can be done to standardize these items. Consumers who need to replace older alarms with newer types that are not compatible can still call electricians for proper installation of a system. Although costly, the older alarms can be replaced. Manufacturing representatives emphasized that it is in their best interests to help consumers by providing replacement information for alarms in systems. However, it was mentioned that it would be too difficult to agree on one standard connection design. There would be arguments and opinions regarding design priorities in addition to possible patent problems. Also, since there are so many different line voltages there was a question of liability.

In conclusion, the group decided that older alarms would gradually phase themselves out. Also, since manufacturing is slowly moving to 5-volt alarms, tandem voltages may eventually become standardized. Although the idea deserves merit (one member noted the replaceable components of a stereo system) it doesn't appear that it is a solvable situation at this time. Forcing the standardization of these items is beyond the scope of UL. The TAP advised members of NEMA to discuss the situation; they will determine if additional action regarding standardization will be required.

MEETING CLOSE

Isaac thanked everybody for their attendance and reemphasized that members could send comments or suggestions to UL regarding requirements for UL 217. He encouraged and invited TAP members to take an active role in the development of the standard and provide any valuable information for UL's review.

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APPENDIX A

ATTENDANCE AT THE FEBRUARY 4 MEETING OF THE TAP FOR SINGLE AND MULTIPLE STATION SMOKE ALARMS

TAP MEMBERS:

*Fabio Almeida	American Sensors Electronics Inc.
Julie I. Ayres	CPSC
Tom Barakat	Coleman Safety & Security Products Inc.
*Emil Braun	NIST
Dick Bukowski	NIST
Larry Ratzlaff	Fymetics
Scott R. Edwards	Gentex Corp.
Ron Baugh	Sentrol, Inc./ESL
*Matthew Hamm	BRK Brands, Inc.
*Doug Peabody	State of CT (National Assoc. of State Fire Marshals)
Rick Huey	COMSIS Corp
*Adam Kozlowski	System Sensor
Jim Milke	University of Maryland
Larry Maruskin	U.S. Fire Administration
Rick Mendlen	HUD

OBSERVERS:

Craig Zajac	Motorola-Chem Sensors
Bob Fischette	Sentrol
Sara Yerkes	NFPA
Mark Earley	NFPA
James F. Hoebel	CPSC
Maureen Cislo	Product Safety Letter

UL STAFF:

Dave Haatja	UL Washington, D.C.
Paul Lloret	UL Santa Clara
Bob Miller	UL Northbrook
Isaac Papier	UL Northbrook
Paul Patty	UL Northbrook
John Parssinen	UL Northbrook

* Substitutes:

Fabio Almeida for Val DiGiovanni
Emil Braun for William Grosshandler
Mathew Hamm for Mark DeVine
Doug Peabody for Tom Brace
Adam Kozlowski for Ronald Mengel

APPENDIX B

RESEARCH SUBMITTED BY SCOTT EDWARDS –
HEARING CONVERSATION PROGRAM (California State Polytechnic University, Pomona)

Hearing Conservation Program

California State Polytechnic University, Pomona

TABLE OF CONTENTS

Hearing Conservation Program

1.0 REFERENCE. California Code of Regulations, Title 8, Article 105, Sections 5095 to 5100; Business Affairs Administrative Manual, Sections 112 and 120.

2.0 POLICY. It is the policy of California State Polytechnic University, Pomona to establish and maintain an effective Hearing Conservation Program (HCP) designed to eliminate or control, overexposure to harmful noise levels and to prevent occupational noise induced hearing loss to faculty, staff, and students. The University shall provide a place of employment that is safe and healthful and will not subject the campus community to avoidable hazards associated with harmful noise levels.

The University shall make every effort to identify high noise level areas on campus and shall take steps to make them readily identifiable to personnel who work in these areas. Protective measures shall be provided by means of engineering controls, administrative controls, and or by providing personal protective equipment when necessary. Employees who's 8-hour time-weighted average noise level exposure equals or exceeds 85 decibels will be enrolled in a hearing conservation program (see Section 9.1).

The University shall provide at no cost to employees a hearing examination designed to provide safe job placement of employees, satisfactory maintenance of employee hearing levels, and to ascertain the effectiveness of noise control methods.

3.0 PURPOSE.

3.1 The purpose of this program is to provide workers, supervisors, and management with an understanding of the seriousness of the threat posed by industrial noise and to explain what departments must do, by law, to control occupational noise exposure.

3.2 According to the U. S. Public Health Services, some 28 million people have their hearing impaired. An estimated 10 million cases of hearing loss are associated with (caused by) excessive noise. People who are exposed to high noise levels for long periods of time can develop noise-induced hearing loss. This is a permanently untreatable condition. Hearing aids only help to amplify different sounds, but they cannot make a person hear any better.

4.0 RESPONSIBILITIES.

4.1 Environmental Health and Safety (EH&S) Office

a. coordinates the campus Hearing Conservation Program, providing consultation to departments according to their specific needs;

b. conducts noise surveys in response to department requests or upon EH&S initiative;

c. provides hearing conservation training to employees enrolled in the hearing conservation program;

d. assists departments in developing methods for noise abatement, reduction or control;

e. approves personal protective devices considered for purchase by departments;

f. establishes and conducts an audiometric testing program for appropriate employees, providing consultation and notification of exam results;

g. maintains and makes available records of exposure measurements and audiometric tests;

h. maintains records of general training activities; and

i. provides University departments with updated and current regulatory information with regard to hearing conservation.

4.2 Departments

a. ensure that noise control is considered when procuring equipment, machinery and tools;

b. identify areas that may overexpose employees to harmful levels of noise and notify the EH&S Office;

c. plan for implementation methods for noise abatement, reduction or control;

d. provide and arrange for hearing conservation training for employees covered by the Hearing Conservation Program; ensure that they read, and understand, and comply with all appropriate safety procedures, whether written or oral, and sign the Safety Program Certification Statement, Form EH&S F-333-02 (see Appendix A);

e. ensure that appropriate personal protective equipment is procured and provided to appropriate employees; enforce the use of such devices when required by Sections 8.3 and 9.2; ensure that such devices are kept in good repair and maintained in a sanitary manner; and

f. make available, to all employees, information regarding occupational hearing conservation and other relative health and safety data.

4.3 Employees

a. report any suspected high noise areas to your supervisor;

b. use common sense and good judgment at all times; the number of potential hazards that may exist or be created in the work place is sometimes unpredictable;

c. request and expect to receive (within a reasonable time frame) information regarding health and safety.

d. read, understand and comply with ail appropriate safety procedures, whether writ ten or oral, while performing assigned duties; and

e. complete and sign the Safety Program Certification Statement, Form EH&S F-333-02 (see Appendix A).

5.0 SOUND LEVELS. The table in Appendix B shows some common equivalents of sound levels in decibels (dB). Decibels are a unit of measure for sound. Exposure to noise with a loudness of 80dB is annoying. It is roughly equivalent to the noise level of an alarm clock about two feet from your ear. Exposure to 90dB can cause physical damage to the ear. Noise at about 120dBA, can actually be painful and permanently damaging.

6.0 EFFECTS OF OVEREXPOSURE.

6.1 The ear has three sections (see Appendix C). The outer ear helps to direct sound into the auditory canal (Ear Canal). The middle ear, separated from the outer ear by the eardrum, consists of three connected bones which transmit the vibrations of the eardrum to the inner ear. In the inner ear a snail shaped organ, the cochlea, transforms the vibrations into nerve impulses for transmission to the brain along the auditory nerve. The cochlea is lined with cells equipped with tiny hairs and is filed with liquid. As the liquid moves in response to the vibrations of the bones of the middle ear, the hairs move sending nerve impulses to the brain for decoding. The effect of continued overexposure to noise is the destruction of the hair cells and a permanent loss of hearing.

6.2 The first warning of hearing loss is often the inability to hear high frequency sounds. People with hearing deficiencies caused by overexposure to noise lose sensitivity to sound at about 4,000 Hz, the approximate frequency of a voice on the telephone. If the overexposure continues, the damage will gradually be extended until the entire hearing range is affected. As more and more hair cells of the inner ear are destroyed, the ability to hear is progressively and permanently reduced. Damaged hair cells cannot be repaired or replaced. As a person loses sensitivity to higher frequencies, sounds become distorted. He/she may be able to hear a conversation but not be able to understand it. The use of a hearing aid makes the sound louder, but not clearer. The sound will still be distorted.

6.3 Overexposure to noise affects the entire body. It is associated with tinnitus (ringing in the ears). increased pulse rate, hypertension, increased secretion of certain hormones, tiredness, nervousness, sleeplessness, and other symptoms of stress.

6.4 How can you tell there is a noise problem where you work? Common indications of overexposures to noise are:

a. difficulty hearing normal speech in the work area.

b. raised voice level for communication at normal distance.

c. ringing in the ears after leaving the work area.

6.5 If you suspect that there is a noise problem, the next step is to request a noise survey. The purpose of the survey is to:

a. measure the noise levels for an area or work task

b. identify the source of the noise, and

c. determine what corrective measures to take

7.0 NOISE SURVEY. Noise surveys are technically complicated and require expensive equipment. The EH&S Office has the necessary equipment to conduct noise level surveys. If a noise survey is needed, the affected employee may inform his/her supervisor who will in turn request this service from the EH&S Office. Noise surveys fall into two broad categories. They are:

a. Preliminary noise survey

b. Detailed noise survey

7.1 The preliminary noise survey, for all practical matters is not a real survey, rather it is an assessment of the noise types and levels in a given area. This survey is useful in determining if a potential noise problem exists.

7.2 The detailed noise survey involves the collection of specific data during three main steps:

a. Area measurements

b. Workstation measurements

c. Exposure duration

7.3 There are four reasons for the detailed survey.

a. To obtain specific information from a work station.

b. Develop guidelines for establishing controls.

c. Define areas where hearing protection is required, and

d. Determine the need for employee inclusion into a hearing conservation program.

8.0 CONTROLLING NOISE.

The most effective controls are engineering controls introduced at the time a structure or machinery is being designed or installed. When the facilities have been built and machinery is already in place and operating, such controls are likely to be more expensive.

If the noise survey reveals a potentially high noise problem there are usually many alternative ways to reduce the exposure to within acceptable limits. The EH&S Office should be able to help the department choose a method which is not only effective but which is also economically feasible.

8.1 Administrative Controls. These may also be referred to as operational controls. Administrative controls include adjusting work schedules to reduce exposure time; limiting machine- operating time; or restricting equipment purchases to a specified maximum sound level.

8.2 Engineering Controls. Engineering controls include barriers, damping, isolation; musing, noise absorption, mechanical isolation, variations in force, pressure or driving speed, and combinations of these and other means of reducing noise. Engineering controls, which regulate noise at its source, often involves customized equipment modifications. Cost for these controls can be expensive, however. Depending on the situation, a combination of Administrative and Engineering controls can be effective and affordable.

8.3 Personal Protective Equipment. When engineering and/or administrative controls either fail to reduce to within acceptable limits or are not technologically feasible, hearing protectors must be used.

When either ear muffs or ear plugs are used, the department should have a sufficient variety to insure that workers can get a good fit. Protective devices should be both effective and comfortable. Ear plugs are made of soft, flexible materials which will conform to the shape of the wearer's ear canal.

When ear muffs are used, make sure that the seal between the muff and the head is tight. Long hair, glasses, and other obstructions may diminish the effectiveness of the device.

9.0 CONTROL OF NOISE EXPOSURE.

The State of California has adopted a set of regulations governing exposure of workers to noise in the workplace. The regulations set exposure limits and detail the University's responsibilities when the limits are exceeded.

The following is a summary of the General Industry Safety Orders regulating exposure of workers to occupational noise. The actual regulations are attached for reference (see Appendix D).

9.1 Hearing Conservation Program. When workers are exposed to an 8-hour time-weighted average (TWA) of 85 decibels or greater, the University shall institute a hearing conservation program which includes monitoring exposure, audiometric testing and evaluation of the audiogram results for all exposed workers.

Required audiometric testing must be conducted by a licensed audiologist, otolaryngologist, qualified physician, or trained technician, and the tests made available to employees. Annual audiograms are compared with the baseline audiogram to determine if there has been any deterioration of the worker's hearing (threshold shift). if a worker suffers a significant threshold shift, the University must fit or refit the worker with hearing protectors, train or retrain him/her in their use, and make sure they are used.

9.2 Hearing Protectors. OSHA's Hearing Conservation Amendments specifies that Hearing Protectors (HP) must be made available to employees when their TWA daily noise exposures exceed 85 dBA and mandates the use of HP when exposures exceed 90dBA. Workers must wear hearing protectors when:

they are exposed to a sound level of 85 dBA or greater and have had a significant threshold shift in hearing.

they are exposed to noise in excess of the limits set in Table N-1 Permissible Noise Exposure, Section 5096 of the California Code of Regulations under Title 8. (Appendix D).

Departments have the responsibility to offer workers a variety of suitable hearing protectors, train workers in the use and care of the devices, and ensure the proper initial fit.

9.3 Training Program. Departments that employ workers who are exposed to noise at or above 85 dBA shall include those employees in an annual training program and shall ensure employee participation in such program. The program topics will include:

a. the effects of noise on hearing,

b. the purpose and effectiveness of hearing protectors, and

c. the purpose and an explanation of audiometric testing.

The department must make available to workers the Cal-OSHA regulations on exposure to noise (see Appendix D or Article 105 of the Cal-OSHA Safety Orders).

9.4 Recordkeeping and Records Access. EH&S Office will maintain records of:

a. exposure measurements for at least 2 years,

b. audiometric tests for the duration of the affected employee's employment, and

c. audiometric test rooms for the same period.

These records must be made available to workers, former workers, worker representatives, and authorized representatives of the Division of Occupational Safety and Health The Request for Medical and Exposure Records Access, Form EH&S F-251 -00, and Authorization for Release of Medical Record Information, Form EH&S F-1665-00, shall be used for this purpose.

APPENDIX A

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA
ENVIRONMENTAL HEALTH AND SAFETY

SAFETY PROGRAM CERTIFICATION STATEMENT

I certify that I have read the foregoing safety program and fully understand my responsibilities with respect to the policy and procedures as outlined. 1 further agree to comply with the provisions of this program.

NAME OF SAFETY PROGRAM

EMPLOYEE SIGNATURE DATE

DEPARTMENT

Distribution: Department Office - White
Employee- Canary
Personnel Services - Pink

EH&S F-333-02 Fee 3/95

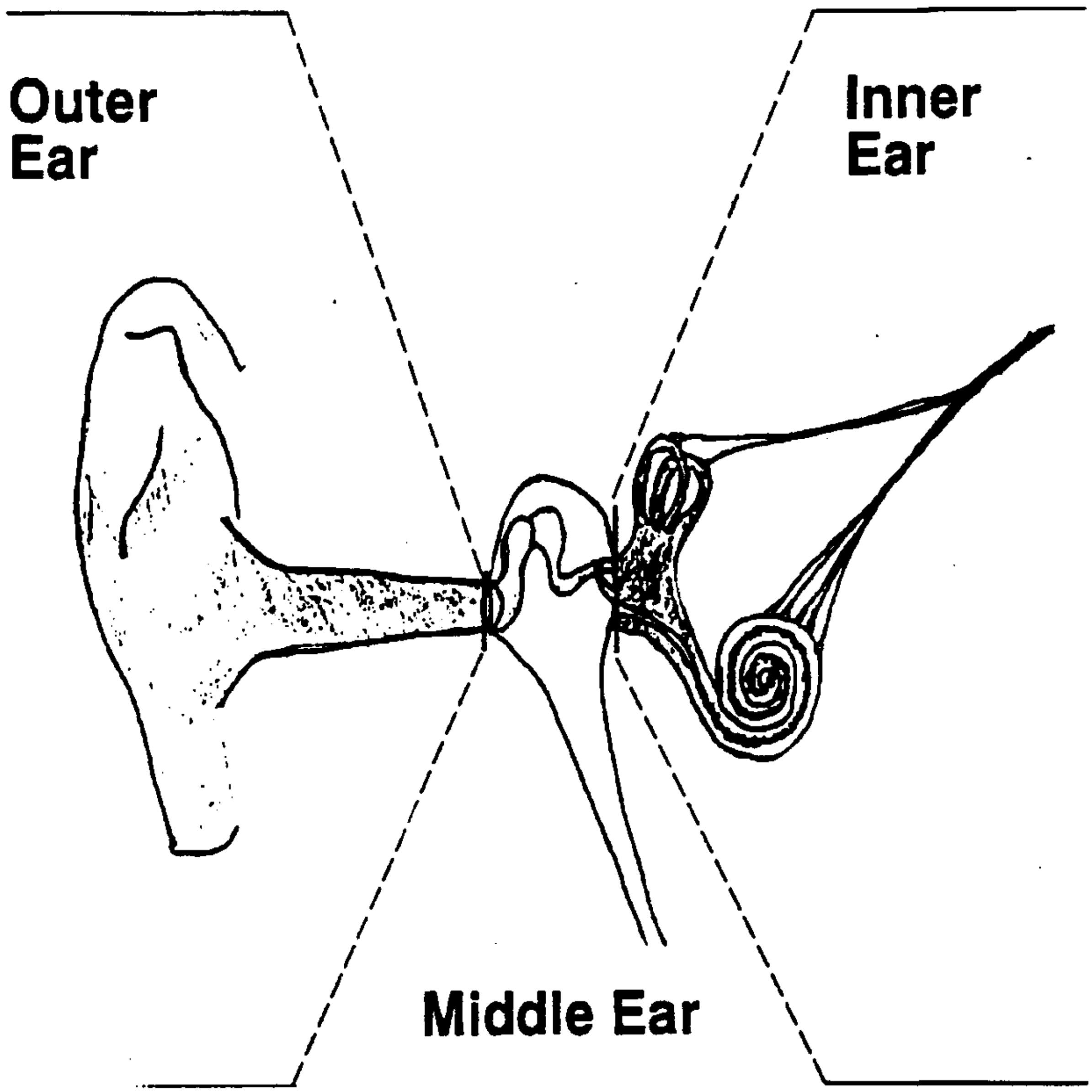
APPENDIX B

COMMON EQUIVALENTS OF
SOUND LEVELS IN DECIBELS (dB)

SOURCE	SOUND PRESSURE LEVEL
Jet Plane Gunshot	140
Riveting (steel tank)	130
Auto Horn Thunder	120
Power Saw Rock Band	110
Punch Press Garbage Truck	100
Subway Heavy Truck	90
Restaurant Alarm Clock	80
Conversation	70
Soft Whisper	30

Exposure to noise with a loudness of 80dB is annoying. It is roughly equivalent to the noise level of an alarm clock about two feet from your ear. Exposure to a 90 dBA (A = time weighted average) can cause physical damage to the ear. At about 120 dBA hearing actually becomes painful and damage to hearing, certain and rapid.

APPENDIX C



APPENDIX D

Group 15. Occupational Noise

Article 105. Control of Noise Exposure

§5095. General.

(a) Scope and Application. Article 105 establishes requirements for controlling occupational exposures to noise. Agriculture, construction, and oil and gas well drilling and servicing operations are exempt from the provisions of Sections 5097 through 5100.

(b) Definitions.

Action Level. An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

Audiogram. A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist. A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech, Hearing and Language Association or licensed by a state board of examiners.

Baseline Audiogram. The audiogram against which future audiograms are compared.

Criterion Sound Level. A sound level of 90 decibels.

Decibel (dB). Unit of measurement of sound level.

dBA (Decibels-A-Weighted). A unit of measurement of sound level corrected to the A-weighted scale, as defined in ANSI S1.4-1971 (R1976), using a reference level of 20 micropascals (0.00002 Newton per square meter).

Hertz (Hz). Unit of measurement of frequency, numerically equal to cycles per second.

Medical Pathology. A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

Otolaryngologist. A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Representative Exposure. Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employer deems to be representative of exposures of other employees in the workplace.

Sound Level. Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.

Sound Level Meter. An instrument for the measurement of sound level.

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Repealer of Group 15, (Article 105, Sections 5095-5099) and new Group 15, (Article 105, Sections 5095-5100 and Appendices A-E) field 6-28-82: effective thirtieth day thereafter (Register 82, No. 27) For prior history, see register 72, No. 6.

2. Amendment field 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

§5096. Exposure Limits for Noise.

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table N-1 of this section when measured on the A-scale of a standard sound level meter at slow response.

(b) When employees are subjected to sound levels exceeding those listed in Table N-1 of this section, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

Table N-1 Permissible Noise Exposure

	Permitted Duration per Workday			Permitted Duration per Workday	
Sound Level (dBA)	Hours-Minutes)	Hours	Sound Level (dBa)	Hours-Minutes	Hours
90	8-0	8.00	103	1-19	1.32
91	6-58	6.96	104	1-9	1.15
92	6-4	6.06	105	1-0	1.00
93	5-17	5.28	106	0-52	0.86
94	4-36	4.60	107	0-46	0.76
95	4-0	4.00	108.	0-40	0.66
96	3-29	3.48	109	0-34	0.56
97	3-2	3.03	110	0-30	0.50
98	2-38	2.63	111	0-26	0.43
99	2-18	2.30	112	0-23	0.38
100	2-0	2.00	113	0-20	0.33
101	1-44	1.73	114	0-17	0.28
102	1-31	1.52	115	0-15	0.25

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C1 /T1 + C2 /T2...Cn /Tn exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level.

(c) If the variations in noise level involve maxima at intervals of 1 second or less, the noise is to be considered continuous.

(d) Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Note: Authority and reference cited: Section 142.3, Labor Code.

§5097. Hearing Conservation Program.

(a) General. The employer shall administer a continuing, effective hearing conservation program, as described in this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A-scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with Appendix A and Table A-1 and without regard to any attenuation provided by the use of personal protective equipment.

(b) Monitoring.

(1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall obtain measurements for employees who may be exposed at or above that level. Such determinations shall be made by December 1, 1982.

(2) The monitoring requirement shall be met by either area monitoring or personal monitoring that is representative of the employee's exposure.

(A) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(B) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this section unless the employer can show that area sampling produces equivalent results.

(C) All continuous, intermittent and impulsive sound levels from 80 dB to 130 dB shall be integrated into the computation.

(D) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(A) Additional employees may be exposed at or above the action level; or

(B) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of Section 5098(b).

(4) The employer shall provide affected employees or their representatives with an opportunity to observe any measurements of employee noise exposure which are conducted pursuant to this section.

(5) The employer shall notify each employee exposed at or above the action level of the results of the monitoring.

(c) Audiometric Testing Program.

(1) The employer shall establish and maintain an audiometric testing program as provided in this section by making audiometric testing available to all employees whose exposures equal or exceed the action level.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix B: Audiometric Measuring Instruments.

(5) The employer shall establish for each employee exposed at or above the action level a valid baseline audiogram against which subsequent audiograms can be compared.

(6) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. This requirement may be met by wearing hearing protectors which will reduce the employee's exposure to a sound level of 80 dBA or below.

(7) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(8) Audiometric tests shall be made available to employees by June 1, 1983 or within 6 months of an employee's first exposure at or above the action level, except that where a mobile test van is used to conduct the audiometric test, the test shall be made available within one year of an employee's first exposure at or above the action level provided that all such employees are given an opportunity for testing.

Note: This requirement may be met by an audiogram available to the employer upon the effective date of this section provided the conditions under which the audiometric test was performed were the same as prescribed by this section.

(9) Where an employer chooses to have audiometric tests performed by a mobile test van in accordance with Section 5097(c)(8) and an employee's baseline audiogram has not been obtained within 6 months of the employee's first exposure at or above the action level, the employer shall make hearing protectors available to the employee in accordance with Section 5098 and require that the hearing protectors are worn by the employee until the baseline audiogram is obtained.

(10) At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above the action level.

(d) Evaluation of Audiogram.

(1) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift, as defined in Section 5097(d)(8), has occurred. This comparison may be done by a technician.

(2) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(3) An audiologist, otolaryngologist or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(A) A copy of the requirements for hearing conservation as set forth in Sections 5097, 5098, 5099 and 5100.

(B) The baseline audiogram and most recent audiogram of the employee to be evaluated.

(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix C, Audiometric Test Rooms.

(D) Records of audiometric calibrations required by paragraph (f) of this section.

(4) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined by Section 5097(d)(8), the employee shall be informed of this fact, in writing, within 21 days of the determination.

(5) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(A) An employee not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them; and

(B) An employee already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(C) Refer the employee for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(D) Inform the employee of the need for an otological examination if a medical pathology of the ear which is unrelated to the use of hearing protectors is suspected.

(6) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour time-weighted average of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(A) Shall inform the employee of the new audiometric interpretation; and

(B) May discontinue the required use of hearing protectors for that employee.

(7) An annual audiogram may be substituted for the baseline audiogram when in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(A) The standard threshold shift revealed by the audiogram is persistent; or

(B) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(8) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000 and 4000 Hz in either ear.

(9) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: Determination and Application of Age Correction to Audiograms.

(e) Audiometric Test Requirements.

(1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000 and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, ANSI S3.6-1969.

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix B, Audiometric Measuring Instruments.

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix C, Audiometric Test Rooms.

(f) Audiometer Calibration.

(1) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 dB or greater shall require an acoustic calibration.

(2) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix D, Acoustic Calibration of Audiometers. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 dB or greater necessitate an exhaustive calibration.

(3) An exhaustive calibration shall be performed at least every two years in accordance with Sections 4.1.2, 4.1.3, 4.1.4.3, 4.2, 4.4.1, 4.4.2, 4.4.3, and 4.5 of ANSI S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

§5098.Hearing Protectors.

(a) General.

(1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn by all employees:

(A) Who are required by Section 5096(b) to wear personal protective equipment; or

(B) Who are exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

1. Are required by Section 5097(c)(9) to wear hearing protectors because baseline audiograms have not yet been established; or

2. Have experienced a standard threshold shift.

(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(b) Hearing Protector Attenuation.

(1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the methods described in Appendix E, Methods for Estimating the Adequacy of Hearing Protector Attenuation.

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by Section 5096(b).

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposures to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be reevaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

§5099. Training Program.

(a) General.

(1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 dBA, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(3) The employer shall ensure that each employee is informed of the following:

(A) The effects of noise on hearing;

(B) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(C) The purpose of audiometric testing, and an explanation of the test procedures.

(b) Access to Information and Training Materials.

(1) The employer shall make available to affected employees or their representatives copies of Article 105 and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to this standard that are supplied to the employer by U.S. Department of Labor, Occupational Safety and Health Administration.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to authorized representatives of the Chief of the Division and the Director, National Institute for Occupational Safety and Health.

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

2. Editorial Correction of subsection (b) (1) printing error (Register 90, No.41).

§5100.Recordkeeping.

(a) Exposure Measurements.

The employer shall maintain an accurate record of all employee exposure measurements required by Section 5097(b).

(b) Audiometric Tests.

(1) The employer shall retain all employee audiograms obtained pursuant to Section 5097(c) and (d).

(2) This record shall include:

(A) Name and job classification of the employee.

(B) Date of the audiogram.

(C) The examiner's name.

(D) Date of the last acoustic or exhaustive calibration of the audiometer.

(E) Employee's most recent noise exposure assessment.

(c) Audiometric Test Rooms.

The employer shall maintain accurate records of the measurements required by Appendix C, Audiometric Test Rooms, of the background sound pressure levels in audiometric test rooms.

(d) Record Retention. The employer shall retain records required in this section for at least the following periods:

(1) Noise exposure measurement records shall be retained for 2 years.

(2) Audiometric test records shall be retained for the duration of the affected employee's employment.

(e) Access to Records. All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee and any authorized representative of the Chief of the Division. The provisions of Sections 3204(a)-(g) and (h) apply to access to records required by this section.

(f) Transfer of Records. If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in Section 5100(d).

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

Appendix A

Noise Exposure Computation

I. Computation of Employee Noise Exposure

(a) Noise dose is computed using Table A-1 as follows: When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: D = 100 C/T where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table A-1 or by the formula shown as a footnote to that table.

(b) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by: D = 100 (C1/T1 + C2/T2 +...+ Cn/Tn), where Cn indicates the total time of exposure at a specific noise level, and Tn indicates the reference duration for that level as given by Table A-1.

(c) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: TWA = 16.61 log10 (D/100) + 90. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(d) A table relating dose and TWA is given in Section II.

Table A-1

A-weight sound level L (decibel)	Reference Duration T (hour)	A-weight sound level L (decibel)	Reference Duration T (hour)
80	32	106	0.87
81	27.9	107	0.76
82	24.3	108	0.66
83	21.1	109	0.57

84	18.4	110	0.5
85	16	111	0.44
86	13.9	112	0.38
87	12.1	113	0.33
88	10.6	114	0.29
89	9.2	115	0.25
90	8	116	0.22
91	7.0	117	0.19
92	6.1	118	0.16
93	5.3	119	0.14
94	4.6	120	0.125
95	4	121	0.11
96	3.5	122	0.095
97	3.0	123	0.082
98	2.6	124	0.072
99	2.3	125	0.063
100	2	126	0.054
101	1.7	127	0.047
102	1.5	128	0.041
103	1.3	129	0.036
104	1.1	130	0.031
105	1		

In the above table, the reference duration, T, is computed by

$T = 8/2Exp(L-90)/5$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level.

Noise exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." Dosimeter readings can be converted to an 8-hour time-weighted average sound level (TWA).

In order to convert the reading of a dosimeter into TWA, use Table A-2. This table applies to dosimeters that are set to calculate dose or percent exposure according to the relationships in Table A-1. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-2, the TWA may be calculated by using the formula:

$TWA = 16.61 \log_{10}(D/100) + 90$ where TWA = 8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

Table A-2
Conversion form "Percent Noise Exposure" or "Dose" to "8-Hour Time weighted Average Sound Level" (TWA)

Dose or Percent Noise Exposure	TWA	Dose or Percent Noise Exposure	TWA	Dose or Percent Noise Exposure	TW
10	3.4	116	91.1	510	10
15	76.3	117	91.1	520	10
20	78.4	118	91.2	530	10
25	80.0	119	91.3	540	10
30	81.3	120	91.3	550	10
35	82.4	125	91.6	560	10
40	83.4	130	91.9	570	10
45	84.2	135	92.2	580	10
50	85.0	140	92.4	590	10

55	85.7	145	92.7	600	10
60	86.3	150	92.9	610	10
65	86.9	155	93.2	620	10
70	93.4	87.4	160	630	10
75	87.9	165	93.6	640	10
80	88.4	170	93.8	650	10
81	88.5	175	94.0	660	10
82	88.6	180	94.2	670	10
83	88.7	185	94.4	680	10
84	88.7	190	94.6	690	10
85	88.8	195	94.8	700	10
86	88.9	200	95.0	710	10
87	89.9	210	95.4	720	10
88	89.1	220	95.7	730	10
89	89.2	230	96.0	740	10
90	89.2	240	96.3	750	10
91	89.3	250	96.6	760	10
92	89.4	260	96.9	770	10
93	89.5	270	97.2	780	10
94	89.6	280	97.4	790	10
95	89.6	290	97.7	800	10
96	89.7	300	97.9	810	10
97	89.8	310	98.2	820	10
98	89.9	320	98.4	830	10
99	89.9	330	98.6	840	10
100	90.0	340	98.8	850	10
101	90.1	350	99.0	860	10
102	90.1	360	99.2	870	10
103	90.2	370	99.4	880	10
104	90.3	380	99.6	890	10
105	90.4	390	99.8	900	10
106	90.4	400	100.0	910	10
107	90.5	410	100.2	920	10
108	90.6	420	100.4	930	10
109	90.6	430	100.5	940	10
110	90.7	440	100.7	950	10
111	90.8	450	100.8	960	10
112	90.8	460	101.0	970	10
113	90.9	470	101.2	980	10
114	90.9	480	101.3	990	10
115	91.1	490	101.5	999	10
500	101.6	500	101.6		

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Editorial correction of Table A-1 filed 3-22-84; effective thirtieth day thereafter (Register 84, No.12).

2. Amendment of Table A-1 filed 8-28-84; effective thirtieth day thereafter (Register 84, No. 35).

Appendix B

Audiometric Measuring Instruments

I. In the event that pulsed-tone audiometers are used, they shall have tone on-time of at least 200 milliseconds.

II. Self-recording audiometers shall comply with the following requirements:

(a) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(b) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(c) The slewing rate for the audiometer attenuator shall not be more than 6 dB except that an initial slewing rate greater than 6 dB is permitted at the beginning of each new test frequency, but only until the second subject response.

(d) The audiometer shall remain at each required test frequency for 30 seconds (+ 3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than 3 seconds.

(e) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency, the threshold shall be the average of the midpoints of the tracing excursions.

Appendix C

Audiometric Test Rooms

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table C-1 when measured by equipment conforming at least to the Type 2 requirements of ANSI S1.4-1971 (R1976), and to the Class II requirements of ANSI S1.11-1971 (R1976).

Table C-1

Maximum Allowable Octave-Band Sound Pressure Levels for

Audiometric Test Rooms

Octave-band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 4

Appendix D

Acoustic Calibration of Audiometers

I. Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this Appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by ANSI S3.6-1969.

(a) Sound Pressure Output Check.

(1) Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

(2) Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

(3) Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

(4) At each frequency the readout on the sound level meter should correspond to the levels in Table D-1 or Table D-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(b) Linearity Check.

(1) With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

(2) Measure the sound levels in the coupler at each 10dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

(3) For each 10-dB decrement on the audiometer, the sound level meter should indicate a corresponding 10 dB decrease.

(4) This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(c) Tolerances.

When any of the measured sound levels deviate from the levels in Table D-1 or Table D-2 by 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are 15 dB or greater at any test frequency.

Table D-2

Reference Threshold Levels for Telephonics TDH-39 Earphones

Frequency	Reference Threshold Level for TDH-39 Hz Earphones dB	Sound Level Meter Reading,
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

Table D-2

Reference Threshold Levels for Telephonics TDH-49 Earphones

Frequency	Reference Threshold Level for TDH-49 Hz Earphones dB	Sound Level Meter Reading,
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5

4000	10.5	80.5
6000	13.5	83.5

Note: Authority and reference cited: Section 142.3, Labor Code.

Appendix E

Methods for Estimating the Adequacy of Hearing Protector

Attenuation

I. For employees who have experienced a standard threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protection attenuation.

II. The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This Appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

III. Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method #2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment. Note: The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

IV. When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(a) When using a dosimeter that is capable of C-weighted measurements:

(1) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see Appendix A).

(2) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(b) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(1) Convert the A-weighted dose to TWA (see Appendix A).

(2) Subtract 7 dB from the NRR.

(3) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(c) When using a sound level meter set to the A-weighting network:

(1) Obtain the employee's A-weighted TWA.

(2) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(d) When using a sound level meter set on the C-weighting network:

(1) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(2) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

Appendix F

Determination and Application of Age Corrections to Audiograms

As permitted by Section 5097(d)(9), increases in an employee's hearing thresholds, as evidenced by an audiogram taken subsequent to a baseline audiogram, may be adjusted (lowered) for presbycusis (hearing loss due to aging). The applicable correction values at various ages and sound frequencies are included in Table F. If the employer chooses to adjust an employee's audiogram pursuant to Section 5097(d)(9), the employer shall follow the procedure described below.

(a) Obtain from Table F the age correction values at each audiometric test frequency of interest (the hearing losses at 2000, 3000, and 4000Hz are relevant to the determination of whether a standard threshold shift, as defined by Section 5097(d)(8), may exist) for the employee by:

(1) Finding the age at which the most recent audiogram was taken and recording the corresponding age correction values; and

(2) Finding the age at which the baseline audiogram was taken and recording the corresponding age correction values.

(b) Subtract the values found in (a)(2) from those found in (a)(1). (The remainders from these subtractions represent the values (in decibels) which may be attributed to aging and are the values by which the most recent audiogram may be adjusted at the respective audiometric test frequencies.)

(c) Subtract the values found in (b) from the hearing threshold values of the most recent audiogram.

When the adjustment of an audiogram for hearing loss due to aging is performed for the purpose of determining whether a standard threshold shift has occurred, the above-described calculations may be restricted to the 2000, 3000, and 4000 Hz frequencies. If the average of the hearing threshold values at 2000, 3000, and 4000 Hz found in step (c), above, is equal to or greater than 10, then the employee has exhibited a standard threshold shift, and the employer must comply with various provisions of Section 5097(d) as well as certain other requirements such as Sections 5098(a)(2)(B)2 and (b)(3).

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Table F.  Age Correction Values in Decibels for Males (M) and Females (F)

                              Audiometric Test Frequencies (Hz)
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Age	1000		2000		3000		4000		60
	M	F	M	F	M	F	M	F	M
20 or Younger	5	7	3	4	4	3	5	3	8
21	5	7	3	4	4	4	5	3	8
22	5	7	3	4	4	4	5	4	8
23	5	7	3	5	4	4	6	4	9
24	5	7	3	5	5	4	6	4	9
25	5	8	3	5	5	4	7	4	10
26	5	8	4	5	5	5	7	4	10
27	5	8	4	5	6	5	7	5	11
28	6	8	4	5	6	5	8	5	11
29	6	8	4	5	6	5	8	5	12
30	6	8	4	6	6	5	9	5	12
31	6	8	4	6	7	6	9	5	13
32	6	9	5	6	7	6	10	6	14
33	6	9	5	6	7	6	10	6	14
34	6	9	5	6	8	6	11	6	15
35	7	9	5	6	8	7	11	7	15
36	7	9	5	7	9	7	12	7	16
37	7	9	6	7	9	7	12	7	17
38	7	10	6	7	9	7	13	7	17
39	7	10	6	7	10	8	14	8	18
40	7	10	6	7	10	8	14	8	19
41	7	10	6	8	10	8	14	8	20
42	8	10	7	8	11	9	16	9	20
43	8	11	7	8	12	9	16	9	21
44	8	11	7	8	12	9	17	9	22
45	8	11	7	8	13	10	18	10	23
46	8	11	8	9	13	10	19	10	24
47	8	11	8	9	14	10	19	11	24
48	9	12	8	9	14	11	20	11	25
49	9	12	9	9	15	11	21	11	26
50	9	12	9	10	16	11	22	12	27
51	9	12	9	10	16	12	23	12	28
52	9	12	10	10	17	12	24	13	29
53	9	13	10	10	18	13	25	13	30
54	10	13	10	11	18	13	26	14	31
55	10	13	11	11	19	14	27	14	32
56	10	13	11	11	20	14	28	15	34
57	10	13	11	11	21	15	29	15	35
58	10	14	12	12	22	15	31	16	36
59	11	14	12	12	22	16	32	16	37
60 or Older	11	14	13	12	23	16	33	17	38

Note: Authority and reference cited: Section 142.3, Labor Code.

History

1. New Appendix F filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).

TITLE 8 General Industry Safety Orders CCR 22

APPENDIX C

SUPPLEMENTARY INFORMATION FROM UL REGARDING THE NORWEGIAN FIRE RESEARCH REPORT

SMOLDERING SMOKE TEST:

During the February 4, 1997 TAP meeting a member of the committee raised a concern about the results of one of the Tests described in the Norwegian Fire Research Report. It was suggested the committee should take a second look at Figures 3,4,5 and 6. ULI enlarged these Figures and plotted the following points:

	Time to reach critical values	Response of UL type alarm	Response of EN type alarm	ULI Type DELTA
Visibility	5,950 seconds	5,050 sec.	5,450 sec.	900 sec.=15 min.
CO@30,000 ppm-min.	5,800 seconds	5,050 sec.	5,450 sec.	750 sec.=12 m 30 s
CO@40,000 ppm-min.	6,150 seconds	5,050 sec	5,450 sec.	1,070 sec.=17 m 50 s

Based on this information alarms located in the room with the smoldering fire activated at more than 10 minutes before critical values were reached. Alarms located in the corridor with the door closed did not respond (Fig. 6) before the critical values in the room of origin were reached. This type of information supports the recent changes to NFPA 72 Chapter 2 requiring detectors in every bedroom.

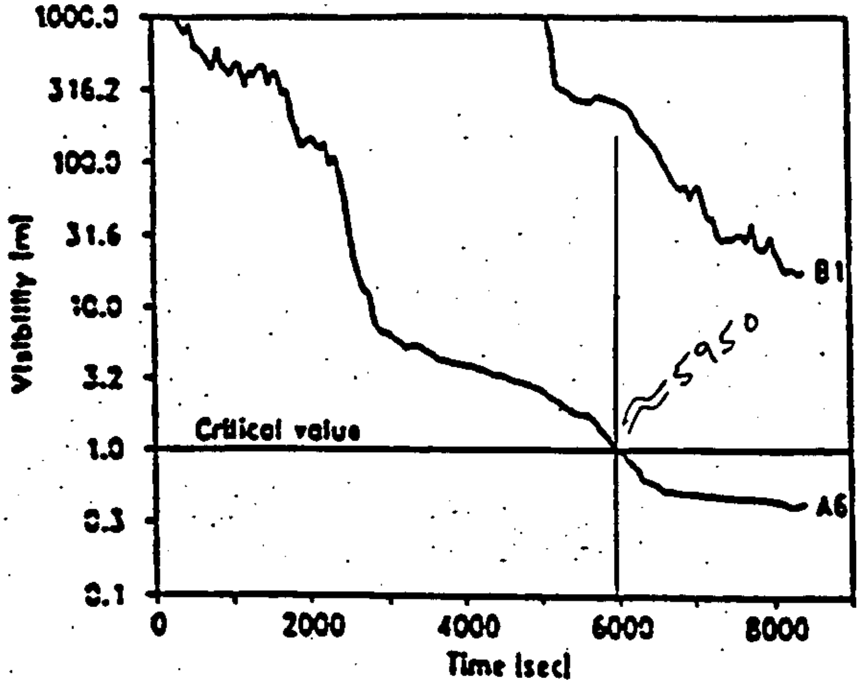


Figure 3 *Smouldering fire. Reduction of the visibility at the ceiling level; position (A6) in the fire room position (B1) in the neighbouring room. Relationship between visibility and optical density (for objects illuminated by scattered light) according to ref. [2].*

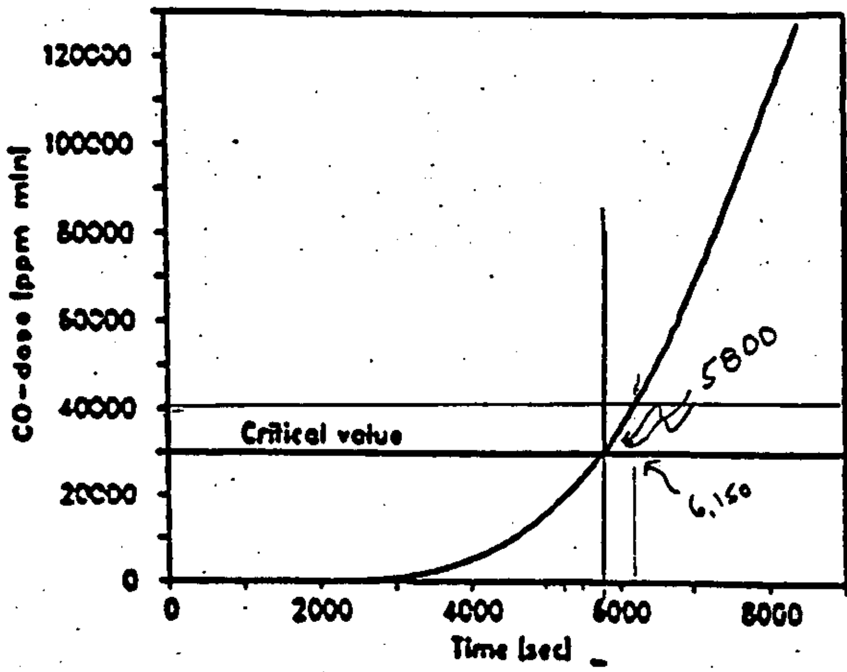


Figure 4

Smouldering fire. Dose of carbon-monoxide, ac-cumulated. According to ref [5] the threshold of COHb content in the blood which hinders the escape of people appears to be in the range of 30-40 %, which corresponds to a CO-dose of approximately 30000-40000 ppm min.

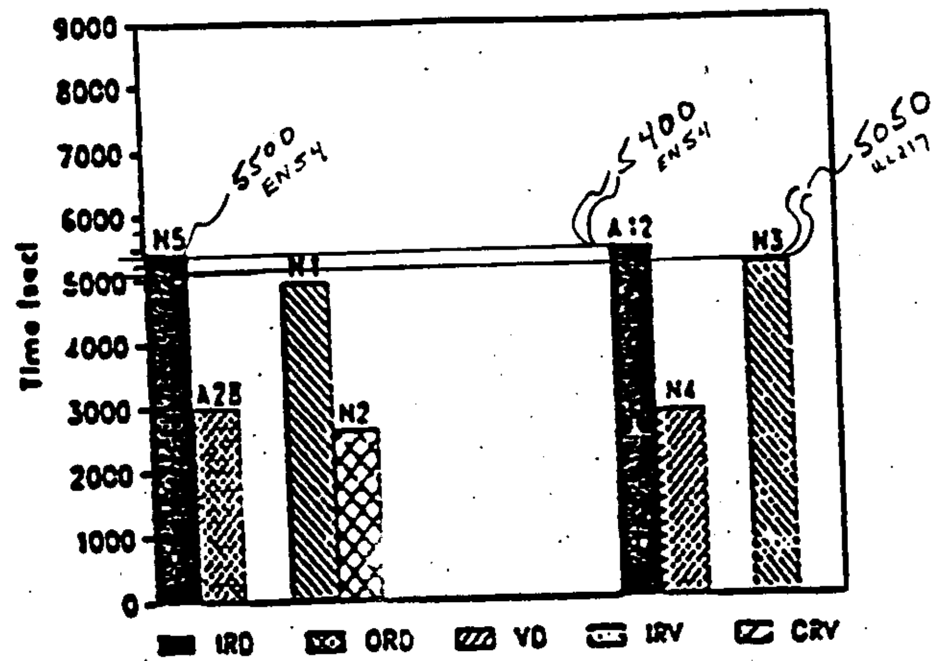
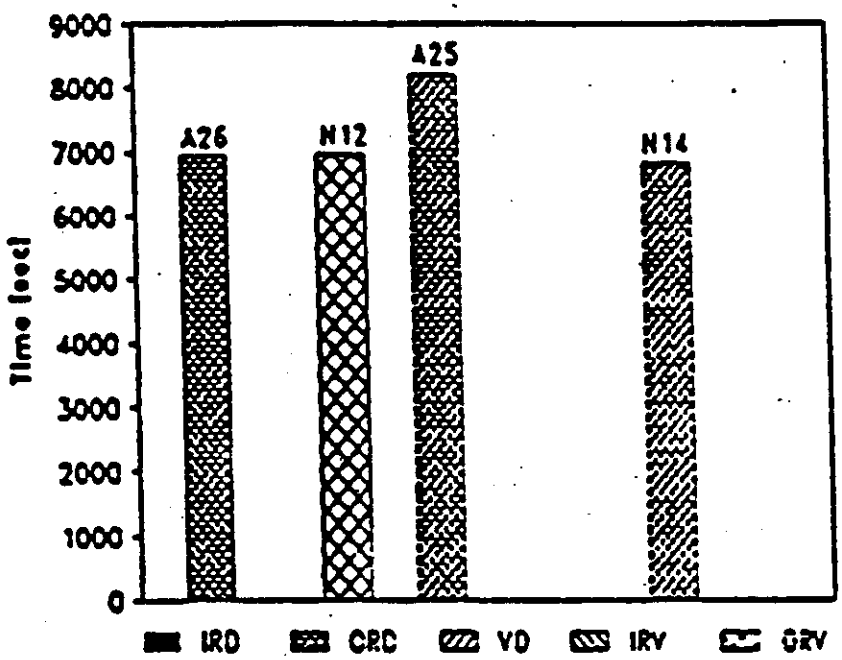


Figure 5 *Smouldering fire. Times of alarm for detectors. Codes and positions, see Table 1 and Fig 2.*



Door closed

Figure 6 *Smouldering fire. Times of alarm for detectors. Codes and positions, see Table 1 and Fig 2.*