ALASKA LEGISLATURE COMMITTEE FILES 1983-1984 8672
2818 SRES SB 79 2.7/8

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Alaska Health Project
P. O. Box 1037, Anchorage, Alaska 99510 (907) 272-8734

March 24, 1983

Pat Pourchot
Senator Bettye Fahrenkamp
Pouch V
Juneau, AK 99811

Dear Pat,

Thanks for the hearing summary and the article.

I am enclosing a list of our Board of Directors and Professional Resources Committee that were requested at the hearing in Juneau. I believe that it was Senator Eliason that specifically requested that this information be made available to the Committee

I hope to hear from you soon about a new draft of SB 79.

Sincerely,

Steven Kadish
Executive Director

cc Eliason 4-11-83

Alaska Health Project
P. O. Box 1037, Anchorage, Alaska 99510 (907) 272-8734

Professional Resources Committee Members

Jan Bolt, R.N., B.S.N., C.C.R.N., Health Educator, Thermal Unit, Providence Hospital

Michael Carroll, M.D., Oncologist

Chancy Croft, Attorney, Croft, Thurlow and Duggan

Neil Fried, Labor Economist, Alaska Department of Labor

Stan Godsoe, Chief of Consultation and Training, Alaska Department of Labor, Occupational Safety and Health Section

Owen Hanley, M.D., Internist

Ray Jorgenson, Chief Industrial Hygienist, Alaska Department of Labor, Occupational Safety and Health Section

Tom Kosatsky, M.D., Medical Epidemiologist, State of Alaska

Bob Landau, Assistant Attorney General, State of Alaska

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Wayne Myers, M.D., Director, WAMI Program, University of Alaska, Fairbanks

Eric Olson, Attorney

Stacie Pascal, Loss Control Representative

George Riley, Safety Officer, University of Alaska, Fairbanks

Art Robson, Attorney

Eric Shortt, Industrial Hygienist, Alaska Department of Labor, Occupational Safety and Health Section

John Sims, Director, Office of Mineral Development

Deborah Williams, Attorney, Smith and Gruening

Daniel Bacon, Environmental & Industrial Hygiene Analyst, Chemical & Geological Labs

Bill Blythe, Industrial Hygienist, Alaska Department of Labor, Occupational Safety and Health Section

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Joe O'Connell, Attorney, Alaska Legal Services

Danny Sanchez, Safety Officer, Fairbanks North Star Borough

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ALASKA EMPLOYERS' COMMITTEE

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Alaska Trucking Association
Alaska Retail Association
Alaska Seafood Processors
Alaska Loggers Association
Alaska Miners Association
Alaska Support Industry Alliance
Anchorage Laundry & Dry Cleaners Association
Resource Development Council
SOHIO

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The Senate
State of Alaska

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The House of Representatives
State of Alaska

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Richard Schultz
Mike Szymanski
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Jerry Ward
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Fred F. Zharoff

The Alaska Employers' Committee (AEC) opposes HB 197 and SB 79, "toxic and hazardous substances in the workplace".

AEC's membership includes over 5,000 Alaskan employers who strongly believe in a safe and healthful workplace.

Unfortunately, neither HB 197 nor SB 79 increase safety and health in the workplace.

We have included AEC's testimony on HB 197 (which is similar to SB 79) to further illustrate the Bills' flaws. The highlights of the testimony are:

1. Federal regulation will be published this summer and chemical manufacturers and distributors will be uniformly covered. Alaskan employers will receive the necessary information, known as Material Safety Data Sheets (MSDS's).

2. Under HB 197 and SB 79, the outside manufacturers and suppliers are not covered. AEC feels that these manufacturers are the most knowledgeable and therefore should provide the "downstream employers" with the MSDS's.

On behalf of the AEC, I am available to respond to any questions you might have.

William E. Schneider
Co-Chairman
Alaska Employers' Committee

P. O. Box 4-2500
Anchorage, AK 99509
907/276-5354

POSITION PAPER/TESTIMONY/ALASKA EMPLOYERS' COMMITTEE

Bill No.: House Bill 197

Title: "An Act relating to hazardous and toxic substances and providing for an effective date."

Contact: Bill Schneider
276-5354

T. J. Thrasher
276-1149

My name is Bill Schneider and with me today is T. J. Thrasher. We presently serve as Co-Chairmen of the Alaska Employers' Committee (AEC). The Alaska Employers' Committee represents over 5,000 employers, including:

> Associated General Contractors, Alaska Trucking Association, Alaska Retail Association, Alaska Seafood Processors, Alaska Loggers Association, Alaska Miners Association, Alaska Support Industry Alliance, Anchorage Laundry and Dry Cleaners Association, Resource Development Council and many individual Alaskan employers.

AEC has directed Ms. Thrasher and myself to be here today and present our Committee views on HB 197. We fully support the goal of this bill, that is, a safe and healthful Alaska workplace.

Unfortunately, this Bill creates many costly hurdles and pitfalls on the path towards worker safety.

More importantly, however, there is a key ingredient missing from this Bill -- common sense.

As someone who has spent over 12 years in the safety profession, I can tell you that the most important tool available in the prevention of accidents, on or off the job, is common sense. Allow me to briefly illustrate the absence of common sense from HB 197.

Most of the goods utilized in Alaska are shipped up from the Lower 48. Several thousand tons of different materials arrive annually by ship, plane and truck.

Under HB 197, over 40,000 of these substances will potentially be classified as toxic or hazardous.

Detailed scientific information must be provided on each of these substances: CAS numbers, chemical names, potential risks, etc.

I agree this information should be provided for selected substances by the manufacturer. They have the expertise to provide the information required by this Bill.

But, as we all know, the manufacturers of almost all of the goods utilized in this state are not here. They are located outside of Alaska and are not covered by this Bill.

There is an alternative course to follow on this path towards workplace safety. It makes sense and I encourage the Committee to give it serious consideration.

The Federal hazard communication covering toxic and hazardous substances will go into effect this summer, according to Thorne Auchter, Undersecretary of Labor for OSHA.

This regulation will apply to all states and will require manufacturers to provide toxic information on their products.

Under HB 197, Alaska employers, with the assistance of the State Department of Labor, must provide the same information. And in many instances, the employer and State will go back to the manufacturer to acquire this information. A costly, duplicative route which can easily be avoided by adopting the federal regulation into our State codes.

Our Committee sees other objectionable provisions of HB 197, but we will reserve those comments unless the Committee seeks that information.

Thank you for your time and I am available for any questions the Committee might have.

TELEPHONE
(907) 479-6281

ARTHUR LYLE ROBSON
MICHAEL P. McCONAHY
ATTORNEYS
3568 GERAGHTY STREET
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ATTORNEYS FOR THE
MEMBERS OF U/A LOCAL 375
PLUMBERS & STEAMFITTERS

MEMORANDUM

MAY 2 - 1983

TO: BETTYE FAHRENKAMP & EVERYBODY

FROM: ARTHUR LYLE ROBSON

DATE: APRIL 28, 1983

RE: SB 79 - RIGHT TO KNOW - LEGISLATION

Having gone to Juneau this week, I cannot repeat again next. I note that House Bill 304 comes up on Monday, May 2nd, as well as the meeting on SB 79, and that in all probability, Sacket's attempt to repeal Davis/Bacon will come up on Tuesday, May 3rd. I simply have too many other things to do.

With respect to the Right to Know Bill, I make the following observation:

1. Waiting for the OSHA action is now no longer a viable option from any point of view.

2. Although the publication may be this July, it is two years before it comes into effect.

3. It regulates only manufacturers (of which we have none in Alaska), distributors (who are the trucking lines who squawk most about the regulation), and importers (who are not really a factor in most toxic substances). There is no regulation of the Alaskan work place, with the exception of trucking lines. It might be worth while to note that trucking lines already have extensive regulation along these lines which is uniform only in the sense of the uniform disregard for same.

4. I recommend that we move on to mark up forthwith because if we don't get going, we'll never get there. There is no indication that the legislature will be any better or differently organized next time around and, therefore, it is no more likely that anything will be accomplished a year from now.

5. I wouldn't worry about OSHA preemption. OSHA is primarily a process of regulation, not statute, and the regulations are only in conflict with state law if the state law is more liberal, that is, less protective, of the worker. Under those circumstances, the OSHA statutes would preempt or set aside of the state law. It appears that there is no possibility of that because of the watered down nature of the OSHA regulations which may become effective in a couple of years.

6. On the definition of substances covered, I still favor having DOL determine which items from the specific lists are to be covered. There should be a provision indicating that they must act within six months of the enactment or effective date of the statute and within sixty days on individual product questions being raised or revisions in the lists which are the source of our itemization of hazardous materials.

7. On training, we would, of course, want to take advantage of in-place training programs. I don't feel that conducting programs in or writing material safety data sheets in any of the multitude of native languages spoken in Alaska will be productive. These languages are primarily spoken and only recently has the University attempted to make them into written languages. The number of individuals who could read them on any job would, therefore, be minimal.

8. I still oppose a thirty day grace period for supplying an MSDS. These could be made available by the Department of Labor even if they were a nominal charge such as 3¢ or 5¢ to pick some up. Under those circumstances, thirty days is completely adequate for mandatory handling of a toxic substance without being supplied with an MSDS.

9. With respect to reports to be filed with DOL, as far as I am concerned, the reports need only indicate (1) what toxic substances are covered, (2) where the information is available to workers, (3) whether the information has been made available to fire and police, and (4) a copy of any applicable MSDS's.

10. The trade secrets situation is a Red Herring and for my money could be ignored. Any language to put in to protect trade secrets should require someone impartial to determine that there really is a trade secret involved.

11. Miscellaneous definitions can be picked up by the DOL in regulations.

12. I view some labeling requirements as essential. If a pallet of something catches fire, it seems futile to run to a stack of MSDS's and try to decipher from the color of the flames what it is that's burning. Color coding can be useful in refineries, etc.

13. I don't care about the anti-waiver provisions because I suspect that the law will find these to be a matter of common law. The Alaska Supreme Court just doesn't buy that sort of stuff.

14. I see no reasons to exempt hospitals because their problem lies with pharmaceuticals and these are already covered and

won't be part of this bill. Hospitals simply like to get an exemption from everything related to labor legislation. They have been quite successful so far and in this state at least are often very abusive employers.

15. With respect to transportation and where Alaska rules become effective, the states that have these laws have no problem, providing that shipping within the borders of the state requires the necessary labeling and MSDS. We would likewise not have a problem. However, if it will make peace with the trucking industry, we could provide that labeling and MSDS requirements attached only at the first trans-shipment or unloading. They might want to talk to Dick Currington on this because he is the person in Alaska probably most aware of the transportation requirements under which shippers already operate.

I will be glad to brain storm on this at any time; I just need a week to recover from the time off this week lobbying.

Sincerely,

ARTHUR LYLE ROBSON, Attorney
for Members of U.A. Local 375
Plumbers & Steamfitters

ALR:CLM

c.c. Nina Mollett - Northern Alaska Environmental Center
Mick Hotrum - Laborers Union No. 942
Steve Kadish - Alaska Health Project
All Fairbanks Union Organizations

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Contacts: Steve Kadish or
Brenda Duffey, 272-8734 &
274-5054

For immediate release: 8/4/83

Editor: Photo available
on request.

-- Alaskans Have a Right to Know --

This summer Alaska's Governor Bill Sheffield signed into law right-to-know legislation (S.B. 79) to provide information to workers about hazardous and toxic substances in the workplace.

The bill passed Alaska's Senate 17 to 1 and breezed through the House 39 to 0. It was supported by health, labor, and environmental groups.

"I'm delighted that the legislature has enacted this bill so quickly. It enjoys wide public support," said Sen. Joe Josephson (D) of Anchorage, one of the bill's sponsors.

Initially the right-to-know legislation was opposed by industry representatives for being too inclusive, broad, and overreaching. They also said the bill was unnecessary because a proposed U.S. Occupational Safety and Health Administration (OSHA) right-to-know regulation would be adequate.

"The Alaskan bill includes all affected Alaskan employers and employees in contrast to the pending federal regulation which only deals with manufacturers. According to Alaska Department of Labor estimates, less than 5 percent of Alaskan employers would have been covered by the proposed federal regulation," said Alaska Health Project Executive Director Steven Kadish.

Kadish's group, Alaska Health Project, supported the Alaskan legislation and worked with different groups involved to reach a bill that was agreeable to the diverse interests.

(more)

"Never let it be said that business interests are only out for a buck or that environmentalists never compromise," Alaska Sen. Bettye Fahrenkamp (D) said about passage of the right-to-know legislation which she co-sponsored with Josephson, Sen. Vic Fischer (D), and Sen. Arliss Sturgulewski (R).

"Passage of this legislation marks the first time that a coalition of health, labor, and environmental groups has formed to protect workers' health in Alaska," Kadish said.

The bill requires that information on health hazards accompanies products containing any one of about 800 known hazardous substances when they are imported into the state. It also calls for employers to post notices and provide training in workplaces where the hazardous materials are used.

The new law gives employees the right to request information on possibly hazardous substances they are working with. If an employer does not have that information, the measure allows the employer three working days to request the information from the state Department of Labor or the manufacturer. If the employee requesting information does not receive a response from the employer within 15 calendar days, the employee has the right to refuse working with the hazardous substance until the information is made available.

"Without enough information about the potential hazard of a material, a worker cannot take precautions to prevent an accident or illness," said Mick Hotrum, a business and safety representative for the Alaska District Council of Laborers.

(more)

In addition to support from health, labor, environmental groups -- and the eventual support of industry representatives -- the right-to-know bill has enthusiastic backing from Alaska's Department of Labor.

"We are pleased that Governor Sheffield has signed S.B. 79 into law. With so many hazardous and toxic substances used in and around the workplace it is very important that the working men and women in Alaska be informed as to what they are handling.

"This department stands ready to assist employers in their safety education programs and to provide information as to the requirements of this law," said Commissioner of Labor Jim Robison.

In discussing the legislation, Kadish pointed out two areas he feels are shortcomings of the bill.

"The bill does not provide for specific labeling of individual products, nor does it require any reporting to the state about specific hazardous materials," he said.

"Some of us will want to monitor the contributions it makes and be ready to offer amendments (to the bill) if experience shows them to be necessary," Josephson commented.

A representative from one of the grass roots environmental groups that supported the legislation cited possible implications the bill has for the community.

"Although the right-to-know bill is a landmark bill for workers, it also marks a potential turning point for community health and environmental protection. The bill could provide the impetus for communities to demand their right to know about toxic substances they are exposed to on a daily basis.

"Furthermore, information gathered on the types, quantities, and hazards of substances used by industry will assist state and local environmental protection groups in managing wastes that result from industry's activities," said David Wigglesworth of the Alaska Center for the Environment.

(30)

Sondra
this will be
an issue
next year
keep in
p.i. file

Alaska Health Project

417 West Eighth Avenue — P. O. Box 10-10[illegible], Anchorage, Alaska 99510 -- (907) 276-2864

November 22, 1983

Richard Arab
Department of Labor
Occupational Safety & Health
P.O. Box 1149
Juneau, Alaska 99811

Dear Richard:

As you requested, I have reviewed S.B. 79 and have several comments and questions.

1. Definition of Exposure. The worker right to know law is based upon employee exposure to toxic and hazardous substances on the job. However, "exposure" is not clearly defined in the bill. I recommend that the definition of exposure reflect the standards of U.S. Occupational Safety and Health Administration (OSHA), American Conference of Governmental Industrial Hygienists, and Alaska Department of Labor. If more than one of these agencies has an exposure standard on a particular substance, then the standard which minimizes the worker's exposure to that substance should be the selected limit.

   However, the requirements of the law should be effective not just in cases where the exposure exceeds the standard, but for all instances where the employee may be exposed including "equipment failure and rupture of containers." In other words, if potential circumstances arise that expose the worker to harmful amounts of a hazardous substance, then the right to know law should be enforced.

2. Regulated Substances. The list of regulated substances may not necessarily coincide with those chemicals now regulated by the Alaska Department of Labor. The list of regulated substances should be a compilation of those chemicals listed in, 1) the latest edition of "Threshold Limit Values for Chemical Substances and Physical Agents In The Work Environment," American Conference on Governmental Industrial Hygienists, 2) 29 CFR Part 1910, Subpart 7, Toxic And Hazardous Substances, "General Industry Standards," Occupational Safety and Health Administration, and 3) others the Alaska Department of Labor now regulates that are not included in either of these two lists. As stated in the law, the number of regulated substances may be expanded if the Alaska Department of Labor chooses to add a substance and if OSHA Form 20 or equivalent information is required under OSHA regulations.

3. Definitions of New Work Assignment. The description of the conditions for safety education before an employee performs a new work assignment (18.60.66) appear clear to me, however, several others have asked me about this. I would recommend a fuller definition perhaps with some examples.

4. In-State Manufacturers. Sec. 18.60.065 requires that substances imported into the state to be accompanied by the OSHA Form 20 or equivalent information. There is no discussion of in-state manufacturers or Alaskan made products. The same requirements should be applied to the Alaska manufacturers as to those outside the state. This point needs further clarification.

5. Material Safety Data Sheet Information. All material safety data sheets (MSDS) are not equal. Some are comprehensive and accurate, and others are vague and incomplete. The intent of the law was to provide employees with all the information on the material safety data sheet. Can the state require a completed material safety data sheet? In my opinion, the provision of the piece of paper does not fulfill the obligations of the law. What options are available?

6. Refusing Work. In the case where 1) 15 days have passed since requesting OSHA Form 20 information on a particular material, and the employee has not received the health and safety material, and 2) the employer has not taken "measures to assure that employees are not exposed to the substance," may the employee legally refuse to work with the substance?

7. Enforcement. Regulations complete with penalties need to be developed and distributed. As this may take some time, I hope you can begin this process as soon as possible. Furthermore, Alaska Department of Labor Safety and Health staff need to be informed of their new responsibilities.

I hope you found these comments useful. Alaska Health Project is pleased with the progress to date on S.B. 79's implementation. We would be happy to assist you in whatever way we can.

Sincerely,

Steven Kadish
Executive Director

cc: Max Andrews
Kevin Dougherty
Senator Fahrenkamp ✓
Senator Vic Fisher
Stan Godsoe
Mick Hotrum
Senator Josephson
Art Robson
Senator Sturgulewski

Chemical Hazard Communication

U.S. Department of Labor
Raymond J. Donovan, Secretary

Occupational Safety and Health Administration
Thorne G. Auchter, Assistant Secretary

1983

OSHA 3084

Chemicals in the Workplace

Approximately 25 million workers—about one in four in the nation's work force—are exposed to one or more chemical hazards. There are an estimated 575,000 existing chemical products, and hundreds of new ones being introduced annually. This poses a serious problem for exposed workers.

Chemical exposure may cause or contribute to many serious health effects such as heart ailments, kidney and lung damage, sterility, cancer, burns, and rashes. Some chemicals may also be safety hazards and have the potential to cause fires and explosions and other serious accidents.

Because of the seriousness of these safety and health problems and the lack of information available to many employees and employers, the Occupational Safety and Health Administration (OSHA) has issued a new final standard entitled "Hazard Communication" (29 CFR 1910.1200). The goal of the standard is to reduce the incidence of chemical source illnesses and injuries in the manufacturing industries.

The purpose of the hazard communication standard is to establish uniform requirements to make sure that the hazards of all chemicals produced, imported, or used within the United States' manufacturing sector [Standard Industrial Classification (SIC) Codes 20 through 39] are evaluated, and that this hazard information is transmitted to affected employers and employees.

Chemical manufacturers and importers must convey hazard information to downstream employers by means of labels on containers and material safety data sheets (MSDS). In addition, all covered employers are required to have a hazard communication program to provide the information to their employees by means of container labeling and other forms of warning, MSDS, and training.

This will ensure that all employers receive the information they need to inform and train their employees properly and to design and put in place employee protection programs. It will also provide necessary hazard information to employees, so they can participate in, and support, the protective measures instituted in their workplaces.

Hazard Evaluation

The quality of the hazard communication program is largely dependent on the adequacy and accuracy of the hazard assessment. Chemical manufacturers and importers are required to review the available scientific evidence concerning the hazards of the chemicals they produce or import, and to report the information they find to their employees and to manufacturing employers who purchase their products. Downstream employers can rely on the evaluation performed by the chemical manufacturer or importer to establish their hazard communication programs.

The chemical manufacturers, importers, and employers are responsible for the quality of the hazard determinations they perform. Each chemical is to be evaluated for its potential to cause adverse health effects and its potential to pose physical hazards, such as flammability. (Definitions of hazards covered are included in the standard.) Chemicals which are listed in one of the following sources are to be considered hazardous in all cases:

- 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA), and
- Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment, American Conference of Governmental Industrial Hygienists (ACGIH).

In addition, chemicals which have been evaluated and found to be a suspect or confirmed carcinogen in the following sources are to be reported as such:

- National Toxicology Program (NTP), Annual Report on Carcinogens,
- International Agency for Research on Cancer (IARC), Monographs, and
- 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances, Occupational and Health Administration (OSHA).

Written Hazard Communication Program

Employers must establish a written, comprehensive hazard communication program which includes provisions for container labeling, material safety data sheets, and an employee training program. It must also contain a list of the hazardous chemicals in each work area, the means the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), hazards associated with chemicals in unlabeled pipes, and the way the employer will inform contractors in manufacturing facilities of the hazards to which their employees may be exposed.

The written program does not have to be lengthy or complicated and some employers may be able to rely on existing hazard communication programs to comply with the above requirements. The written program must be available to employees, their designated representatives, the Assistant Secretary for Occupational Safety and Health, and the Director of the National Institute for Occupational Safety and Health (NIOSH).

Labels and Other Forms of Warning

Chemical manufacturers, importers, and distributors must be sure that containers of hazardous chemicals leaving the workplace are labeled, tagged or marked with the identity, appropriate hazard warnings, and the name and address of the manufacturer or other responsible party.

In the workplace, each container must be labeled, tagged or marked with the identity of hazardous chemicals contained therein, and must show hazard warnings appropriate for employee protection. The hazard warning can be any type of message, words, pictures, or symbols which convey the hazards of the chemical(s) in the container. Labels must be legible, in English (plus other languages, if desired), and prominently displayed.

Several exemptions to in-plant individual container labels are given:

- Employers can post signs or placards which convey the hazard information if there are a number of stationary containers within a work area which have similar contents and hazards.
- Various types of standard operating procedures, process sheets, batch tickets, blend tickets, and similar written materials can be substituted for container labels on stationary process equipment if they contain the same information and are readily available to employees in the work area.
- Employers are not required to label portable containers, into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who makes the transfer.
- Employers are not required to label pipes or piping systems.

Material Safety Data Sheets (MSDS)

Chemical manufacturers and importers must develop material safety data sheets for each hazardous chemical they produce or import. Employers are responsible for obtaining or developing a MSDS for each hazardous chemical used in their workplaces.

The following summarizes the MSDS section in the standard 29 CFR 1910.1200. Each MSDS must be in English and include information regarding the specific chemical identity of the hazardous chemical(s) involved and the common names.

Beyond the identity information, the employer must provide information on the physical and chemical characteristics of the hazardous chemical; known acute and chronic health effects and related health information; exposure limits; whether the chemical is considered to be a carcinogen by NTP, IARC, or OSHA; precautionary measures; emergency and first aid procedures; and the identification of the organization responsible for preparing the sheet.

Copies of the material safety data sheet for hazardous chemicals in a given work site are to be readily accessible to employees in that area. As a source of detailed information on hazards, they must be located close to workers, and readily available to them during each workshift.

Employee Information and Training

Employers must establish a training and information program for employees exposed to hazardous chemicals in their work area at the time of initial assignment and whenever a new hazard is introduced into their work area. When this standard takes effect, all employees covered by the standard must have received training equivalent to the required initial assignment training.

Information

The discussion topics must include, at least:

- The existence of this hazard communication standard and the requirements of the standard.
- The components of the hazard communication program in the employees' workplaces.
- Operations in their work area where hazardous chemicals are present.
- Where the employer will be keeping the written hazard evaluation procedures, communications program, lists of hazardous chemicals, and the required material safety data sheets.

Training

The employee training plan must consist of,

- How the hazard communication program is implemented in that workplace, how to read and interpret information on labels and MSDS, and how employees can obtain and use the available hazard information.
- The hazards of the chemicals in the work area.

- Measures employees can take to protect themselves from the hazards.
- Specific procedures put into effect by the employer to provide protection such as work practices and the use of personal protective equipment (PPE).
- Methods and observations—such as visual appearance or smell —workers can use to detect the presence of a hazardous chemical they may be exposed to.

Trade Secrets

A "trade secret" is something that gives an employer an opportunity to obtain an advantage over competitors who do not know it or use it. For example, a trade secret may be a confidential device, pattern, information, or chemical make-up. Chemical industry trade secrets are generally formulas, process data, or a "specific chemical identity." The latter is the type of trade secret information referred to in the hazard communication standard. The term includes the chemical name, the Chemical Abstracts Services (CAS) Registry Number, or any other specific information which reveals the precise designation. It does not include common names.

The standard strikes a balance between the need to protect exposed employees and the employer's need to maintain the confidentiality of a *bona fide* trade secret. This is done by providing for limited disclosure to health professionals who are furnishing medical or other occupational health services to exposed employees, under specified conditions of need and confidentiality.

Medical Emergency

The chemical manufacturer, importer, or employer must immediately disclose the specific chemical identity of a hazardous chemical to a treating physician or nurse when the information is needed for proper emergency or first aid treatment. As soon as circumstances permit, the chemical manufacturer, importer, or employer may obtain a written statement of need and a confidentiality agreement.

Under the contingency described here, the treating physician or nurse has the ultimate responsibility for determining that a medical emergency exists. At the time of the emergency, the professional judgment of the physician or nurse regarding the situation must form the basis for triggering the immediate disclosure requirement. Because the chemical manufacturer, importer, or employer can demand a written statement of need and a confidentiality agreement to be completed after the emergency is abated, further disclosure of the trade secret can be effectively controlled.

Non-Emergency Situation

In non-emergency situations, chemical manufacturers, importers, or employers must disclose the withheld specific chemical identity to health professionals providing medical or other occupational health services to exposed employees if certain conditions are met. In this context, "health professionals" include physicians, industrial hygienists, toxicologists, or epidemiologists.

The request for information must be in writing and must describe with reasonable detail the medical or occupational health need for the information. The request of the health professional will be considered if the information will be used for one or more of the following activities:

- To assess the hazards of the chemicals to which employees will be exposed.
- To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels.
- To conduct pre-assignment or periodic medical surveillance of exposed employees.
- To provide medical treatment to exposed employees.
- To select or assess appropriate personal protective equipment for exposed employees.
- To design or assess engineering controls or other protective measures for exposed employees.
- To conduct studies to determine the health effects of exposure.

The health professional must also specify why alternative information is insufficient. The request for information must explain in detail why disclosure of the specific chemical identity is essential, and include the procedures to be used to protect the confidentiality of the information. It must include an agreement not to use the information for any purpose other than the health need stated or to release it under any circumstances, except to OSHA.

The standard further describes in detail the steps that will be followed in the event that an employer decides not to disclose the specific chemical identity requested by the health professional.

U.S. Department of Labor
Regional Offices for the Occupational
Safety and Health Administration

Region I
(CT, MA, ME, NH, RI, VT)
16-18 North Street
1 Dock Square Building
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Telephone: (617) 223-6710

Region II
(NJ, NY, Puerto Rico, Virgin
Islands)
1 Astor Plaza, Room 3445
1515 Broadway
New York, NY 10036
Telephone: (212) 944-3426

Region III
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3535 Market Street
Philadelphia, PA 19104
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Atlanta, GA 30367
Telephone: (404) 881-3573

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(IA, KS, MO, NE)
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909 First Avenue
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About This Pamphlet

The information contained in this flyer is not considered as a substitute for any provisions of the Occupational Safety and Health Act of 1970 or for any standards issued by the Occupational Safety and Health Administration.

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GPO 903-128

TLVs®

Threshold Limit Values
for
Chemical Substances
and
Physical Agents
in the
Work Environment
with
Intended Changes
for
1982

American Conference of Governmental Industrial Hygienists

ISBN: 0-936712-39-2

Interpretations of TLVs: All requests for interpretations of TLVs must be in writing, in care of the Executive Secretary, ACGIH. Interpretations will be made only after full committee review and approval. Interpretations will be published annually in the *Annals of the American Conference of Governmental Industrial Hygienists*, the volume which covers the annual meeting.

Documentation of the Threshold Limit Values®: A separate companion piece to the TLVs is issued by ACGIH under this title. This publication gives the pertinent scientific information and data with reference to literature sources that were used to base each limit. Each documentation also contains a statement defining the type of response against which the limit is safeguarding the worker. For a better understanding of the TLVs it is essential that the Documentation be consulted when the TLVs are being used.

The Fourth Edition (1980), including the 1981 and 1982 Supplemental Documentations, is available at $70 per single copy. The Supplemental Documentations are also available as separate publications at $10 per single copy. Either may be ordered from the Publications Office, ACGIH.

Requests for interpretations or reproduction permission, and/or placement of an order may use following address:

ACGIH
6500 Glenway Ave., Bldg. D-5
Cincinnati, OH 45211

TLVs®
Threshold Limit Values for Chemical Substances in Work Air
Adopted by ACGIH for 1982

PREFACE
CHEMICAL CONTAMINANTS

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

Threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

The amount and nature of the information available for establishing a TLV varies from substance to substance; consequently, the precision of the estimated TLV is also subject to variation and the latest *Documentation* should be consulted in order to assess the extent of the data available for a given substance.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) as a relative index of hazard or toxicity, (2) in the evaluation or control of community air pollution nuisances, (3) in estimating the toxic potential of continuous, uninterrupted exposures or other extended work periods, (4) as proof or disproof of an existing disease or physical condition, or (5) for adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ.

The TLV-TWA should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations.

In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

Legal Status. The Threshold Limit Values, as issued by ACGIH, are recommendations and should be used as guidelines for good practices. Wherever these values (of whatever year) have been used or included by reference in Federal and/or State statutes and registers, the TLVs do have the force and effects of law.

"Notice of Intent." At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intended Changes." This Notice provides not only an opportunity for comment, *but solicits suggestions of substances to be added to the list*. The suggestions *should be accompanied by substantiating evidence*. The list of Intended Changes follows the Adopted Values in the TLV booklet. Values listed in parenthesis in the "Adopted" list are to be used during the period in which a proposed change for that Value is listed in the Notice of Intended Changes.

Definitions. Three categories of Threshold Limit Values (TLVs) are specified herein, as follows:

a) Threshold Limit Value-Time Weighted Average (TLV-TWA) — the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

b) Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) — the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue change, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA also is not exceeded. It is not a separate independent exposure limit, rather it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

A STEL is defined as a 15-minute time-weighted average exposure which should not be exceeded at any time during a work day even if the eight-hour time-weighted average is within the TLV. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL. An averaging period other than 15 minutes may be recommended when this is warrented by observed biological effects.

c) Threshold Limit Value-Ceiling (TLV-C) — the concentration that should not be exceeded even instantaneously.

For some substances, e.g., irritant gases, only one category, the TLV-Ceiling, may be relevant. For other substances, either two or three categories may be relevant, depending upon their physiologic action. It is important to observe that if any one of these three TLVs is exceeded, a potential hazard from that substance is presumed to exist.

The committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

Time-Weighted Average vs Ceiling Limits. Time-weighted averages permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. In some instances it may be permissible to calculate the average concentration for a workweek rather than for a workday. The relationship between threshold limit and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which threshold limits may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations — even for short periods — produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All-factors must be taken into consideration in arriving at a decision as to whether a hazardous condition exists.

Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose threshold limit is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling "C" limit that should not be exceeded. It is implicit in these definitions that the manner of sampling to determine noncompliance with the limits for each group must differ; a single brief sample, that is applicable to a "C" limit, is not appropriate to the time-weighted limit; here, a sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

Whereas the ceiling limit places a definite boundary which concentrations should not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are permissible above the listed values. It should be noted that the same factors are used by the Committee in determining the magnitude of the value of the STELs, or whether to include or exclude a substance for a "C" listing.

"Skin" Notation. Listed substances followed by the designation "Skin" refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by air borne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. This attention-calling designation is intended to suggest appropriate measures for the prevention of cutaneous absorption so that the threshold limit is not invalidated.

Mixtures. Special consideration should be given also to the application of the TLVs in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in Appendix C.

Nuisance Particulates. In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics: (1) The architecture of the air spaces remains intact. (2) Collagen (scar tissue) is not formed to a significant extent. (3) The tissue reaction is potentially reversible.

Excessive concentrations of nuisance dusts in the workroom air may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears and nasal passages (Portland Cement dust), or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.

A threshold limit of 10 mg/m³, or 30 mppcf, of total dust < 1% quartz, or, 5 mg/m³ respirable dust is recommended for substances in these categories and for which no specific threshold limits have been assigned. This limit, for a normal workday, does not apply to brief exposures at higher concentrations. Neither does it apply to those substances which may cause physiologic impairment at lower concentrations but for which a threshold limit has not yet been adopted. Some nuisance particulates are given in Appendix D.

Simple Asphyxiants — "Inert" Gases or Vapors. A number of gases and vapors, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiologic effects. A TLV may not be recommended for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content should be 18 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, pO_2 of 135 mm Hg). Atmospheres deficient in O_2 do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant. Specific examples are listed in Appendix E.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude) and the like may place added stress on the body so that the effects from exposure at a threshold limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. *Although most threshold limits have built-in safety factors to guard against adverse effects to moderate deviations* from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations. For example, continuous work at temperatures above 90°F, or overtime extending the workweek more than 25%, might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the Threshold Limit Values.

Biologic Limit Values (BLVs). Other means exist and may be necessary for monitoring worker exposure other than reliance on the Threshold Limit Values for industrial air, namely, the Biologic Limit Values. These values represent limiting amounts of substances (or their effects) to which the worker may be exposed without hazard to health or well-being as determined in *his* tissues and fluids or in *his* exhaled breath. The biologic measurements on which the BLVs are based can furnish two kinds of information useful in the control of worker exposure: (1) measure of the individual worker's over-all exposure; (2) measure of the worker's individual and characteristic response. Measurements of response furnish a superior estimate of the physiologic status of the worker, and may be made of (a) changes in amount of some critical biochemical constituent, (b) changes in activity of a critical enzyme, (c) changes in some physiologic function. Measurement of exposure may be made by (1) determining in blood, urine, hair, nails, in body tissues and fluids, the amount of substance to which the worker was exposed; (2) determination of the amount of the metabolite(s) of the substance in tissues and fluids; (3) determination of the amount of the substance in the exhaled breath. The biologic limits may be used as an adjunct to the TLVs for air, *or in place of them*. The BLVs, and their associated procedures for determining compliance with them, should thus be regarded as an effective means of providing health surveillance of the worker.

Tests are available (J. Occup. Med. 15: 564, 1973; Ann. N.Y. Acad. Sci., *151, Art. 2:* 968, 1968) that may be used to detect those individuals hypersusceptible to a variety of industrial chemicals (respiratory irritants, hemolytic chemicals, organic isocyanates, carbon disulfide).

Unlisted Substances. Many substances present or handled in industrial processes do not appear on the TLV list. In a number of instances the material is rarely present as a particulate, vapor or other airborne contaminant, and a TLV is not necessary. In other cases sufficient information to warrant development of a TLV, even on a tentative basis, is not available to the Committee. Other substances, of low toxicity, could be included in Appendix D pertaining to nuisance particulates. This list (as well as Appendix E) is not meant to be all inclusive; the substances serve only as examples.

In addition there are some substances of not inconsiderable toxicity, which have been omitted primarily because only a limited number of workers (e.g., employees of a single plant) are known to have potential exposure to possibly harmful concentrations.

Operational Guidelines: The ACGIH Board of Directors has adopted operational guidelines for the Chemical Agents TLV Committee. These guidelines prescribe: charge, authority, policies, membership, organization, and operating procedures. The policies include the appeals procedures. Copies of the guidelines document are available from the Publications Office at a cost of $5 per copy.

Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm[a]	mg/m³[b]	ppm[a]	mg/m³[b]
Acetaldehyde [75-07-0]	100	180	150	270
Acetic acid [64-19-7]	10	25	15	37
Acetic anhydride [108-24-7]	C 5	C 20	—	—
•Acetone [67-64-1]	750	1,780	1,000	2,375
Acetonitrile [75-05-8] — Skin	40	70	60	105
Acetylene [74-86-2]	E	—	—	—
Acetylene dichloride, see 1, 2-Dichloroethylene				
Acetylene tetrabromide [79-27-6]	1	15	1.5	20
Acetylsalicylic acid (Asprin) [50-78-2]	—	5	—	—
Acrolein [107-02-8]	0.1	0.25	0.3	0.8
Acrylamide [79-06-1] — Skin	—	0.3	—	0.6
Acrylic acid [79-10-7]	10	30	—	—
‡Acrylonitrile [107-13-1] — Skin	(2, A1a)	(4.5, A1a)	—	—
Aldrin [309-00-2] — Skin	—	0.25	—	0.75
Allyl alcohol [107-18-6] — Skin	2	5	4	10
Allyl chloride [107-05-1]	1	3	2	6
Allyl glycidyl ether (AGE) [106-92-3] — Skin	5	22	10	44
Allyl propyl disulfide [2179-59-1]	2	12	3	18
α-Alumina [1344-28-1]	—	D	—	20
Aluminum [7429-90-5]				
Metal & oxide	—	10	—	20
Pyro powders	—	5	—	—
Welding fumes	—	5	—	—
Soluble salts	—	2	—	—
Alkyls (NOC†)	—	2	—	—
4-Aminodiphenyl [92-67-1] — Skin	—	A1b	—	A1b
2-Aminoethanol, see Ethanolamine				
2-Aminopyridine [504-29-0]	0.5	2	2	4
3-Amino 1, 2, 4-triazole, see Amitrol				
Amitrol [61-82-5]	A2	A2	—	—
Ammonia [7664-41-7]	25	18	35	27
Ammonium chloride fume [12125-02-9]	—	10	—	20

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.

Footnotes (a thru l) see Page 34.

•1982 Addition

‡See Notices of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Ammonium sulfamate [7773-06-0]	—	10	—	20
n-Amyl acetate [628-63-7]	100	530	150	800
sec-Amyl acetate [626-38-0]	125	670	150	800
Aniline [62-53-3] & homologues — Skin	2	10	5	20
Anisidine [29191-52-4] (o-, p-isomers) — Skin	0.1	0.5	—	—
Antimony [7440-36-0] & compounds, as Sb	—	0.5	—	—
Antimony trioxide [1327-33-9]				
Handling and use, as Sb	—	0.5	—	—
Production	—	A2	—	—
ANTU [86-88-4]	—	0.3	—	0.9
Argon [7440-37-1]	E	—	—	—
Arsenic [7440-38-2] & soluble compounds, as As	—	0.2	—	—
Arsenic trioxide production [1327-53-3]	—	A2	—	—
Arsine [7784-42-1]	0.05	0.2	—	—
Asbestos [1332-21-4], see MINERAL DUSTS	—	A1a	—	A1a
Asphalt (petroleum) fumes [8052-42-4]	—	5	—	10
‡Atrazine [1912-24-9]	—	(10)	—	—
Azinphos-methyl [86-50-0] — Skin	—	0.2	—	0.6
Barium [7440-39-3], soluble compounds, as Ba	—	0.5	—	—
Benomyl [17804-35-2]	0.8	10	1.3	15
Benzene [71-43-2]	10, A2	30, A2	25, A2	75, A2
*Benzidine [92-87-5] — Skin	—	A1b	—	A1b
p-Benzoquinone, see Quinone				
Benzoyl peroxide [94-36-0]	—	5	—	—
Benzo(a)pyrene [50-32-8]	—	A2	—	A2
Benzyl chloride [100-44-7]	1	5	—	—
Beryllium [7440-41-7]	—	0.002, A2	—	—
Biphenyl [92-52-4]	0.2	1.5	0.6	4
Bismuth telluride [1304-82-1]	—	10	—	20

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Footnotes (a thru I) see Page 34.
*1982 Addition
‡See Notices of Intended Changes.

	ADOPTED			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Se-doped	—	5	—	10
Borates, tetra, sodium salts [1303-96-4],				
Anhydrous	—	1	—	—
Decahydrate	—	5	—	—
Pentahydrate	—	1	—	—
Boron oxide [1303-86-2]	—	10	—	20
Boron tribromide [10294-33-4]	1	10	3	30
Boron trifluoride [7637-07-2]	C 1	C 3	—	—
Bromacil [314-40-9]	1	10	2	20
Bromine [7726-95-6]	0.1	0.7	0.3	2
Bromine pentafluoride [7789-30-2]	0.1	0.7	0.3	2
Bromochloromethane, see Chlorobromomethane				
Bromoform [75-25-2] — Skin	0.5	5	—	—
Butadiene (1, 3-butadiene) [106-99-0]	1,000	2,200	1,250	2,750
Butane [106-97-8]	800	1,900	—	—
Butanethiol, see Butyl mercaptan				
2-Butanone, see Methyl ethyl ketone (MEK)				
2-Butoxyethanol [111-76-2] — Skin	25	120	75	360
n-Butyl acetate [123-86-4]	150	710	200	950
sec-Butyl acetate [105-46-4]	200	950	250	1,190
tert-Butyl acetate [540-88-5]	200	950	250	1,190
Butyl acrylate [141-32-2]	10	55	—	—
n-Butyl alcohol [71-36-3] — Skin	C 50	C 150	—	—
sec-Butyl alcohol [78-92-2]	100	305	150	455
tert-Butyl alcohol [75-65-0]	100	300	150	450
Butylamine [109-73-9] — Skin	C 5	C 15	—	—
tert-Butyl chromate, as CrO_3 [1189-85-1] — Skin	—	C 0.1	—	—
n-Butyl glycidyl ether (BGE) [2426-08-6]	25	135	—	—
n-Butyl lactate [138-22-7]	5	25	—	—
Butyl mercaptan [109-79-5]	0.5	1.5	—	—
o-sec-Butylphenol [89-72-5] — Skin	5	30	—	—
p-tert-Butyltoluene [98-51-1]	10	60	20	120

Capital letters A, B, D & E refer to Appendices, C denotes ceiling limit.
Footnotes (a thru I) see Page 34.

Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Cadmium [7440-43-9]				
Dust & salts, as Cd	—	0.05	—	0.2
Cadmium oxide [1306-19-0]				
Fume, as Cd	—	C 0.05	—	—
‡ Production, as Cd	—	(A2)	—	—
Calcium carbonate/ marble [1317-65-3]	—	D	—	20
Calcium cyanamide [156-62-7]	—	0.5	—	1
Calcium hydroxide [1305-62-0]	—	5	—	—
Calcium oxide [1305-78-8]	—	2	—	—
Calcium silicate [1344-95-2]	—	D	—	—
Camphor, synthetic [76-22-2]	2	12	3	18
Caprolactam [105-60-2]				
Dust	—	1	—	3
Vapor	5	20	10	40
Captafol [2425-06-1] — Skin	—	0.1	—	—
Captan [133-06-2]	—	5	—	15
Carbaryl [63-25-2]	—	5	—	10
Carbofuran [1563-66-2]	—	0.1	—	—
Carbon black [7440-44-0]	—	3.5	—	7
Carbon dioxide [124-38-9]	5,000	9,000	15,000	27,000
Carbon disulfide [75-15-0] — Skin	10	30	—	—
Carbon monoxide [630-08-0]	50	55	400	440
Carbon tetrabromide [558-13-4]	0.1	1.4	0.3	4
Carbon tetrachloride [56-23-5] — Skin	5, A2	30, A2	20, A2	125, A2
Carbonyl chloride, see Phosgene				
Carbonyl fluoride [353-50-4]	2	5	5	15
Catechol (Pyrocatechol) [120-80-9]	5	20	—	—
Cellulose (paper fiber) [9004-34-6]	—	D	—	20
Cesium hydroxide [21351-79-1]	—	2	—	—
Chlordane [57-74-9] — Skin	—	0.5	—	2

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru i) see Page 34.
‡See Notice of Intended Changes.

Substance [CAS #]	ADOPTED			
	TWA		STEL	
	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Chlorinated camphene [8001-35-2] — Skin	—	0.5	—	1
Chlorinated diphenyl oxide [55720-99-5]	—	0.5	—	2
Chlorine [7782-50-5]	1	3	3	9
Chlorine dioxide [10049-04-4]	0.1	0.3	0.3	0.9
Chlorine trifluoride [7790-91-2]	C 0.1	C 0.4	—	—
Chloroacetaldehyde [107-20-0]	C 1	C 3	—	—
α-Chloroacetophenone [532-27-4] (Phenacyl chloride)	0.05	0.3	—	—
Chloroacetyl chloride [79-04-9]	0.05	0.2	—	—
Chlorobenzene [108-90-7] (Monochlorobenzene)	75	350	—	—
‡o-Chlorobenzylidene malononitrile [2698-41-1] — Skin	(0.05)	(0.4)	—	—
Chlorobromomethane [74-97-5]	200	1,050	250	1,300
2-Chloro-1, 3-butadiene, see β Chloroprene				
Chlorodifluoromethane [75-45-6]	1,000	3,500	1,250	4,375
Chlorodiphenyl (42% Chlorine) [53449-21-9] — Skin	—	1	—	2
Chlorodiphenyl (54% Chlorine) [11097-69-1] — Skin	—	0.5	—	1
1-Chloro, 2, 3-epoxy-propane, see Epichlorohydrin				
2-Chloroethanol, see Ethylene chlorohydrin				
Chloroethylene, see Vinyl chloride				
Chloroform [67-6[illegible]]	10, A2	50, A2	50, A2	225, A2
bis-Chloromethyl ether [542-88-1]	0.001, A1a	0.005, A1a	—	—
1-Chloro-1-nitropropane [600-25-9]	2	10	—	—
Chloropentafluoroethane [76-15-3]	1,000	6,320	—	—

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit
Footnotes (a thru i) see Page 34.
‡See Notice of Intended Changes.

		ADOPTED VALUES		
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Chloropicrin [76-06-2]	0.1	0.7	0.3	2
β-Chloroprene [126-99-8] — Skin	10	45	—	—
o-Chlorostyrene [1331-28-8]	50	285	75	430
o-Chlorotoluene [95-49-8] — Skin	50	250	75	375
2-Chloro- 6-(trichloromethyl) pyridine, see Nitrapyrin				
Chlorpyrifos [2921-88-2] — Skin	—	0.2	—	0.6
Chromite ore processing (Chromate), as Cr.	—	0.05, A1a	—	—
Chromium [7440-47-3]				
Metal	—	0.5	—	—
Soluble chromic, chromus salts, as Cr.	—	0.5	—	—
Chromium (II) compounds, as Cr	—	0.5	—	—
Chromium (III) compounds, as Cr	—	0.5	—	—
Chromium (VI) compounds, as Cr				
Water soluble	—	0.05	—	—
Certain water insoluble	—	0.05, Ala	—	—
Chromyl chloride [14977-61-8]	0.025	0.15	—	—
Chrysene [218-01-9]	A2	A2	—	—
Clopidol [2971-90-6]	—	10	—	20
Coal tar pitch volatiles [8007-45-2], as benzene solubles	—	0.2, A1a	—	—
‡Cobalt [7440-48-4], as Co metal, dust & fume	—	(0.1)	—	—
Copper [7440-50-8]				
Fume	—	0.2	—	—
Dusts & mists, as Cu	—	1	—	2
Cotton dust, raw	—	0.2[k)]	—	0.6
Cresol [1319-77-3], all isomeres — Skin	5	22	—	—
Crotonaldehyde [123-73-9]	2	6	6	18
Crufomate [299-86-5]	—	5	—	20
Cumene [98-82-8] — Skin	50	245	75	365

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.
‡See Notice of Intended Changes.
k) See p. 36.

		ADOPTED VALUES		
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Cyanamide [420-04-2]	—	2	—	—
Cyanides [151-50-8; 143-33-9], as CN — Skin	—	5	—	—
Cyanogen [460-19-5]	10	20	—	—
Cyanogen chloride [506-77-4]	C 0.3	C 0.6	—	—
Cyclohexane [110-8[illegible]-7]	300	1,050	375	1,300
Cyclohexanol [108-9[illegible]]	50	200	—	—
Cyclohexanone [108-94-1]	25	100	100	400
Cyclohexene [110-83-8]	300	1,015	—	—
Cyclohexylamine [108-91-8] — Skin	10	40	—	—
Cyclonite [121-82-4] — Skin	—	1.5	—	3
Cyclopentadiene [542-92-7]	75	200	150	400
Cyclopentane [287-92-3]	600	1,720	900	2,580
Cyhexatin [13121-70-5]	—	5	—	10
2, 4-D [94-75-7]	—	10	—	20
DDT (Dichlorodiphenyl-trichloroethane) [50-29-3]	—	1	—	3
Decaborane [17702-41-9] — Skin	0.05	0.3	0.15	0.9
Demetron [8065-48-3] — Skin	0.01	0.1	0.03	0.3
Diacetone alcohol [123-42-2]	50	240	75	360
1, 2-Diaminoethane, see Ethylenediamine				
Diazinon [333-41-5] — Skin	—	0.1	—	0.3
Diazomethane [334-88-3]	0.2	0.4	—	—
Diborane [19287-45-7]	0.1	0.1	—	—
1, 2-Dibromoethane, see Ethylene dibromide				
2-N-Dibutylaminoethanol [102-81-8] — Skin	2	14	4	28
Dibutyl phosphate	1	5	2	10
Dibutyl phthalate [84-74-2]	—	5	—	10
Dichloroacetylene [7572-29-4]	C 0.1	C 0.4	—	—
o-Dichlorobenzene [95-50-1]	C 50	C 300	—	—
p-Dichlorobenzene [106-46-7]	75	450	110	675
3, 3'-Dichlorobenzidene [91-94-11] — Skin	—	A2	—	A2

Capital letters A, B, D, & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.

Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Dichlorodifluoromethane [75-71-8]	1,000	4,950	1,250	6,200
1, 3-Dichloro-5, 5-dimethyl hydantoin [118-52-5]	—	0.2	—	0.4
1, 1-Dichloroethane [75-34-3]	200	810	250	1,010
1, 2-Dichloroethane, see Ethylene dichloride				
1, 1-Dichloroethylene, see Vinylidene chloride				
1, 2-Dichloroethylene [540-59-0]	200	790	250	1,000
Dichloroethyl ether [111-44-4] — Skin	5	30	10	60
Dichlorofluoromethane [75-43-4]	10	[illegible]	—	—
Dichloromethane, see Methylene chloride				
1, 1-Dichloro-1-nitroethane [594-72-9]	2	10	10	60
1, 2-Dichloropropane, see Propylene dichloride				
Dichloropropene [542-75-6] — Skin	1	5	10	50
2, 2-Dichloropropionic acid [75-99-0]	1	6	—	—
Dichlorotetrafluoroethane [76-14-2]	1,000	7,000	1,250	8,750
Dichlorvos [62-73-7] — Skin	0.1	1	0.3	3
Dicrotophos [141-66-2] — Skin	—	0.25	—	—
Dicyclopentadiene [77-73-6]	5	30	—	—
Dicyclopentadienyl iron [102-54-5]	—	10	—	20
Dieldrin [60-57-1] — Skin	—	0.25	—	0.75
Diethanolamine [111-42-2]	3	15	—	—
Diethylamine [109-89-7]	10	30	25	75
Diethylaminoethanol [100-37-8] — Skin	10	50	—	—
Diethylene triamine [111-40-0] — Skin	1	4	—	—
Diethyl ether, see Ethyl ether				
Diethyl ketone [96-22-0]	200	705	—	—
Diethyl phthalate [84-66-2]	—	5	—	10
Difluorodibromomethane [75-61-6]	100	860	150	1,290

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.

Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Diglycidyl ether (DGE) [2238-07-5]	0.1	0.5	—	—
Dihydroxybenzene, see Hydroquinone				
Diisobutyl ketone [108-83-8]	25	150	—	—
Diisopropylamine [108-18-9] — Skin	5	20	—	—
Dimethoxymethane, see Methylal				
Dimethyl acetamide [127-19-5] — Skin	10	35	15	50
Dimethylamine [124-40-3]	10	18	—	—
Dimethylaminobenzene, see Xylidene				
Dimethylaniline [121-69-7] (N, N-Dimethylaniline) — Skin	5	25	10	50
Dimethylbenzene, see Xylene				
Dimethyl carbamyl chloride [79-44-7]	A2	A2	—	—
Dimethyl-1, 2-dibromo-2-dichloroethyl phosphate, see Naled				
Dimethylformamide [68-12-2] — Skin	10	30	20	60
2, 6-Dimethyl-4-heptanone, see Diisobutyl ketone				
1, 1-Dimethylhydrazine [57-14-7] — Skin	0.5, A2	1, A2	1, A2	2, A2
Dimethylphthalate [131-11-3]	—	5	—	10
Dimethyl sulfate [77-78-1] — Skin	0.1, A2	0.5, A2	—	—
Dinitolmide [148-01-6]	—	5	—	10
Dinitrobenzene [528-29-0] (all isomers) — Skin	0.15	1	0.5	3
Dinitro-o-cresol [534-52-1] — Skin	—	0.2	—	0.6
3, 5-Dinitro-o-toluamide, see Dinitolmide				
Dinitrotoluene [121-14-2] — Skin	—	1.5	—	5
Dioxane, tech. grade [123-91-1] — Skin	25	90	100	360
Dioxathion [78-34-2] — Skin	—	0.2	—	—
Diphenyl, see Biphenyl				
Diphenylamine [122-39-4]	—	10	—	20
Diphenylmethane diisocyanate, see Methylene bisphenyl isocyanate				

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Dipropylene glycol methyl ether [34590-94-8] — Skin	100	600	150	900
Dipropyl ketone [123-19-3]	50	235	—	—
Diquat [85-00-7]	—	0.5	—	1
Di-sec, octyl phthalate [117-81-7] (Di-2-ethylhexylphthalate)	—	5	—	10
Disulfiram [97-77-8]	—	2	—	5
Disulfoton [298-04-4]	—	0.1	—	0.3
2, 6-Ditert. butyl-p-cresol [128-37-0]	—	10	—	20
Diuron [330-54-1]	—	10	—	—
Divinyl benzene [108-57-6]	10	50	—	—
Emery [112-62-9]	—	D	—	20
Endosulfan [115-29-7] — Skin	—	0.1	—	0.3
Endrin [72-20-8] — Skin	—	0.1	—	0.3
Epichlorohydrin [106-89-8] — Skin	2	10	5	20
EPN [2104-64-5] — Skin	—	0.5	—	2
1, 2-Epoxypropane, see Propylene oxide				
2, 3-Epoxy-1-propanol, see Glycidol				
Ethane [74-84-0]	E	—	—	—
Ethanethiol, see Ethyl mercaptan				
Ethanolamine [141-43-5]	3	8	6	15
Ethion [563-12-2] — Skin	—	0.4	—	—
‡2-Ethoxyethanol [110-80-5] — Skin	(50)	(185)	(100)	(370)
‡2-Ethoxyethyl acetate [111-15-9] — Skin	(50)	(270)	(100)	(540)
Ethyl acetate [141-78-6]	400	1,400	—	—
Ethyl acrylate [140-88-5] — Skin	5	20	25	100
Ethyl alcohol (Ethanol) [46-17-5]	1,000	1,900	—	—
Ethylamine [75-04-7]	10	18	—	—
Ethyl amyl ketone [41-85-5]	25	130	—	—
Ethyl benzene [100-41-4]	100	435	125	545
Ethyl bromide [74-96-4]	200	890	250	1,110
Ethyl butyl ketone [106-35-4]	50	230	75	345
Ethyl chloride [75-00-3]	1,000	2,600	1,250	3,250

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Footnotes (a thru f) see Page 34.

‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Ethylene [74-85-1]	E	—	—	—
Ethylene chlorohydrin [107-07-3] — Skin	C 1	C 3	—	—
Ethylenediamine [107-15-3]	10	25	—	—
*Ethylene dibromide [106-93-4] — Skin	A2	A2	—	—
Ethylene dichloride [107-06-2]	10	40	15	60
Ethylene glycol [107-21-1]				
‡ Particulate	—	(10)	—	(20)
Vapor	C 50	C 125	—	—
‡Ethylene glycol dinitrate [628-96-6] — Skin	(0.02)	(0.1)	(0.05)	(0.3)
Ethylene glycol methyl ether acetate, see 2-Methoxyethyl acetate				
‡Ethylene oxide [75-21-8]	(10)	(20)	—	—
Ethyleneimine [151-56-4] — Skin	0.5	1	—	—
Ethyl ether [60-29-7]	400	1,200	500	1,500
Ethyl formate [109-94-4]	100	300	150	450
Ethylidene chloride, see 1, 1-Dichloroethane				
Ethylidene norbornene [16219-75-3]	C 5	C 25	—	—
Ethyl mercaptan [75-08-1]	0.5	1	2	3
*N-Ethylmorpholine [100-74-3] — Skin	5	40	20	95
Ethyl silicate [78-10-4]	10	85	30	255
Fensulfothion [115-90-2]	—	0.1	—	—
‡Fenthion [55-38-9]	—	(0.1)	—	(0.3)
Ferbam [14484-64-1]	—	10	—	20
Ferrovanadium dust [12604-58-9]	—	1	—	0.3
Fibrous[d] glass dust	—	10	—	—
Fluorides, as F	—	2.5	—	—
Fluorine [7782-41-4]	1	2	2	4
Fluorotrichloromethane, see Trichlorofluoromethane				
Fonofos [944-22-9] — Skin	—	0.1	—	—
‡Formaldehyde [50-00-0]	(C 2)	(C 3)	—	—
Formamide [75-12-7]	20	30	30	45
Formic acid [64-18-6]	5	9	—	—
Furfural [98-01-1] — Skin	2	8	10	40
*Furfuryl alcohol [98-00-0] — Skin	10	40	15	60
*Gasoline [8006-61-9]	300	900	500	1,500

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Footnotes (a thru f) see Page 34.

*1982 Addition.

‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Germanium tetrahydride [7782-65-2]	0.2	0.6	0.6	1.8
Glass, fibrous or dust, see Fibrous glass dust				
Glutaraldehyde [111-30-8]	C 0.2	C 0.7	—	—
Glycerin mist [56-81-5]	—	D	—	—
Glycidol [556-52-5]	25	75	100	300
Glycol monoethyl ether, see 2-Ethoxyethanol				
Graphite (Natural) [7782-42-5], see MINERAL DUSTS				
Graphite (Synthetic)	—	D	—	—
Gypsum [10101-4-4]	—	D	—	20
Hafnium [7440-58-6]	—	0.5	—	1.5
Helium [7440-59-7]	E	—	—	—
Heptachlor [76-44-8] — Skin	—	0.5	—	2
Heptane [142-82-5] (n-Heptane)	400	1,600	500	2,000
2-Heptanone, see Methyl n-amyl ketone				
3-Heptanone, see Ethyl butyl ketone				
*Hexachlorobutadiene [76-68-3]	0.02, A2	0.24, A2	—	—
Hexachlorocyclopentadiene [77-47-4]	0.01	0.1	0.03	0.3
*Hexachloroethane [67-72-1] — Skin	10	100	—	—
Hexachloronaphthalene [1335-87-1] — Skin	—	0.2	—	0.6
Hexafluoroacetone [684-16-2]	0.1	0.7	0.3	2
Hexamethyl phosphoramide [680-31-9] — Skin	A2	A2	—	—
*Hexane (n-Hexane) [110-54-3]	50	180	—	—
*Other isomeres	500	1,800	1,000	3,600
2-Hexanone, see Methyl n-butyl ketone				
Hexone, see Methyl isobutyl ketone				
sec-Hexyl acetate [142-92-7]	50	300	—	—
Hexylene glycol [107-41-5]	C 25	C 125	—	—
Hydrazine [302-01-2] — Skin	0.1, A2	0.1, A2	—	—
Hydrogen [1333-74-0]	E	—	—	—
Hydrogenated terphenyls [92-94-4]	0.5	5	—	—

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Footnotes (a thru f) see Page 34.
*1982 Addition.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Hydrogen bromide [10035-10-6]	3	10	—	—
Hydrogen chloride [7647-01-1]	C 5	C 7	—	—
Hydrogen cyanide [74-90-8] — Skin	C 10	C 10	—	—
Hydrogen fluoride [7664-39-3], as F	3	2.5	6	5
Hydrogen peroxide [7722-84-1]	1	1.5	2	3
Hydrogen selenide [7783-07-5], as Se	0.05	0.2	—	—
Hydrogen sulfide [7783-06-4]	10	14	15	21
Hydroquinone [123-31-9]	—	2	—	4
4-Hydroxy-4-methyl-2-pentanone, see Diacetone alcohol				
2-Hydroxypropyl acrylate [999-61-1] — Skin	0.5	3	—	—
Indene [95-13-6]	10	45	15	70
Indium [7440-74-6] & compounds, as In	—	0.1	—	0.3
Iodine [7553-56-2]	C 0.1	C 1	—	—
Iodoform [75-47-8]	0.6	10	1	20
Iron oxide fume (Fe_2O_3) [1309-37-1], as Fe	B3	5	—	10
*Iron pentacarbonyl [13463-40-6], as Fe	0.1	0.8	0.2	0.16
Iron salts, soluble, as Fe	—	1	—	2
Isoamyl acetate [123-92-2]	100	525	125	655
Isoamyl alcohol [123-51-3]	100	360	125	450
Isobutyl acetate [110-19-0]	150	700	187	875
Isobutyl alcohol [78-83-1]	50	150	75	225
Isooctyl alcohol [26952-21-6]	50	270	—	—
Isophorone [78-59-1]	C 5	C 25	—	—
Isophorone diisocyanate — Skin	0.01	0.09	—	—
Isopropoxyethanol [109-59-1]	25	105	75	320
Isopropyl acetate [108-21-4]	250	950	310	1,185
Isopropyl alcohol [67-63-0]	400	980	500	1,225
Isopropylamine [75-31-0]	5	12	10	24

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.
*1982 Addition.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
N-Isopropylaniline [643-28-7] — Skin	2	10	5	20
Isopropyl ether [108-20-3]	250	1,050	310	1,320
Isopropyl glycidyl ether [4016-14-2] (IGE)	50	240	75	360
Kaolin	—	D	—	20
Ketene [463-51-4]	0.5	0.9	1.5	3
Lead [7439-92-1], inorg., dusts & fumes, as Pb	—	0.15	—	0.45
‡Lead arsenate [10102-48-4], as Pb	—	(0.15)	—	(0.45)
Lead chromate [18454-12-1], as Cr	—	0.05, A2	—	—
Limestone [1317-65-3]	—	D	—	20
Lindane [58-89-9] — Skin	—	0.5	—	1.5
Lithium hydride [7580-67-8]	—	0.025	—	—
L.P.G. (Liquified petroleum gas)	1,000	1,800	1,250	2,250
Magnesite [546-90-0]	—	D	—	20
Magnesium oxide fume [1309-48-4]	—	10	—	—
Malathion [121-75-5] — Skin	—	10	—	—
Maleic anhydride [108-31-6]	0.25	1	—	—
Manganese [7439-96-5], as Mn				
Dust & compounds	—	C 5	—	—
Fume	—	1	—	3
Manganese cyclopentadienyl tricarbonyl [12108-13-3], as Mn — Skin	—	0.1	—	0.3
Manganese tetroxide	—	1	—	—
Marble/calcium carbonate [1317-65-3]	—	D	—	20
Mercury [7439-97-6], as Hg — Skin				
Alkyl compounds	—	0.01	—	0.03
All forms except alkyl				
* Vapor	—	0.05	—	—
* Aryl & inorganic compounds	—	0.1	—	—
Mesityl oxide [141-79-7]	15	60	25	100
Methacrylic acid [79-41-4]	20	70	—	—

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Footnotes (a thru f) see Page 34

*1982 Addition.

‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Methane [74-82-8]	E	—	—	—
Methanethiol, see Methyl mercaptan				
Methomyl [16752-77-5] — Skin	—	2.5	—	—
Methoxychlor [72-43-5]	—	10	—	—
‡2-Methoxyethanol [109-86-4]— Skin	(25)	(80)	(35)	(120)
‡2-Methoxyethyl acetate [110-49-6] — Skin	(25)	(120)	(35)	(170)
*4-Methoxyphenol [150-76-5]	—	5	—	—
Methyl acetate [79-20-9]	200	610	250	760
Methyl acetylene [74-99-7]	1,000	1,650	1,250	2,040
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800	1,250	2,250
Methyl acrylate [96-33-3] — Skin	10	35	—	—
Methylacrylonitrile [126-98-7] — Skin	1	3	2	6
Methylal [109-87-5]	1,000	3,100	1,250	3,875
Methyl alcohol [67-56-1] (methanol) — Skin	200	260	250	310
Methylamine [74-89-5]	10	12	—	—
Methyl amyl alcohol, see Methyl isobutyl carbinol				
Methyl n-amyl ketone [591-78-6]	50	235	100	465
*N-Methyl aniline [100-61-8] — Skin	0.5	2	1	5
Methyl bromide [74-83-9] — Skin	5	20	15	60
Methyl n-butyl ketone [591-78-6]	5	20	—	—
Methyl chloride [74-87-3]	50	105	100	205
Methyl chloroform [71-55-6]	350	1,900	450	2,450
Methyl 2-cyanoacrylate [137-05-3]	2	8	4	16
Methylcyclohexane [108-87-2]	400	1,600	500	2,000
Methylcyclohexanol [25639-42-3]	50	235	75	350
o-Methylcyclohexanone [583-60-8] — Skin	50	230	75	345

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Footnotes (a thru f) see Page 34.

*1982 Addition.

‡See Notice of Intended Changes.

Substance [CAS #]	ADOPTED VALUES TWA ppm$^{a)}$	 TWA mg/m$^{3\,b)}$	 STEL ppm$^{a)}$	 STEL mg/m$^{3\,b)}$
Methylcyclopentadienyl manganese tricarbonyl, [12108-13-3] — Skin, as Mn	—	0.2	—	0.6
Methyl demeton [8022-00-2] — Skin	—	0.5	—	1.5
Methylene bisphenyl isocyanate (MDI) [101-68-8]	C 0.02	C 0.2	—	—
Methylene chloride [75-09-2]	100	360	500	1,700
4, 4′-Methylene bis (2-chloroaniline) [101-14-4] — Skin	0.02, A2	0.22, A2	—	—
Methylene bis(4-cyclohexylisocyanate) [101-68-8]	C 0.01	C 0.11	—	—
4, 4-Methylene dianiline [101-77-9] — Skin	0.1	0.8	0.5	4
Methyl ethyl ketone (MEK) [78-93-3]	200	590	300	885
Methyl ethyl ketone peroxide [1338-23-4]	C 0.2	C 1.5	—	—
Methyl formate [107-31-3]	100	250	150	375
5-Methyl-3-heptanone, see Ethyl amyl ketone				
Methyl hydrazine [60-34-4] — Skin	C 0.2, A2	C 0.35, A2	—	—
Methyl iodide [74-88-4] — Skin	2, A2	10, A2	5, A2	30, A2
*Methyl isoamyl ketone [110-12-3]	50	240	—	—
Methyl isobutyl carbinol [105 30-6] — Skin	25	100	40	165
Methyl isobutyl ketone [108-10-1]	50	205	75	300
Methyl isocyanate [624-83-9] — Skin	0.02	0.05	—	—
Methyl isopropyl ketone [563-80-4]	200	705	—	—
Methyl mercaptan [74-93-1]	0.5	1	—	—
Methyl methacrylate [80-62-6]	100	410	125	510

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f) see Page 34.
*1982 Addition.

Substance [CAS #]	ADOPTED VALUES TWA ppm$^{a)}$	 TWA mg/m$^{3\,b)}$	 STEL ppm$^{a)}$	 STEL mg/m$^{3\,b)}$
Methyl parathion [298-00-0] — Skin	—	0.2	—	0.6
Methyl propyl ketone [107-87-9]	200	700	250	875
Methyl silicate [681-84-5]	1	6	5	30
α-Methyl styrene [98-83-9]	50	240	100	485
Mevinphos [7786-34-7] — Skin	0.01	0.1	0.03	0.3
Molybdenum [7439-98-7], as Mo				
Soluble compounds	—	5	—	10
Insoluble compounds	—	10	—	20
Monocrotophos [6923-22-4]	—	0.25	—	—
Morpholine [110-91-8] — Skin	20	70	30	105
Naled [300-76-5]	—	3	—	6
Naphthalene [91-20-3]	10	50	15	75
β-Naphthylamine [91-59-8]	—	A1b	—	A1b
Neon [7440-01-9]	E	—	—	—
Nickel carbonyl, as Ni	0.05	0.35	—	—
Nickel [7440-02-0]				
Metal	—	1	—	—
Soluble compounds, as Ni	—	0.1	—	0.3
Nickel carbonyl [13463-39-3], as Ni	0.05	0.35	—	—
Nickel sulfide roasting, fume & dust, as Ni	—	1, A1a	—	—
Nicotine [54-11-5] — Skin	—	0.5	—	1.5
Nitrapyrin [1929-82-4]	—	10	—	20
Nitric acid [7697-37-2]	2	5	4	10
Nitric oxide [10102-43-9]	25	30	35	45
*p-Nitroaniline [100-01-6] — Skin	—	3	—	—
Nitrobenzene — Skin	1	5	2	10
‡p-Nitrochlorobenzene [98-95-3] — Skin	—	(1)	—	(2)
4-Nitrodiphenyl [92-93-3]	—	A1b	—	A1b
Nitroethane [79-24-3]	100	310	150	465
Nitrogen dioxide [10102-44-0]	3	6	5	10

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Footnotes (a thru f) see Page 34.
*1982 Addition.
‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Nitrogen trifluoride [7783-54-2]	10	30	15	45
‡Nitroglycerin (NG) [55-63-0] — Skin	(0.02)	(0.2)	(0.05)	(0.5)
Nitromethane [75-52-5]	100	250	150	375
†1-Nitropropane [108-03-2]	25	90	35	135
‡2-Nitropropane [79-46-9]	(C 25, A2)	(C 90, A2)	—	—
N-Nitrosodimethylamine [62-75-9] (dimethylnitrosoamine) — Skin	—	A2	—	A2
*Nitrotoluene [99-08-1] — Skin	2	11	—	—
Nitrotrichloromethane, see Chloropicrin				
Nonane [111-84-2]	200	1,050	250	1,300
Octachloronaphthalene [2234-13-1] — Skin	—	0.1	—	0.3
Octane [111-65-9]	300	1,450	375	1,800
Oil mist, mineral	—	5[c]	—	10
Osmium tetroxide [20816-12-0], as Os	0.0002	0.002	0.0006	0.006
Oxalic acid [144-62-7]	—	1	—	2
Oxygen difluoride [7783-41-7]	0.05	0.1	0.15	0.3
Ozone [10028-15-6]	0.1	0.2	0.3	0.6
Paraffin wax fume [8002-74-2]	—	2	—	6
Paraquat [1910-42-5], respirable sizes	—	0.1	—	—
Parathion [56-38-2] — Skin	—	0.1	—	0.3
Particulate polycyclic aromatic hydro-carbons (PPAH), see Coal tar pitch volatiles				
Pentaborane [19624-22-7]	0.005	0.01	0.015	0.03
Pentachloronaphthalene [1321-64-8]	—	0.5	—	2
Pentachlorophenol [87-86-5] — Skin	—	0.5	—	1.5
Pentaerythritol [115-77-5]	—	D	—	20
Pentane [109-66-0]	600	1,800	750	2,250
2-Pentanone, see Methyl propyl ketone				
‡Perchloroethylene [127-18-4]	50	335	(—)	(—)

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Footnotes (a thru f) see Page 34.
*1982 Addition.
†NOC = Not otherwise classified.
‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a]	mg/m^3[b]	ppm[a]	mg/m^3[b]
Perchloromethyl mercaptan [594-42-3]	0.1	0.8	—	—
Perchloryl fluoride [7616-94-6]	3	14	6	28
Phenol [108-95-2] — Skin	5	19	10	38
Phenothiazine [92-84-2] — Skin	—	5	—	10
N-Phenyl-beta-naphthylamine [135-88-6]	A2	A2	—	—
p-Phenylene diamine [106-50-3] — Skin	—	0.1	—	—
Phenyl ether [101-84-8], vapor	1	7	2	14
Phenylethylene, see Styrene, monomer				
*Phenyl glycidyl ether (PGE) [122-60-1]	1	6	—	—
‡Phenylhydrazine [100-63-0] — Skin	(5)	(20)	(10)	(45)
Phenyl mercaptan [108-98-5]	0.5	2	—	—
Phenylphosphine [638-21-1]	C 0.05	C 0.25	—	—
Phorate [298-02-2] — Skin	—	0.05	—	0.2
Phosdrin, see Mevinphos				
Phosgene [75-44-5]	0.1	0.4	—	—
Phosphine [3803-51-2]	0.3	0.4	1	1
Phosphoric acid [7664-38-2]	—	1	—	3
Phosphorus [7723-14-0] (yellow)	—	0.1	—	0.3
*Phosphorus oxychloride [10026-13-8]	0.1	0.6	0.5	3
Phosphorus pentachloride [10026-13-8]	0.1	1	—	—
Phosphorus pentasulfide [1314-80-3]	—	1	—	3
*Phosphorus trichloride [7719-12-2]	0.2	1.5	0.5	3
Phthalic anhydride [85-44-9]	1	6	4	24
m-Phthalodinitrile [626-17-5]	—	5	—	—
Picloram [1918-02-1]	—	10	—	20

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Footnotes (a thru f) see Page 34.
*1982 Addition.
‡See Notice of Intended Changes.

Substance [CAS #]	ADOPTED VALUES TWA ppm$^{a)}$	 TWA mg/m$^{3\,b)}$	 STEL ppm$^{a)}$	 STEL mg/m$^{3\,b)}$
Picric acid [88-89-1] — Skin	—	0.1	—	0.3
Pindone [83-26-1]	—	0.1	—	0.3
•Piperazine dihydrochloride [142-64-3]	—	5	—	—
2-Pivalyl-1, 3-indandione, see Pindone				
Plaster of Paris	—	D	—	20
Platinum [7440-06-4]				
Metal	—	1	—	—
Soluble salts, as Pt	—	0.002	—	—
Polychlorobiphenyls, see Chlorodiphenyls				
Polytetrafluoroethylene decomposition products	—	B1	—	B1
Potassium hydroxide [1310-58-3]	—	C 2	—	—
Propane [74-98-6]	E	—	—	—
Propane sultone [1120-71-4]	A2	A2	—	—
Propargyl alcohol [107-19-7] — Skin	1	2	3	6
β-Propiolactone [57-57-8]	0.5, A2	1.5, A2	1, A2	3, A2
Propionic acid [79-09-4]	10	30	15	45
Propoxur [114-26-1]	—	0.5	—	2
n-Propyl acetate [109-60-4]	200	840	250	1,050
Propyl alcohol [71-23-8] — Skin	200	500	250	625
n-Propyl nitrate [627-13-4]	25	105	40	470
Propylene [115-07-1]	E	—	—	—
Propylene dichloride [78-87-5]	75	350	110	510
‡Propylene glycol dinitrate [6423-43-4] (PGDN) — Skin	(0.02)	(0.1)	(0.05)	(0.3)
Propylene glycol monomethyl ether [107-98-2]	100	360	150	540
‡Propylene imine [75-55-8] — Skin	(2)	(5)	—	—
Propylene oxide [75-56-9]	20	50	—	—
Propyne, see Methyl acetylene				
Pyrethrum [8003-34-7]	—	5	—	10
Pyridine [110-86-1]	5	15	10	30
Quinone [106-51-4]	0.1	0.4	0.3	1
RDX, see Cyclonite				

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Footnotes (a thru f) see Page 34.
•1982 Addition.
‡See Notice of Intended Changes.

Substance [CAS #]	ADOPTED VALUES TWA ppm$^{a)}$	 TWA mg/m$^{3\,b)}$	 STEL ppm$^{a)}$	 STEL mg/m$^{3\,b)}$
Resorcinol [108-46-3]	10	45	20	90
Rhodium [7440-16-6]				
• Metal	—	1	—	—
‡ Soluble salts, as Rh	—	(0.001)	—	(0.003)
Ronnel [299-84-3]	—	10	—	—
Rosin core solder pyrolysis products, as formaldehyde	—	0.1	—	0.3
Rotenone (commercial) [83-79-4]	—	5	—	10
Rouge	—	D	—	20
Rubber solvent (Naphtha)	400	1,600	—	—
Selenium compounds [7782-49-2], as Se	—	0.2	—	—
Selenium hexafluoride [7783-79-1], as Se	0.05	0.2	—	—
Sesone [136-78-7]	—	10	—	20
Silane, see Silicon tetrahydride				
Silicon [7440-21-3]	—	D	—	20
Silicon carbide [409-21-2]	—	D	—	20
‡Silicon tetrahydride [7803-62-5]	(0.5)	(0.7)	(1)	(1.5)
Silver [7440-22-4], as Ag				
Metal	—	0.1	—	—
Soluble compounds	—	0.01	—	—
Sodium azide [26628-22-8]	C 0.1	C 0.3	—	—
Sodium bisulfite [7631-90-5]	—	5	—	—
Sodium 2, 4-dichloro-phenoxyethyl sulfate, see Sesone				
Sodium fluoroacetate [62-74-8] — Skin	—	0.05	—	0.15
Sodium hydroxide [1310-73-2]	—	C 2	—	—
Sodium metabisulfite [7681-57-4]	—	5	—	—
Starch [9005-84-9]	—	D	—	20
Stibine [7803-52-3]	0.1	0.5	0.3	1.5
•Stoddard solvent [8052-41-3]	100	525	200	1,050
Strychnine [57-24-9]	—	0.15	—	0.45
Styrene, monomer [100-42-5]	50	215	100	425

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Footnotes (a thru f) see Page 34.
•1982 Addition.
‡See Notice of Intended Changes.

		ADOPTED VALUES			
		TWA		STEL	
Substance	[CAS #]	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Subtilisins [1395-21-7] (Proteolytic enzymes as 100% pure crystalline enzyme)		—	C0.00006$^{m)}$	—	—
Sucrose [57-50-1]		—	D	—	20
Sulfotep [3689-24-5] — Skin		—	0.2	—	0.6
Sulfur dioxide [7446-09-5]		2	5	5	10
Sulfur hexafluoride [2551-62-4]		1,000	6,000	1,250	7,500
Sulfuric acid [7864-93-9]		—	1	—	—
Sulfur monochloride [10025-67-9]		1	6	3	18
Sulfur pentafluoride [5714-22-7]		0.025	0.25	0.075	0.75
Sulfur tetrafluoride [7783-60-0]		0.1	0.4	0.3	1
Sulfuryl fluoride [2699-79-8]		5	20	10	40
Systox, see Demeton					
2, 4, 5-T [93-76-5]		—	10	—	20
Tantalum [7440-25-7]		—	5	—	10
TEDP, see Sulfotep					
Tellurium & compounds [13494-80-9], as Te			0.1	—	—
Tellurium hexafluoride [7783-80-4], as Te		0.02	0.2	—	—
Temephos [3383-96-8]		—	10	—	20
TEPP [107-49-3] — Skin		0.004	0.05	0.01	0.2
Terphenyls [92-94-4]		C 0.5	C 5	—	—
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane [76-11-9]		500	4,170	625	5,210
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane [76-12-0]		500	4,170	625	5,210
1, 1, 2, 2-Tetrachloroethane [79-34-5] — Skin		(5)	(35)	(10)	(70)
Tetrachloroethylene, see Perchloroethylene					
Tetrachloromethane, see Carbon tetrachloride					
Tetrachloronaphthalene [1335-88-2]		—	2	—	4
Tetraethyl lead [78-00-2], as Pb — Skin		—	0.100$^{f)}$	—	0.3
Tetrahydrofuran [109-99-9]		200	590	250	735

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Footnotes (a thru f) see Page 34.
m) See Page 36.

		ADOPTED			
		TWA		STEL	
Substance	[CAS #]	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Tetramethyl lead [75-74-1], as Pb — Skin		—	0.150$^{f)}$	—	0.5
Tetramethyl succinonitrile [3333-52-6] — Skin		0.5	3	2	9
Tetranitromethane [509-14-8]		1	8	—	—
Tetrasodium pyrophosphate [7722-88-5]		—	5	—	—
Tetryl [479-45-8] (2, 4, 6-trinitrophenyl-methylnitramine) — Skin		—	1.5	—	3.0
Thallium [7440-28-0]					
Soluble compounds, as Tl — Skin		—	0.1	—	—
4, 4'-Thiobis(6-tert. butyl-m-cresol) [96-69-5]		—	10	—	20
Thioglycolic acid [68-11-1]		1	5	—	—
Thiram [137-26-8]		—	5	—	10
Tin [7440-31-5]					
• Metal		—	2	—	4
• Oxide & inorganic compounds, except SnO_4, as Sn		—	2	—	4
Organic compounds, as Sn — Skin		—	0.1	—	0.2
Titanium dioxide [13463-67-7], as Ti		—	D	—	20
o-Tolidine [119-93-7]		A2	A2	—	—
Toluene [108-88-3] (toluol) — Skin		100	375	150	560
‡Toluene-2, 4-diisocyanate (TDI) [584-84-9]		(C 0.02)	(C 0.14)	—	—
‡o-Toluidine [95-53-4] — Skin		(2)	(9)	—	—
Toxaphene, see Chlorinated camphene					
Tributyl phosphate [126-73-8]		0.2	2.5	0.4	5
Trichloroacetic acid [76-03-9]		1	5	—	—
1, 2, 4-Trichlorobenzene [120-82-1]		5	40	—	—
1, 1, 1-Trichloroethane, see Methyl chloroform					

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Footnotes (a thru f) see Page 34.
*1982 Addition
‡See Notices of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
1, 1, 2-Trichloroethane [79-00-5] — Skin	10	45	20	90
‡Trichloroethylene [79-01-6]	50	270	(150)	(805)
•Trichlorofluoromethane [75-69-4]	C 1,000	C 5,600	—	—
Trichloromethane, see Chloroform				
Trichloronaphthalene [1321-65-9]	—	5	—	10
Trichloronitromethane, see Chloropicrin				
1, 2, 3-Trichloropropane [96-18-4]	50	300	75	450
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane [76-13-1]	1,000	7,600	1,250	9,500
Tricyclohexyltin hydroxide, see Cyhexatin				
‡Triethylamine [121-44-8]	(25)	(100)	(40)	(160)
Trifluorobromomethane [75-63-8]	1,000	6,100	1,200	7,300
Trimellitic anhydride [552-30-7]	0.005	0.04	—	—
Trimethyl benzene [25551-13-7]	25	125	35	170
•Trimethyl phosphite [121-45-9]	2	10	5	25
2, 4, 6-Trinitrophenol, see Picric acid				
2, 4, 6-Trinitrophenyl-methylnitramine, see Tetryl				
•2, 4, 6-Trinitrotoluene (TNT) [118-96-7] — Skin	—	0.5	—	3
Triorthocresyl phosphate [78-30-8]	—	0.1	—	0.3
Triphenyl amine [603-34-9]	—	5	—	—
Triphenyl phosphate [115-86-6]	—	3	—	6
Tungsten [7440-33-7], as W				
Insoluble compounds	—	5	—	10
Soluble compounds	—	1	—	3
Turpentine [8006-64-2]	100	560	150	840
Uranium (natural) [7440-61-1], Soluble & insoluble compounds, as U	—	0.2	—	0.6
Valeraldehyde [110-62-3]	50	175	—	—

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Footnotes (a thru f) see Page 34.
•1982 Addition
‡See Notices of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
•Vanadium, as V_2O_5 [1314-62-1], respirable dust & fume	—	0.05	—	—
Vegetable oil mists	—	D	—	—
Vinyl acetate [108-05-4]	10	30	20	60
Vinyl benzene, see Styrene				
Vinyl bromide [593-60-2]	5, A2	20, A2	—	—
Vinyl chloride [75-01-4]	5, A1a	10, A1a	—	—
Vinyl cyanide, see Acrylonitrile				
Vinyl cyclohexene dioxide [106-87-6]	10, A2	60, A2	—	—
‡Vinylidene chloride [75-5-4]	(10)	(40)	(20)	(80)
Vinyl toluene [25013-15-4]	50	240	100	485
VM & P Naphtha [8030-30-6]	300	1,350	400	1,800
Warfarin [81-81-2]	—	0.1	—	0.3
Welding fumes (NOC†)	—	5, B2	—	B2
Wood dust (certain hard woods as beech & oak)	—	1	—	—
Soft wood	—	5	—	10
Xylene [1330-20-7] (o-, m-, p-isomers) — Skin	100	435	150	655
m-Xylene α, α'-diamine [1477-55-0]	—	C 0.1	—	—
•Xylidene [1300-73-8] — Skin	2	10	—	—
Yttrium [7440-65-5]	—	1	—	3
Zinc chloride fume [7646-85-7]	—	1	—	2
Zinc chromate [13530-65-9], as Cr	—	0.05, A2	—	—
Zinc oxide [1314-13-2]				
Fume	—	5	—	10
Dust	—	D	—	—
Zinc stearate [557-05-1]	—	D	—	20
Zirconium compounds [7440-67-2], as Zr	—	5	—	10

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Footnotes (a thru f) see Page 34.
•1982 Addition.
‡See Notice of Intended Changes

a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm Hg pressure.
b) Approximate milligrams of substance per cubic meter of air.
d) < 7 μm in diameter.
e) As sampled by method that does not collect vapor.
f) For control of general room air, biologic monitoring is essential for personnel control.

Radioactivity: The Committee accepts the philosophy and recommendations of the National Council on Radiation Protection and Measurements (NCRP) for the ionizing radiation TLV. The NCRP is charted by Congress to, in part, collect, analyze, develop and disseminate information and recommendations about protection against radiation and about radiation measurements, quantities and units, including development of basic concepts in these areas. NCRP Report No. 39 (reference 1) provides basic philosophy and concepts leading to protection criteria established in the same report. Other NCRP reports address specific areas of radiation protection and, collectively, provide an excellent basis for establishing a sound program for radiation control. The Committee recommends the listed references as substantative documentation of a sound basis for ionizing radiation protection. The Committee also strongly recommends that all exposures to ionizing radiations be kept low as reasonably achievable within the stated guidance.

References:

1. *Basic Radiation Protection Criteria.* NCRP Report No. 39, issued January 15, 1971.
2. *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.* US Department of Commerce, National Bureau of Standards Handbook 69, issued June 5, 1959, with Addendum 1 Issued August 1963. Available as NCRP Report No. 22.

The above documents, as well as information on numerous other NCRP Reports addressing specific subjects in ionizing radiation protection are available from: NCRP Publications, PO Box 30175, Washington, DC 20014.

MINERAL DUSTS

Substance	
SILICA, SiO_2	
Crystalline	
Quartz [1480-60-7]	TLV in mppcf[g]: $\frac{300^{h)}}{\%\ \text{quartz} + 10}$ TLV for respirable dust in mg/m³: $\frac{10\ \text{mg/m}^{3\,i)}}{\%\ \text{Respirable quartz} + 2}$ TLV for "total dust," respirable and nonrespirable: $\frac{30\ \text{mg/m}^3}{\%\ \text{quartz} + 3}$
Cristobalite [14464-46-1]	Use one-half the value calculated from the count or mass formulae for quartz.
Tridymite [15468-32-3]	Use one-half the value calculated from formulae for quartz.
Silica, fused [60676-86-0]........	Use quartz formulae.
Tripoli [1317-95-9]	Use respirable[i] mass quartz formula
‡*Amorphous* [7631-86-9].....................	(20 mppcf[g])
SILICATES (< *1*% quartz)	
Asbestos	
Amosite [12172-73-5]	0.5 fiber > 5μm/cc, A1a
Chrysotile [12001-29-5]........	2 fibers > 5μm/cc, A1a
Crocidolite [12001-28-4]........	0.2 fiber > 5μm/cc, A1a
Other forms	2 fibers > 5μm/cc, A1a
Graphite (natural) [7782-42-5]	15 mppcf
Mica [12001-26-2]	20 mppcf
Mineral wool fiber	10 mg/m³
Perlite	30 mppcf
Portland Cement..........	30 mppcf
Soapstone	20 mppcf
‡Talc (nonasbestiform) [14807-96-6]...........	(20 mppcf)
‡Talc (fibrous), (use Asbestos limit.)	

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‡See Notice of Intended Changes.

COAL DUST

2 mg/m^3 (respirable dust fraction < 5% quartz).
If > 5% quartz, use respirable mass formula.

NUISANCE PARTICULATES

(see Appendix D)

30 mppcf or 10 mg/m^3 [j]
of total dust < 1% quartz, or, 5 mg/m^3 respirable dust.

Conversion factors:
mppcf × 35.3 = Million particles per cubic meter
= particles per cc

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g) Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

h) The percentage of quartz in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

i) Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic Diameter (μm) (unit density sphere)	% passing selector
≲ 2	90
2.5	75
3.5	50
5.0	25
10	0

j) containing < 1% quartz; if quartz content > 1%, use formulae for quartz.

k) Lint-free dust as measured by the vertical elutriator, cotton-dust sampler described in the *Transactions of the National Conference on Cotton Dust*, p. 33 by J. R. Lynch, (May 2, 1970).

l) As determined by the membrane filter method at 400–450X magnification (4 mm objective) phase contrast illumination.

m) Based on "high volume" sampling.

n) "Respirable" dust as defined by the British Medical Research Council Criteria,(1) and as sampled by a device producing equivalent results.(2)

(1) Hatch, T. E. and Gross: *Pulmonary Deposition and Retention of Inhaled Aerosols*, p. 149. Academic Press, New York, (1964).

(2) AIHA Aerosol Technology Committee: Interim Guide for Respirable Mass Sampling. *Am. Ind. Hyg. Assoc. J. 31(2)*:133 (1970).

NOTICE OF INTENDED CHANGES

(for 1982)

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least two years. If, after two years no evidence comes to light that questions the appropriateness of the values herein, the values will be reconsidered for the "Adopted" list. Documentation is available for each of these substances.

	TWA		STEL	
Substance [CAS #]	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
†Acrylonitrile [107-13-1] — Skin	2, A2	4.5, A2	—	—
Atrazine [1912-24-9]	—	5	—	—
Cadmium oxide production	—	0.05	—	—
o-Chlorobenzylidene malononitrile [2698-41-1]	C 0.05	C 0.4	—	—
Chloromethyl methyl ether [107-30-2]	A2	A2	—	—
Cobalt carbonyl, as Co	—	0.1	—	—
Cobalt hydrocarbonyl [16842-03-8], as Co	—	0.1	—	—
Cobalt metal, dust & fume [7440-48-4], as Co	—	0.05	—	0.1
Enflurane [13838-16-9]	75	575	—	—
†2-Ethoxyethanol [110-80-5] — Skin	5	19	—	—
†2-Ethoxyethyl acetate [111-15-9] — Skin	5	27	—	—
†Ethylene glycol [107-21-1], particulate DELETE, see Appendix G				
Ethylene glycol dinitrate (EGDN) [628-96-6] — Skin	0.05	0.3	0.1	0.6

Capital letters A, B, D & F refer to Appendices, C denotes ceiling limit.
†1982 Revision or Addition.

Substance [CAS #]	TWA ppm$^{a)}$	TWA mg/m$^{3\,b)}$	STEL ppm$^{a)}$	STEL mg/m$^{3\,b)}$
†Ethylene oxide [75-21-8]	1, A2	2, A2	—	—
†Fenamiphos [22224-92-6] — Skin	—	0.1	—	—
Fenthion [55-38-9]	—	0.2	—	—
†Formaldehyde [50-00-0]	C 1, A2	C 1.5, A2	—	—
†Grain dust	—	4	—	—
Halothane [151-67-7]	50	400	—	—
Lead arsenate [10102-48-4], as $Pb_3(AsO_4)_2$	—	0.15	—	0.45
†2-Methoxyethanol [109-86-4] — Skin	5	16	—	—
†2-Methoxyethyl acetate [110-49-6] — Skin	5	24	—	—
†Metribuzin [21087-64-9]	—	5	—	—
p-Nitrochlorobenzene [100-00-5] — Skin	0.5	3	—	—
Nitroglycerin (NG) [55-63-0] — Skin	0.05	0.5	0.1	1
2-Nitropropane [79-46-9]	10, A2	35, A2	20, A2	70, A2
†Perchloroethylene [127-18-4] — Skin	50	335	200	1,340
Persulfates, alkali metal, as S_2O_8	—	2	—	—
Phenylhydrazine [100-63-0] — Skin	5, A2	20, A2	10, A2	45, A2
Propylene glycol dinitrate (PGDN) [6423-43-4] — Skin	0.05	0.3	0.1	0.6
Propylene imine [75-55-8] — Skin	2, A2	5, A2	—	—
†Rhodium, Insoluble compounds, as Rh	—	1	—	—
Soluble compounds, as Rh	—	0.01	—	—
Silicon tetrahydride (Silane) [7803-62-5]	5	7	—	—
†Sulprofos [35400-43-2]	—	1	—	—
Toluene-2, 4-diisocyanate (TDI) [584-84-9]	0.005	0.04	0.02	0.15
†o-Toluidine [95-53-4] — Skin	2, A2	9, A2	—	—
†Trichloroethylene [79-01-6]	50	270	200	1,080
Triethylamine [121-44-8]	10	40	15	60
Trimethylamine [75-50-3]	10	40	15	60
†Vinylidine chloride [75-35-4]	5	20	20	80

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
†1982 Revision or Addition.

NOTICE OF INTENDED CHANGES MINERAL DUSTS

Substance	TLV
Diatomaceous earth, natural [60676-86-0]	1.5 mg/m³, Respirable dust
Silica, amorphous [7631-86-9]	6 mg/m³, Total dust (all sampled sizes) 3 mg/m³, Respirable dust (< 5 μm)
Talc (containing no fibers) [14807-96-6]	15 mppcf or 2 mg/m³, Respirable dust
Talc (fiber-containing)	2 fibers/cc, > 5 μm in length

APPENDIX A
Carcinogens

The Committee lists below those substances in industrial use that have proven carcinogenic in man, or have induced cancer in animals under appropriate experimental conditions. Present listing of those substances carcinogenic for man takes two forms: Those for which a TLV has been assigned (1a) and those for which environmental conditions have not been sufficiently defined to assign a TLV (1b).

A1a. *Human Carcinogens*. Substances, or substances associated with industrial processes, recognized to have carcinogenic or cocarcinogenic potential, with an assigned TLV:

	TLV
**Acrylonitrile — Skin	2 ppm
Asbestos	
Amosite	0.5 fiber > 5μm/cc
Chrysotile	2 fibers > 5μm/cc
Crocidolite	0.2 fiber > 5μm/cc
Other forms	2 fibers > 5μm/cc
bis (Chloromethyl) ether	0.001 ppm
Chromite ore processing (chromate)	0.05 mg/m³, as Cr
Chromium (VI), certain water insoluble compounds	0.05 mg/m³, as Cr

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**See Notice of Intended Changes.

Coal tar pitch volatiles ..	0.2 mg/m^3, as benzene solubles
Nickel sulfide roasting, fume & dust...........	1.0 mg/m^3, as Ni
Vinyl chloride	5 ppm

• • •

A1b. *Human Carcinogens*. Substances, or substances associated with industrial processes, recognized to have carcinogenic potential without an assigned TLV:

4-Aminodiphenyl (p-Xenylamine) — Skin
‡ Benzidine — Skin
** Chloromethyl methyl ether
β-Naphthylamine
4-Nitrodiphenyl

For the substances in 1b no exposure or contact by any route — respiratory, skin or oral, as detected by the most sensitive methods — shall be permitted. The worker should be properly equipped to insure virtually no contact with the carcinogen.

A2. *Industrial Substances Suspect of Carcinogenic Potential for MAN*. Chemical substances or substances associated with industrial processes, which are suspect of inducing cancer, based on either (1) limited epidemiologic evidence, exclusive of clinical reports of single cases, or (2) demonstration of carcinogenesis in one or more animal species by appropriate methods.

† Acrylonitrile — Skin	2 ppm
Amitrol	——
Antimony trioxide production*	——
Arsenic trioxide production	——
Benzene	10 ppm
Benzo(a)pyrene	——
Beryllium	2.0 $\mu g/m^3$
Cadmium oxide production	——
Carbon tetrachloride — Skin	5 ppm
Chloroform	10 ppm
Chloromethyl methyl ether	——

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*Cigarette smoking can enhance the incidence of respiratory cancers from this or others of these substances or processes.

†1982 Addition.

‡1982 Adoption.

**See Notice of Intended Changes.

Chromates of lead and zinc, as Cr	0.05 mg/m^3
Chrysene	——
3, 3'-Dichlorobenzidine — Skin	——
Dimethylcarbamyl chloride	——
1, 1-Dimethyl hydrazine — Skin	0.5 ppm
Dimethyl sulfate — Skin	0.1 ppm
‡ Ethylene dibromide — Skin	——
Ethylene oxide	1 ppm
† Formaldehyde	C 1 ppm
‡ Hexachlorobutadiene	0.02 ppm
Hexamethyl phosphoramide — Skin	——
Hydrazine — Skin	0.1 ppm
4, 4'-Methylene bis (2-chloroaniline) — Skin	0.02 ppm
Methyl hydrazine — Skin	C 0.2 ppm
Methyl iodide — Skin	2 ppm
2-Nitropropane	10 ppm
N-Nitrosodimethylamine — Skin	——
N-Phenyl-beta-naphthylamine	——
Phenylhydrazine — Skin	5 ppm
Propane sultone	——
beta-Propiolactone	0.5 ppm
Propylene imine — Skin	2 ppm
‡ o-Tolidine	——
† o-Toluidine — Skin	2 ppm
Vinyl bromide	5 ppm
Vinyl cyclohexene dioxide	10 ppm

For the above, worker exposure by all routes should be carefully controlled to levels consistent with the animal and human experience data (see Documentation), including those substances with a listed TLV.

THE COMMITTEE GUIDELINES FOR CLASSIFICATION OF EXPERIMENTAL ANIMAL CARCINOGENS

The following guidelines are offered in the present state of knowledge as an aid in classifying substances in the occupational environment found to be carcinogenic in experimental animals. A need was felt by the Threshold Limits Committee for such a classification in order to

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†1982 Addition.

‡1982 Adoption.

take the first step in developing an appropriate TLV for occupational exposure.

Determination of Approximate Threshold of Response Requirement. In order to determine in which category to classify an experimental carcinogen for the purpose of assigning an industrial air limit (TLV), an approximate threshold of neoplastic response must be determined. Because of practical experimental difficulties, a precisely defined threshold cannot be attained. For the purposes of standard-setting, this is of little moment, as an appropriate risk, or safety, factor can be applied to the approximate threshold, the magnitude of which is dependent on the degree of potency of the carcinogenic response.

To obtain the best 'practical' threshold of neoplastic response, dosage decrements should be less than logarithmic. This becomes particularly important at levels greater than 10 ppm (or corresponding mg/m^3). Accordingly, after a range-finding determination has been made by logarithmic decreases, two additional dosage levels are required within the levels of "effect" and "no effect" to approximate the true threshold of neoplastic response.

The second step should attempt to establish a metabolic relationship between animal and man for the particular substance found carcinogenic in animals. If the metabolic pathways are found comparable, the substance should be classed highly suspect as a carcinogen for man. If no such relation is found, the substance should remain listed as an experimental animal carcinogen until evidence to the contrary is found.

Proposed Classification of Experimental Animal Carcinogens. Substances occurring in the occupational environment found carcinogenic for animals may be grouped into three classes, those of high, intermediate and low potency. In evaluating the incidence of animal cancers, significant incidence of cancer is defined as a neoplastic response which represents, in the judgment of the Committee, a significant excess of cancers above that occurring in negative controls.

EXCEPTIONS: No substance is to be considered an occupational carcinogen of any practical significance which reacts by the respiratory route at or above 1000 mg/m^3 for the mouse, 2000 mg/m^3 for the rat; by the dermal route, at or above 1500 mg/kg for the mouse, 3000 mg/kg for the rat; by the gastrointestinal route at or above 500 mg/kg/d for a lifetime, equivalent to about 100 g T.D. for the rat, 10 g T.D. for the mouse.

These dosage limitations exclude such substances as dioxane and trichlorethylene from consideration as carcinogens.

Examples: Dioxane — rats, hepatocellular and nasal tumors from 1015 mg/kg/d, oral
Trichloroethylene — female mice, tumors (30/98 @ 900 mg/kg/d), oral

Industrial Substances of High Carcinogenic Potency in Experimental Animals.

1. A substance to qualify as a carcinogen of high potency must fulfill one of the three following conditions in two animal species:

   1a. *Respiratory.* Elicit cancer from (1) dosages below 1 mg/m^3 (or equivalent ppm) via the respiratory tract in 6-7-hour daily repeated inhalation exposures throughout lifetime; or (2) from a single intratracheally administered dose not exceeding 1 mg of particulate, or liquid, per 100 ml or less of animal minute respiratory volume;

   Examples: bis-Chloromethyl ether, malignant tumors, rats, @ 0.47 mg/m^3 (0.1 ppm) in 2 years;
   Hexamethyl phosphoramide, nasal squamous cell carcinoma, rats, @ 0.05 ppm, in 13 months

   OR

   1b. *Dermal.* Elicit cancer within 20 weeks by skin-painting, twice weekly at 2 mg/kg body weight or less per application for a total dose equal to or less than 1.5 mg, in a biologically inert vehicle;

Examples: 7, 12-Dimethylbenz(a)anthracene — skin tumors @ 0.12-0.8 mg T.D. in four weeks

Benzo(a)pyrene, mice 12 μg, 3X/wk for 18 mos. T.D. 2.6 mg, 90.9% skin tumors

OR

1c. *Gastrointestinal*. Elicit cancer by daily intake via the gastrointestinal tract, within six months, with a six-month holding period, at a dosage below 1 mg/kg body weight per day; total dose, rat, ≦ 50 mg; mouse, ≦ 3.5 mg;

Examples: 7, 12-Dimethylbenz(a)anthracene — mammary tumors from 10 mg 1X

3-Methylcholanthrene — Tumors @ 3 sites from 8 mg in 89 weeks

Benzo(a)pyrene, mice, 3.9% leukemias, from 30 mg T.D. 198 days

2. Elicit cancer by all three routes in at least two animal species at dose levels prescribed for high or intermediate potency.

Industrial Substances of Intermediate Carcinogenic Potency in Experimental Animals.

To qualify as a carcinogen of intermediate potency, a substance should elicit cancer in two animal species at dosages intermediate between those described in A3a and A3c by two routes of administration.

Example: Carbamic acid ethyl ester
Dermal, mammary tumors, mice, 100%, 63 weeks, 500–1400 mg T.D.
Gastrointestinal, various type tumors, mice 42 weeks, 320 mg T.D.

Gastrointestinal, various type tumors, rats, 60 weeks, 110–930 mg T.D.

Industrial Substances of Low Carcinogenic Potency in Experimental Animals.

To qualify as a carcinogen of low potency, a substance should elicit cancer in one animal species by any *one* of three routes of administration at the following prescribed dosages and conditions:

1a. *Respiratory*. Elicit cancer from (1) dosages greater than 10 mg/m^3 (or equivalent ppm) via the respiratory tract in 6- 7-hour, daily repeated inhalation exposures, for 12 months' exposure and 12 months' observation period; or (2) from intratracheally administered dosages totaling more than 10 mg of particulate or liquid per 100 ml or more of animal minute respiratory volume;

Examples: Beryl (beryllium aluminum silicate) malig. lung tumors, rats, @ 15 mg/m^3 @ 17 months

Benzidine, var. tumors, rats, 10–20 mg/m^3 @ > 13 mos.

OR

1b. *Dermal*. Elicit cancer by skin-painting of mice in twice weekly dosages of > 10 mg/kg body weight in a biologically inert vehicle for at least 75 weeks, i.e., ≧ 1.5g T.D.

Examples: Shale tar, mouse, 0.1 ml × 50 = 5g T.D. 59/60 skin tumors

Arsenic trioxide, man, dose unknown, but estimated to be high

1c. *Gastrointestinal*. Elicit cancer from daily oral dosages of 50 mg/kg/day or greater during the lifetime of the animal.

APPENDIX B
SUBSTANCES OF VARIABLE COMPOSITION

B1 *Polytetrafluoroethylene* decomposition products*. Thermal decomposition of the fluorocarbon chain in air leads to the formation of oxidized products containing carbon, fluorine and oxygen. Because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluoride to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimal.

B2 *Welding Fumes — Total Particulate (NOC)†*
TLV, 5 mg/m^3

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*Trade Names: Algoflon, Fluon, Halon, Teflon, Tetran.
†Not otherwise classified (NOC).

Welding fumes cannot be classified simply. The composition and quantity of both are dependent on the alloy being welded and the process and electrodes used. Reliable analysis of fumes cannot be made without considering the nature of the welding process and system being examined; reactive metals and alloys such as aluminum and titanium are arc-welded in a protective, inert atmosphere such as argon. These arcs create relatively little fume, but an intense radiation which can produce ozone. Similar processes are used to arc-weld steels, also creating a relatively low level of fumes. Ferrous alloys also are arc-welded in oxidizing environments which generate considerable fume, and can produce carbon monoxide instead of ozone. Such fumes generally are composed of discreet particles of amorphous slags containing iron, manganese, silicon and other metallic constituents depending on the alloy system involved. Chromium and nickel compounds are found in fumes when stainless steels are arc-welded. Some coated and flux-cored electrodes are formulated with fluorides and the fumes associated with them can contain significantly more fluorides than oxides. Because of the above factors, arc-welding fumes frequently must be tested for individual constituents which are likely to be present to determine whether specific TLV's are exceeded. Conclusions based on total fume concentration are generally adequate if no toxic elements are present in welding rod, metal, or metal coating and conditions are not conducive to the formation of toxic gases.

Most welding, even with primitive ventilation, does not produce exposures inside the welding helmet above 5 mg/m³. That which does, should be controlled.

APPENDIX C
MIXTURES

C.1 THRESHOLD LIMIT VALUES FOR MIXTURES

When two or more hazardous substances, which act upon the same organ system, are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1}+\frac{C_2}{T_2}+\ldots\frac{C_n}{T_n}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit (See Example 1A.a. and 1A.c.).

Exceptions to the above rule may be made when there is a good reason to believe that the chief effects of the different harmful substances are not in fact additive, but *independent* as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit ordinarily is exceeded only when at least one member of the series $\left(\frac{C_1}{T_1} + \text{ or } + \frac{C_2}{T_2} \text{ etc.}\right)$ itself has a value exceeding unity (See Example 1A.c.).

Synergistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or synergistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristically emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc.

C.1A Examples of THRESHOLD LIMIT VALUES FOR MIXTURES

The following formulae apply only when the components in a mixture have similar toxicologic effects; they should not be used for mixtures with widely differing reactivities, e.g. hydrogen cyanide & sulfur dioxide. In such case the formula for Independent Effects (1A.c.) should be used.

1A.a. General case, where air is analyzed for each component:

a. *Additive effects. (Note: It is essential that the atmosphere be analyzed both qualitatively and quantitatively for each component present, in order to evaluate compliance or noncompliance with this calculated TLV.)*

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots = 1$$

Example No. 1A.a.: Air contains 400 ppm of acetone (TLV = 1000 ppm) 150 ppm of sec-butyl acetate (TLV = 200 ppm) and 100 ppm of 2-butanone (TLV = 200 ppm)

Atmospheric concentration of mixture = 400 + 150 + 100 = 650 ppm of mixture

$$\frac{400}{1000} + \frac{150}{200} + \frac{100}{200} = 0.4 + 0.75 + 0.5 = 1.65$$

Threshold Limit is exceeded.

1A.b. Special case when the source of contaminant is a liquid mixture and the atmospheric composition is *assumed* to be similar to that of the original material; e.g. on a time-weighted average exposure basis, all of the liquid (solvent) mixture eventually evaporates.

Additive effects (approximate solution)

1. The percent composition (by weight) of the liquid mixture is known, the TLVs of the constituents must be listed in mg/m³.

(Note: In order to evaluate compliance with this TLV, field sampling instruments should be calibrated, in the laboratory, for response to this specific quantitative and qualitative air vapor mixture, and also to fractional concentrations of this mixture; e.g., 1/2 the TLV; 1/10 the TLV; 2 × the TLV; 10 × the TLV; etc.)

TLV of mixture =

$$\frac{1}{\frac{f_a}{TLV_a} + \frac{f_b}{TLV_b} + \frac{f_c}{TLV_c} + \ldots \frac{f_n}{TLV_n}}$$

Example No. 1: Liquid contains (by weight)

50% heptane: TLV = 400 ppm or 1600 mg/m³
1 mg/m³ ≈ 0.25 ppm

30% methyl chloroform: TLV = 350 ppm or 1900 mg/m³
1 mg/m³ ≈ 0.18 ppm

20% perchloroethylene: TLV = 100 ppm or 670 mg/m³
1 mg/m³ ≈ 0.15 ppm

$$\text{TLV of Mixture} = \frac{1}{\frac{0.5}{1600} + \frac{0.3}{1900} + \frac{0.2}{670}}$$

$$= \frac{1}{0.00031 + 0.00016 + 0.00030}$$

$$= \frac{1}{0.00077} = 1300 \text{ mg/m}^3$$

of this mixture

50% or (1300) (0.5) = 650 mg/m³ is heptane

30% or (1300) (0.3) = 390 mg/m³ is methyl chloroform

20% or (1300) (0.2) = 260 mg/m³ is perchloroethylene

These values can be converted to ppm as follows:

heptane: 650 mg/m³ × 0.25 = 162 ppm
methyl chloroform: 390 mg/m³ × 0.18 = 70 ppm
perchloroethylene: 260 mg/m³ × 0.15 = 39 ppm

TLV of mixture = 162 + 70 + 39 = 271 ppm, or 1300 mg/m³

1A.c. *Independent effects.*

Air contains 0.15 mg/m³ of lead (TLV, 0.15) and 0.7 mg/m³ of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.15} = 1; \qquad \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

1B. TLV for Mixtures of Mineral Dusts.

For mixtures of biologically active mineral dusts the general formula for mixtures may be used.

For mixture containing 80% nonasbestiform talc and 20% quartz, the TLV for 100% of the mixture is given by:

$$\text{TLV} = \frac{1}{\frac{0.8}{20} + \frac{0.2}{2.7}} = 9 \text{ mppcf}$$

TLV of nonasbestiform talc (pure) = 20 mppcf
TLV of quartz (pure) =

$$\frac{300}{100 + 10} = \frac{300}{110} = 2.7 \text{ mppcf}$$

Essentially the same result will be obtained if the limit of the more (most) toxic component is used provided the effects are additive. In the above example the limit for 20% quartz is 10 mppcf.

For another mixture of 25% quartz, 25% amorphous silica and 50% talc:

25% quartz — TLV (pure) = 2.7 mppcf
25% amorphous silica — TLV (pure) = 20 mppcf
50% talc TLV (pure) = 20 mppcf

$$\text{TLV} = \frac{1}{\frac{0.25}{2.7} + \frac{0.25}{20} + \frac{0.5}{20}} = 8 \text{ mppcf}$$

The limit for 25% quartz approximates 9 mppcf.

APPENDIX D

Some Nuisance Particulates(o)

TLV, 30 mppcf or 10 mg/m³ of total
dust < 1% quartz, or, 5 mg/m³
respirable dust

α-Alumina (Al_2O_3)
Calcium carbonate
Calcium silicate
Cellulose (paper fiber)
Emery
Glycerin Mist
Graphite (synthetic)
Gypsum
Kaolin
Limestone
Magnesite
Marble
Mineral Wool Fiber
Pentaerythritol
Plaster of Paris
Portland Cement
Rouge
Silicon
Silicon Carbide
Starch
Sucrose
Titanium Dioxide
Vegetable oil mists
  (except castor, cashew nut, or similar irritant oils)
Zinc Stearate
Zinc oxide dust

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o) When toxic impurities are not present, e.g. quartz < 1%.

APPENDIX E

Some Simple Asphyxiants(p)

Acetylene
Argon
Ethane
Ethylene
Helium
Hydrogen
Methane
Neon
Propane
Propylene

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p) As defined on pg. 6.

APPENDIX F

Conversion of mppcf to Mass Concentration

Calculations for Conversion of Particle Count Concentration (by Standard Light Field — Midget Impinger Techniques), in mppcf, to Respirable Mass Concentration (by Respirable Sampler) in mg/m³.(q)

1. In 1967, Jacobsen and Tomb,(q) derived an empirical relationship of 5.6 mppcf to 1 milligram of respirable dust per cubic meter of air, based on 23 sets of samples, mostly coal dust. Studies on conversion factors have been undertaken and preliminary evidence suggests that the application of any single conversion factor may not be adequate for use in risk assessments, epidemiology studies, or setting TLVs.

   The following calculation results in an equivalence of 6.37 mppcf to 1 mg/m³ of respirable dust. Thus, an approximate ratio of 6 mppcf to 1 mg/m³ of respirable dust is suggested for conversion of TLVs from a count to a mass basis when the density and mass median diameter have not been determined.

2. Basic assumptions:

   a) Average density for silica containing dusts ≈ 2.5 g/cm³ (2500 mg/cm³). Pulmonary significant dust densities may vary from 1.2 g/cm³ for coal dust to 3.1 g/cm³ for Portland Cement. Silica densities vary from 2.2 (amorphous) to 2.3 (cristobalite and tridymite) to 2.5 (alpha-quartz.) gms per cm³.

   b) The mass median diameter (mmd) of particles collected in midget impinger samplers and counted by the standard light field technique, *and* collected in a respirable sampler is approximately 1.5 μm or 1.5 × 10^{-4} cm. This assumption is, of course, quite arbitrary since the mmd of all dust clouds is quite variable, depending on many independent parameters, such as source of dust, age of dust cloud, meteorological conditions, processes and equipment changes, etc. If the density and the mass median diameter of the dust particles are known, the nomograph in Figure 1 can be used to convert dust count concentrations (mppcf) to respirable mass concentrations (mg/m^3).

3. Calculation:

   a) vol. per particle: $4/3\ \pi r^3$; $r = 0.75 \times 10^{-4}$ cm
   $= 4/3 \cdot \pi \cdot (0.75 \times 10^{-4})^3$
   $= 1.77 \times 10^{-12}$ cm^3

   b) wt. per particle = vol. × density
   $= 1.77 \times 10^{-12}$ cm^3 $\times 2.5 \times 10^3$ mg/cm^3
   $= 4.425 \times 10^{-9}$ mg/particle

   c) 1 particle/ft.^{3} = 35.5 part./m^3
   (since 35.5 cu ft = 1 cu m.)
   10^6 part./ft^3 = mppcf = 35.5×10^6 part./m^3

   wt. of 1 mppcf ≡ 35.5×10^6 part./m^3 $\times$ 4.425×10^{-9} mg/part.

   1 mppcf ≡ 0.157 mg/m^3
   or
   6.37 mppcf ≡ 1 mg/m^3
   or approximately 6 mpccf ≡ 1 mg/m^3.

Reference

1. **Jacobson, M. and T. F. Tomb:** Relationship Between Gravimetric Respirable Dust Concentration and Midget Impinger Number Concentration. *Am. Ind. Hyg. Assoc. J. 28:*554 (Nov.–Dec. 1967).

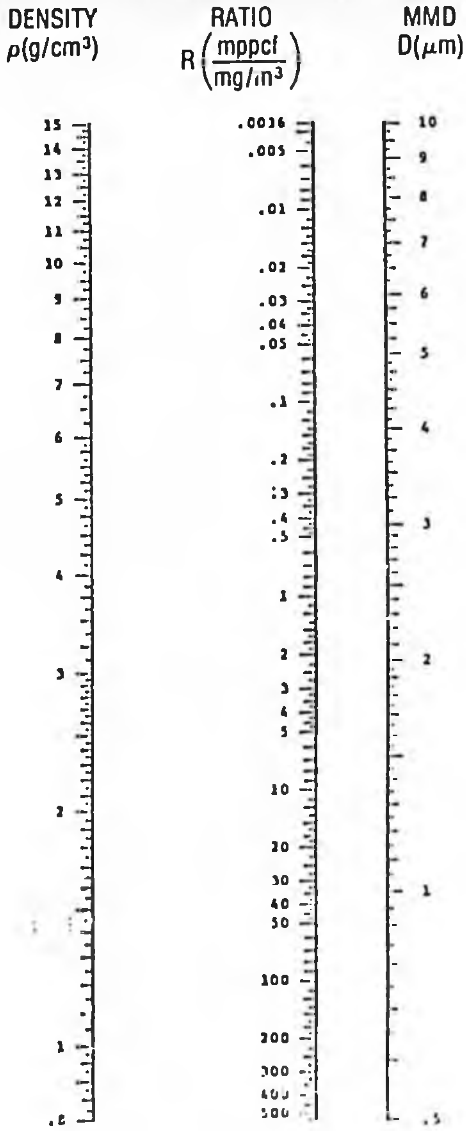

Figure 1 — Ratio of Particle Count — mppcf to Respirable Mass Concentration — mg/m^3 (as function of density and mmd)†

†Prepared by P. E. Caplan and R. J. Smith

Table 1

Equivalent TLVs in mppcf and mg/m³ (Respirable Mass) for Mineral Dusts†

Substance	Threshold Limit Value		
	Count mppcf	Resp. Mass mg/m³	Total Mass* mg/m³
Silica (SiO_2)			
Amorphous	20	(3)**	(6)
Cristobalite	1.5	0.05	0.15
Fused silica	3	0.1	0.3
Quartz	3	0.1	0.3
Tridymite	1.5	0.05	0.15
Coal Dust	(12)	2	(4)
Diatomaceous earth, natural	—	1.5	—
Graphite (natural)	15	(2.5)	(5)
Mica	20	(3)	(6)
Mineral wool fiber	—	(5)	10
Nuisance particulates	30	(5)	10
Perlite	30	(5)	(10)
Portland Cement	30	(5)	(10)
Soapstone	20	(3)	(6)
Tripoli	(3)	0.1	(0.3)

†Assuming that the mass median diameter is 1.5μm and density is 2.5 g/cm³.

*Unless otherwise specified, respirable mass is presumed to equal approximately 50% of total mass.

**All values in parentheses ( ) represent newly calculated values based on equivalence of 6 mppcf = 1 mg/m³ respirable mass and respirable mass = 50% total mass.

APPENDIX G

Chemical Substances and Other Issues Under Study[1]

Chemical Substances

Acetonitrile
Acetophenone
Acetyl acetone
Allyl chloride
Aluminum oxide
Asbestos
Bismuth telluride
Carbonyl fluoride
Cellulose
Chlorinated camphene (60%)
Chlorinated naphthalenes
Chlorine
bis-Chloromethyl ether
Copper dust & fume
Diatomaceous earth

Diethylenetriamine
Emery
Epichlorohydrin
Ethyl chloride
Ethylene dichloride
Graphite
Hexafluoroacetone
Isocyantes
Jet fuel
Methylenedianiline
Methyl methacrylate
Methyl tertiary butyl ether
Nickel, metal & soluble compounds
Nitrous oxide
Osmium tetroxide
"Other"glycol ethers
Piperizine
Propylene chloride
Propylene oxide
Silica, all forms
Silicon carbide
Silicon tetrahydride (Silane)
Styrene, monomer
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Tetrachloronaphthalene
Tin hydride
1,2,3-Trichloropropane
Trimellitic anhydride
m-Xylene 2,2'-diamine (MXDA, meta-meta-xylenediamine)

Other Issues

Dual vapor and particulate TLVs.[2]

Role of Biological Exposure Indices relative to air-borne contaminant TLV's.[2]

Role of STELs and Excursion limits.[2] STELs will be used for specific health effects and Excursion limits will be used for substances without a specific STEL.

Should mppcf values be retained (Appendix F)?

Should welding fume value (not otherwise classified, NOC) be retained or should specific analytical determinations be made for metals and other compounds and these values be compared to specific TLVs?

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[1] Information, data especially, and comments are solicited to assist the committee in its deliberations and in the development of draft documents. Draft documentations are used by the committee to decide what action, if any to recommend on a given substance or question.

[2] Study papers appear in the *Annals of the American Conference of Governmental Industrial Hygienists*, Volume 4, *Transactions of the 1982 Meeting* (available late 1982).

APPENDIX H
Registered® Trade Names

Trade Name	Generic Name
Abate	Temephos
Ammate	Ammonium sulfamate
Azodrin	Monocrotophos
Baygon	Propoxur
Baytex	Fenthion
Bidrin	Dicrotophos
Bolstar	Sulprofos
Butyl Cellosolve	2-Butoxyethanol
Cellosolve acetate	2-Ethoxyethyl acetate
Coyden	Clopidol
Crag herbicide	Sesone
Dasanit	Fensulfothion
Delnav	Dioxathion
Dibrom	Naled
Difolatan	Captafol
Disyston	Disulfoton
Dursban	Chlorpyrifos
Dyfonate	Fonofos
Furadan	Carbofuran
Guthion	Azinphos-methyl
Lannate	Methomyl
Methyl Cellosolve	2-Methoxyethanol
Methyl Cellosolve acetate	2-Methoxyethyl acetate
Nemacur	Fenamiphos
Nialate	Ethion
N-Serve	Nitrapyrin
Pival	Pindone
Plictran	Cyhexatin
Sencor	Metribuzin
Sevin	Carbaryl
Teflon	Polytetrafluoroethylene
Thimet	Phorate
Thiodan	Endosulfan
Tordon	Picloram
Zoalene	Dinitolmide

TLVs®
Threshold Limit Values
for
Physical Agents
Adopted by
ACGIH
for 1982

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PREFACE

PHYSICAL AGENTS

These threshold limit values refer to levels of physical agents and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variations in individual susceptibility, exposure of an occasional individual at, or even below, the threshold limit may not prevent annoyance, aggravation of a pre-existing condition, or physiological damage.

These threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and when possible, from a combination of the three.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) in the evaluation or control of the levels of physical agents in the community, (2) as proof or disproof of an existing physical disability, or (3) for adoption by countries whose working conditions differ from those in the United States of America.

These values are reviewed annually by the Committee on Threshold Limits for Physical Agents for revisions or additions, as further information becomes available.

Notice of Intent — At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intent." This notice provides not only an opportunity for comment, but solicits suggestions of physical agents to be added to the list. The suggestions should be accompanied by substantiating evidence.

As Legislative Code — The Conference recognizes that the Threshold Limit Values may be adopted in legislative codes and regulations. If so used, the intent of the concepts contained in the Preface should be maintained and provisions should be made to keep the list current.

THRESHOLD LIMIT VALUES

HEAT STRESS

These Threshold Limit Values refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table 1 are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C.(1, 2)

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

1. Outdoors with solar load:
   WBGT = 0.7 NWB + 0.2 GT + 0.1 DB
2. Indoors or Outdoors with no solar load:
   WBGT = 0.7 NWB + 0.3 GT

where:

WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.

Higher heat exposures than shown in Table 1 are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant to work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38.0°C.

EVALUATION AND CONTROL

I. *Measurement of the Environment*

The instruments required are a dry-bulb, a natural wet-bulb, a globe thermometer, and a stand. The measurement of the environmental factors shall be performed as follows:

A. The range of the dry and the natural wet bulb thermometer shall be −5°C to 50°C with an accuracy of ±0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet-bulb thermometer shall be kept wet with distilled water for at least 1/2 hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick shall be wetted by direct application of water from a syringe 1/2 hour before each reading. The wick shall extend over the bulb of the thermometer, covering the stem about one additional bulb length. The wick should always be clean and new wicks should be washed before using.

B. A globe thermometer, consisting of a 15 cm. (6-inch) diameter hollow copper sphere painted on the outside with a matte black finish or equivalent, shall be used. The bulb or sensor of a thermometer (range −5°C to 100°C with an accuracy of ±0.5°C) must be fixed in the center of the sphere. The globe thermometer shall be exposed at least 25 minutes before it is read.

TABLE 1

Permissible Heat Exposure Threshold Limit Values
(Values are given in °C. WBGT)

	Work Load		
Work — Rest Regimen	Light	Moderate	Heavy
Continuous work	30.0	26.7	25.0
75% Work — 25% Rest, Each hour	30.6	28.0	25.9
50% Work — 50% Rest, Each hour	31.4	29.4	27.9
25% Work — 75% Rest, Each hour	32.2	31.1	30.0

C. A stand shall be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs, and the wet-bulb and globe thermometer are not shaded.

D. It is permissible to use any other type of temperature sensor that gives identical reading as that of a mercury thermometer under the same conditions.

E. The thermometers must be so placed that the readings are representative of the condition where the men work or rest, respectively.

The methodology outlined above is more fully explained by Minard.(3-4)

TABLE 2

Assessment of Work Load(9)

Average values of metabolic rate during different activities.

A. Body position and movement	kcal/min
Sitting	0.3
Standing	0.6
Walking	2.0–3.0
Walking up hill	add 0.8 per meter (yard) rise

B. Type of Work		Average kcal/min	Range kcal/min
Hand work			
	light	0.4	0.2–1.2
	heavy	0.9	
Work with one arm			
	light	1.0	0.7–2.5
	heavy	1.8	
Work with both arms			
	light	1.5	1.0–3.5
	heavy	2.5	
Work with body			
	light	3.5	2.5–15.0
	moderate	5.0	
	heavy	7.0	
	very heavy	9.0	

TABLE 3

Activity Examples(9)

Light hand work: writing, hand knitting

Heavy hand work: typewriting

Heavy work with one arm: hammering in nails (shoemaker, upholsterer)

Light work with two arms: filing metal, planing wood, raking of a garden

Moderate work with the body: cleaning a floor, beating a carpet

Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation

Assembly line work using a heavy hand tool.

A. Walking along	2.0 kcal/min
B. Intermediate value between heavy work with two arms and light work with the body	3.0 kcal/min
	5.0 kcal/min
C. Add for basal metabolism	1.0 kcal/min
Total	6.0 kcal/min

II. *Work Load Categories*

Heat produced by the body and the environmental heat together determine the total heat load. Therefore, if work is to be performed under hot environmental conditions, the workload category of each job shall be established and the heat exposure limit pertinent to the work load evaluated against the applicable standard in order to protect the worker from exposure beyond the permissible limit.

A. The work load category may be established by ranking each job into light, medium, and heavy categories on the basis of type of operation. Where the work load is ranked into one of said three categories, i.e.

(1) light work (up to 200 kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work,

(2) moderate work (200–350 kcal/hr or 800–1400 Btu/hr): e.g., walking about with moderate lifting and pushing,

(3) heavy work (350–500 kcal/hr or 1400–2000 Btu/hr): e.g., pick and shovel work,

the permissible heat exposure limit for that work load shall be determined from Table 1.

B. The ranking of the job may be performed either by measuring the worker's metabolic rate while performing his job or by estimating his metabolic rate with the use of Tables 2 and 3. Additional tables available in the literature(5-8) may be utilized also. When this method is used the permissible heat exposure limit can be determined by Figure 1.

III. *Work-Rest Regimen*

The permissible exposure limits specified in Table 1 and Figure 1 are based on the assumption that the WBGT value of the resting place is the same or very close to that of the work place. Where the WBGT of the work area is different from that of the rest area a time-weighted average value should be used for both environmental and metabolic heat. When time-weighted average values are used the appropriate curve on Figure 1 is the solid line labeled "continuous."

The time-weighted average metabolic rate (M) shall be determined by the equation:

$$\text{Av. M} = \frac{(M_1) \times (t_1) + (M_2) \times (t_2) + \ldots. + (M_n) \times (t_n)}{(t_1) + (t_2) + \ldots. + (t_n)}$$

Where M_1 M_2, M_n are estimated or measured metabolic rates for the various activities of the worker during the total time period. t_1, t_2, t_n are the elapsed times in minutes spent at the corresponding metabolic rate as determined by a time study.

The time-weighted average WBGT shall be determined by the equation:

$$\text{Av. WBGT} = \frac{(\text{WBGT}_1) \times (t_1) + (\text{WBGT}_2) \times t_2 + \ldots + (\text{WBGT}_n) \times (t_n)}{(t_1) + (t_2) + \ldots + (t_n)}$$

where WBGT_1, WBGT_2, WBGT_n are calculated values of WBGT for the various work and rest areas occupied during total time periods. t_1, t_2, t_n are the elapsed times in minutes spent in the corresponding areas which are determined by a time study. Where exposure to hot environmental conditions is continuous for several hours or the entire work day, the time-weighted averages shall be calculated as hourly time-weighted average i.e., $t_1 + t_2 + \ldots + t_n = 60$ minutes. Where the exposure is intermittent, the time-weighted averages shall be calculated as two-hour time-weighted averages, i.e., $t_1 + t_2 + \ldots + t_n = 120$ minutes.

The permissible exposure limits for continuous work are applicable where there is a work-rest regimen of a 5-day work week and an 8-hour work day with a short morning and afternoon break (approximately 15 minutes) and a longer lunch break (approximately 30 minutes). Higher exposure limits are permitted if additional resting time is allowed. All breaks, including unscheduled pauses and administrative or operational waiting periods during work may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

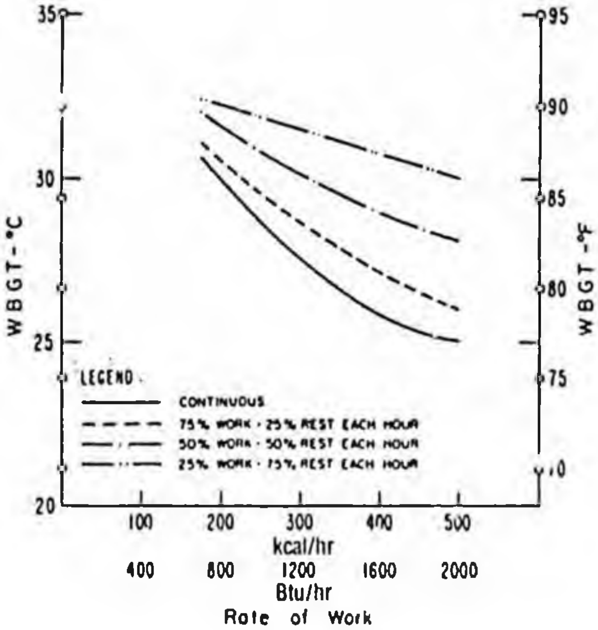

Figure 1 — Permissible Heat Exposure Threshold Limit Value

IV. *Water and Salt Supplementation*

During the hot season or when the worker is exposed to artificially generated heat, drinking water shall be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup every 15–20 minutes (about 150 ml or 1/4 pint).

The water shall be kept reasonably cool (10°–15°C or 50.0°–60.0°F) and shall be placed close to the workplace so that the worker can reach it without abandoning the work area.

The workers should be encouraged to salt their food abundantly during the hot season and particularly during hot spells. If the workers are unacclimatized, salted drinking water shall be made available in a concentration of 0.1% (1g NaCl to 1.0 liter or 1 level tablespoon of salt to 15 quarts of water). The added salt shall be completely dissolved before the water is distributed, and the water shall be kept reasonably cool.

V. *Other Considerations*

A. *Clothing:* The permissible heat exposure TLVs are valid for light summer clothing as customarily worn by workers when working under hot environmental conditions. If special cothing is required for performing a particular job and this clothing is heavier or it impedes sweat evaporation or has higher insulation value, the worker's heat tolerance is reduced, and the permissible heat exposure limits indicated in Table 1 and Figure 1 are not applicable. For each job category where special clothing is required, the permissible heat exposure limit shall be established by an expert.

B. *Acclimatization and Fitness:* Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during his first week of exposure to hot environmental conditions. The recommended heat stress TLVs are valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically un-fit workers must be exposed to heat stress conditions.

References:

1. *Health Factors Involved in Working Under Conditions of Heat Stress.* WHO Technical Report Series No. 412 (1969).
2. **Dukes-Dobos, F. N. and A. Henschel:** Development of Permissible Heat Exposure Limits for Occupational Work. *ASHRAE Journal 15(9)*:57–62 (Sept. 1973).
3. **Minard, D.:** *Prevention of Heat Casualties in Marine Corps Recruit., Period of 1955–60, with Comparative Incidence Rates and Climatic Heat Stresses in Other Training Categories.* Research Report No. 4, Contract No. MR 005.01-0001.01, Naval Medical Research Institue, Bethesda, MD (Feb. 21, 1961). Published in *Military Medicine 126(44)*:261–272 (April 1961).
4. **Minard, D. and R. L. O'Brien:** *Heat Casualties in the Navy and Marine Corps 1959–1962 with Appendices on the Field Use of the Wet Bulb-Globe Temperature Index.* Research Report No. 7, Contract No. MR 005.01-0001.01, Naval Medical Research Institute, Bethesda, MD (March 12, 1964).
5. **Astrand, Per-Olof and Kaare Rodahl.** *Textbook of Work Physiology.* McGraw-Hill Book Co., New York, San Francisco (1970).
6. Ergonomics Guide to Assessment of Metabolic and Cardiac Costs of Physical Work. *Am. Ind. Hyg. Assoc. J. 32*:560 (1971).
7. *Energy Requirements for Physical Work.* Research Progress Report No. 30. Purdue Farm Cardiac Project, Agricultural Experiment Station, West Lafayette, IN (1961).
8. **Durnin, J. V. G. A. and R. Passmore:** *Energy, Work and Leisure.* Heinemann Educational Books, Ltd., London (1967).
9. **Lehmann, G. E., A. Muller and H. Spitzer:** Der Kalorienbedarf bie Gewerblicher Arbeit! *Arbeitsphysiol. 14*:166 (1950).

IONIZING RADIATION

The Committee accepts the philosophy and recommendations of the National Council on Radiation Protection and Measurements (NCRP) for the ionizing radiation TLV. The NCRP is charted by Congress to, in part, collect, analyze, develop and disseminate information and recommendations about protection against radiation and about radiation measurements, quantities and units, including development of basic concepts in these areas. NCRP Report No. 39 provides basic philosophy and concepts leading to protection criteria established in the same report.[1] Other NCRP reports address specific areas of radiation protection and, collectively, provide an excellent basis for establishing a sound program for radiation control. The Committee recommends the listed references as substantative documentation of a sound basis for ionizing radiation protection. The committee also strongly recommends that all exposures to ionizing radiations be kept as low as reasonably achievable within the stated guidance.

References:

1. *Basic Radiation Protection Criteria.* NCRP Report No. 39 (January 15, 1971).
2. *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.* National Bureau of Standards Handbook 69, (June 5, 1959), with *Addendum 1* (August 1963). Available as NCRP Report No. 22.

The above documents, as well as information on numerous other NCRP Reports addressing specific subjects in ionizing radiation protection are available from: NCRP Publications, PO Box 30175, Washington, DC 20014.

LASERS

The threshold limit values are for exposure to laser radiation under conditions to which nearly all workers may be exposed without adverse effects. The values should be used as guides in the control of exposures and should not be regarded as fine lines between safe and dangerous levels. They are based on the best available information from experimental studies.

Limiting Apertures

The TLVs expressed as radiant exposure or irradiance in this section may be averaged over an aperture of 1 mm except for TLVs for the eye in the spectral range of 400–1400 nm, which should be averaged over a 7 mm limiting aperture (pupil); and except for all TLVs for wavelengths between 0.1–1 mm where the limiting aperture is 10 mm. No modification of the TLVs is permitted for pupil sizes less than 7 mm.

The TLVs for "extended sources" apply to sources which subtend an angle greater than α (Table 7) which varies with exposure time. This angle is *not* the beam divergence of the source.

Correction Factors A and B (C_A and C_B)

The TLVs for ocular exposure in Tables 4 and 5 are to be used as given for all wavelength ranges. The TLVs for wavelengths between 700 nm and 1049 nm are to be increased by a uniformly extrapolated factor (C_A) as shown in Figure 2. Between 1049 nm and 1400 nm, the TLV has been increased by a factor (C_A) of five. For certain exposure times at wavelengths between 550 nm and 700 nm, correction factor (C_B) must be applied.

The TLVs for skin exposure are given in Table 6. The TLVs are to be increased by a factor (C_A) as shown in Figure 2 for wavelengths between 700 nm and 1400 nm. To aid in the determination of TLVs for exposure durations requiring calculations of fractional powers Figures 3, 4, 5 and 6 may be used.

Repetitively Pulsed Lasers

Since there are few experimental data for multiple pulses, caution must be used in the evaluation of such exposures. The protection standards for irradiance or radiant exposure in multiple pulse trains have the following limitations:

(1) The exposure from any single pulse in the train is limited to the protection standard for a single comparable pulse.

(2) The average irradiance for a group of pulses is limited to the protection standard as given in Tables 4, 5, or 7 of a single pulse of the same duration as the entire pulse group.

(3) When the Instantaneous Pulse Repetition Frequency (PRF) of any pulses within a train exceeds one, the protection standard applicable to each pulse is reduced as shown in Figure 6 for pulse durations less than 10^{-5} second. For pulses of greater duration, the following formula should be followed:

$$\text{Standard}\begin{pmatrix}\text{single pulse}\\ \text{in train}\end{pmatrix} = \frac{\text{Standard (pulse } n\tau)}{n}$$

where:

n = number of pulses in train
τ = duration of a single pulse in the train
Standard ($n\tau$) = protection standard of one pulse having a duration equal to $n\tau$ seconds.

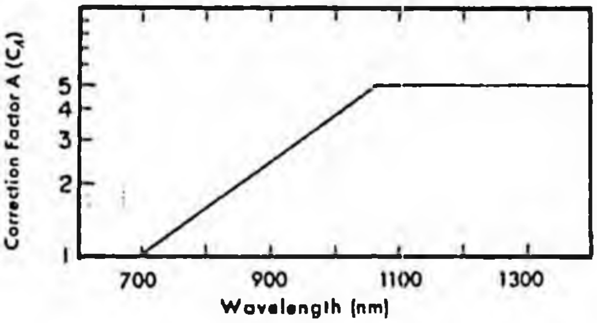

Figure 2 — TLV correction factor for $\lambda = 700 - 1400$ nm*

*For $\lambda = 700 - 1049$ nm, $C_A = 10^{[0.002(\lambda - 700)]}$
For $\lambda = 1050 - 1400$ nm, $C_A = 5$

TABLE 4

Threshold Limit Value for Direct Ocular Exposures (Intrabeam Viewing) from a Laser Beam

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UVC	200 nm to 280 nm	10^{-9} to 3×10^{4}	3 mJ • cm^{-2}
UVB	280 nm to 302 nm	"	3 "
	303 nm	"	4 "
	304 nm	"	6 "
	305 nm	"	10 "
	306 nm	"	16 "
	307 nm	"	25 "
	308 nm	"	40 "
	309 nm	"	63 "
	310 nm	"	100 "
	311 nm	"	160 "
	312 nm	"	250 "
	313 nm	"	400 "
	314 nm	"	630 "

*not to exceed $0.56\, t^{1/4}$ J • cm^{-2} for $t \leqq 10$ s.

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UVA	315 nm to 400 nm	10^{-9} to 10	$.56\, t^{1/4}$ J • cm^{-2}
	" "	10 to 10^{3}	1.0 J • cm^{-2}
	" "	10^{3} to 3×10^{4}	1.0 mW • cm^{-2}
Light	400 nm to 700 nm	10^{-9} to 1.8×10^{-5}	5×10^{-7} J • cm^{-2}
	400 nm to 700 nm	1.8×10^{-5} to 10	$1.8\,(t/\sqrt{t})$ mJ • cm^{-2}
	400 nm to 549 nm	10 to 10^{4}	10 mJ • cm^{-2}
	550 nm to 700 nm	10 to T_1	$1.8\,(t/\sqrt{t})$ mJ • cm^{-2}
	550 nm to 700 nm	T_1 to 10^{4}	10 C_B mJ • cm^{-2}
	400 nm to 700 nm	10^{4} to 3×10^{4}	C_B μW • cm^{-2}
IR-A	700 nm to 1049 nm	10^{-9} to 1.8×10^{-5}	$5\, C_A \times 10^{-7}$ J • cm^{-2}
	700 nm to 1049 nm	1.8×10^{-5} to 10^{3}	$1.8\, C_A\,(t/\sqrt{t})$ mJ • cm^{-2}
	1050 nm to 1400 nm	10^{-9} to 10^{-4}	5×10^{-6} J • cm^{-2}
	1050 nm to 1400 nm	10^{-4} to 10^{3}	$9(t/\sqrt{t})$ mJ • cm^{-2}
	700 nm to 1400 nm	10^{3} to 3×10^{4}	320 C_A μW • cm^{-2}
IR-B & C	1.4 μm to 10^{3} μm	10^{-9} to 10^{-7}	10^{-2} J • cm^{2}
	" "	10^{-7} to 10	$0.56\,\sqrt{t}$ J • cm^{-2}
	" "	10 to 3×10^{4}	0.1 W • cm^{-2}

C_A – See Fig. 2.
$C_B = 1$ for $\lambda = 400$ to 549 nm; $C_B = 10^{0.015(\lambda - 550)}$ for $\lambda = 550$ to 700 nm.
$T_1 = 10$ s for $\lambda = 400$ to 549 nm; $T_1 = 10 \times 10^{0.02(\lambda - 550)}$ for $\lambda = 550$ to 700 n.

TABLE 5

Threshold Limit Values for Viewing a Diffuse Reflection of a Laser Beam or an Extended Source Laser

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UV	200 nm to 400 nm	10^{-9} to 3×10^{4}	Same as Table 3
Light	400 nm to 700 nm	10^{-9} to 10	$10\ \sqrt[4]{t}\ J \bullet cm^{-2} \bullet sr^{-1}$
	400 nm to 549 nm	10 to 10^{4}	$21\ J \bullet cm^{-2} \bullet sr^{-1}$
	550 nm to 700 nm	10 to T_1	$3.83\ (t/\sqrt[4]{\ })\ J \bullet cm^{-2} \bullet sr^{-1}$
	550 nm to 700 nm	T_1 to 10^{4}	$21\ C_B\ J \bullet cm^{-2} \bullet sr^{-1}$
	400 nm to 700 nm	10^{4} to 3×10^{4}	$2.1\ C_B t \times 10^{-3}\ W \bullet cm^{-2} \bullet sr^{-1}$
IR-A	700 nm to 1400 nm	10^{-9} to 10	$10\ C_A\ \sqrt[4]{t}\ J \bullet cm^{-2} \bullet sr^{-1}$
	700 nm to 1400 nm	10 to 10^{3}	$3.83\ C_A\ (t/\sqrt[4]{t})\ J \bullet cm^{-2} \bullet sr^{-1}$
	700 nm to 1400 nm	10^{3} to 3×10^{4}	$0.64\ C_A\ W \bullet cm^{-2} \bullet sr^{-1}$
IR-B & C	1.4 μm to 1 mm	10^{-9} to 3×10^{4}	Same as Table 3

C_A, C_B, and T_1 are the same as in footnote to Table 4.

TABLE 6

Threshold Limit Value for Skin Exposure from a Laser Beam

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UV	200 nm to 400 nm	10^{-9} to 3×10^{4}	Same as Table 4
Light &	400 nm to 1400 nm	10^{-9} to 10^{-7}	$2\ C_A \times 10^{-2}\ J \bullet cm^{-2}$
IR-A	" "	10^{-7} to 10	$1.1\ C_A\ \sqrt[4]{t}\ J \bullet cm^{-2}$
IR-A	" "	10 to 3×10^{4}	$0.2\ C_A\ W \bullet cm^{-2}$
IR-B & C	1.4 μm to 1 mm	10^{-9} to 3×10^{4}	Same as Table 4

$C_A = 1.0$ for $\lambda = 400\text{-}700$ nm; see Figure 2 for $\lambda = 700$ to 1400 nm.

TABLE 7

Limiting Angle to Extended Source Which May Be Used for Applying Extended Source TLVs

Exposure Duration(s)	Angle α (mrad)
10^{-9}	8.0
10^{-8}	5.4
10^{-7}	3.7
10^{-6}	2.5
10^{-5}	1.7
10^{-4}	2.2
10^{-3}	3.6
10^{-2}	5.7
10^{-1}	9.2
1.0	15
10	24
10^{2}	24
10^{3}	24
10^{4}	24

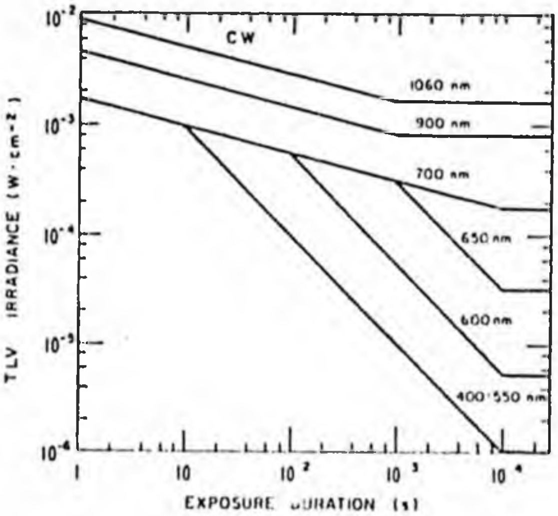

Figure 3a — TLV for intrabeam (direct) viewing of CW laser beam (400–1400 nm)

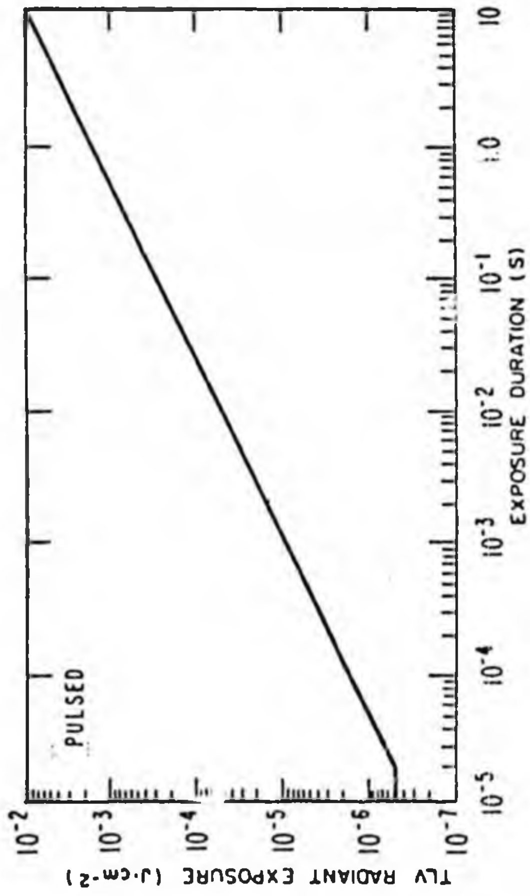

Figure 3b — TLV for intrabeam (direct) viewing of laser beam (400–700 nm).

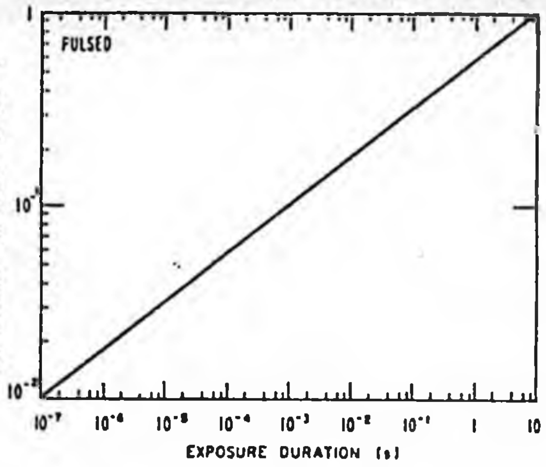

Figure 4a — TLV for laser exposure of skin and eyes for far-infrared radiation (wave-lengths greater than 1.4 μm).

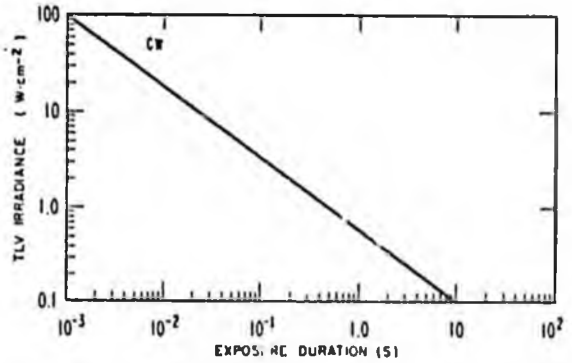

Figure 4b — TLV for CW laser exposure of skin and eyes for far-infrared radiation (wave-lengths greater than 1.4 μm).

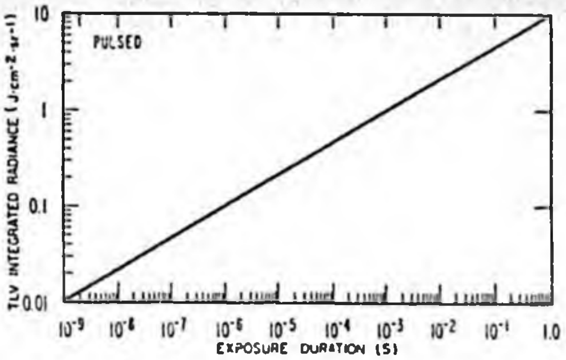

Figure 5a — TLV for extended sources or diffuse reflections of laser radiation (400–700 nm).

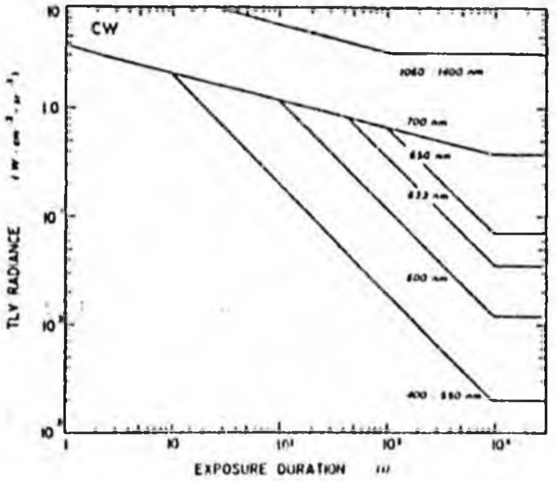

Figure 5b — TLV for extended sources or diffuse reflections of laser radiation (400–1400 nm).

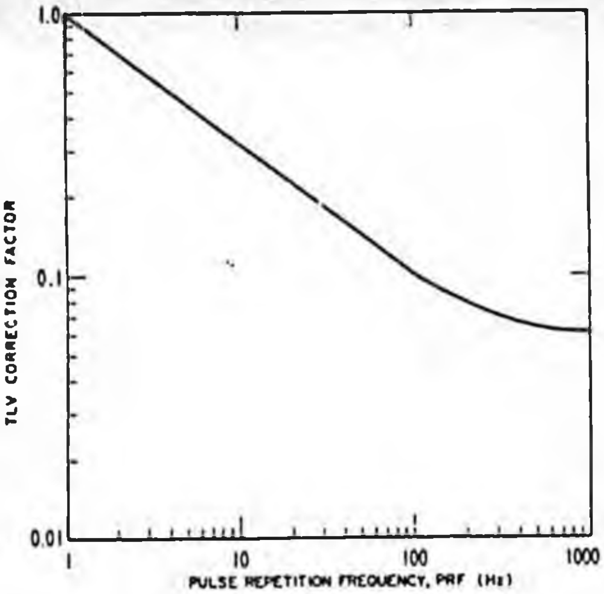

Figure 6 — Multiplicative correction factor for repetitively pulsed lasers having pulse durations less than 10^{-5} second. TLV for a single pulse of the pulse train is multiplied by the above correction factor. Correction factor for PRF greater than 1000 Hz is 0.06.

**MICROWAVES

These Threshold Limit Values refer to microwave energy in the frequency range of 300 MHz to 300 GHz and represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect.

Under conditions of moderate to severe heat stress, the recommended values may need to be reduced.[1] Therefore, these values should be used as guides in the control of exposure to microwave energy and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values:

The Threshold Limit Value for occupational exposure to microwave energy, where power density or field intensity is known and exposure time is controlled, is as follows:

1. For exposure to continuous wave (CW) sources, the power density level shall not exceed 10 milliwatts per square centimeter (mW/cm²) for continuous exposure, and the total exposure time shall be limited to an 8-hour workday. This power density is approximately equivalent to a free-space electric field strength of 200 volts-per-meter rms (V/m) and a free-space magnetic field strength of 0.5 ampere-per-meter rms (A/m).
2. Exposures to CW power density levels greater than 10 mW/cm² are permissible up to a maximum of 25 mW/cm² based upon an average energy density of 1 milliwatt-hour per square centimeter (mWh/cm²) averaged over any 0.1 hour period. For example, at 25 mW/cm², the permissible exposure duration is approximately 2.4 minutes in any 0.1 hour period.
3. For repetitively pulsed microwave sources, the average field strength or power density is calculated by multiplying the peak-pulse value by the duty cycle. The duty cycle is equal to the pulse duration in seconds times the pulse repetition rate in Hertz. Exposure during an 8-hour workday shall not exceed the following values which are averaged over any 0.1 hour period:

Power Density	10 mW/cm²
Energy Density	1 mWh/cm²
Mean Squared Electric Field Strength	40,000 V²/m²
Mean Squared Magnetic Field Strength	0.25 A²/m²

4. Exposure is not permissible in CW or repetitively pulsed fields with an average power density in excess of 25 mW/cm² or approximate equivalent free-space field strengths of 300 V/m or 0.75 A/m.

Reference:

1. Mumford, W. W.: Heat Stress Due to R. F. Radiation. *Proceedings of IEEE 57(2):* 171–178 (Feb. 1969).

NOISE

These threshold limit values refer to sound pressure levels and durations of exposure that represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech. Prior to 1979, the medical profession had defined hearing impairment as an average hearing threshold level in excess of 25 decibels (ANSI-S3.6-

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**See Notice of Intended Changes.

Table 8
Threshold Limit Values

Duration per Day Hours	Sound Level dBA†
16	80
8	85
4	90
2	95
1	100
1/2	105
1/4	110
1/8	115*

†Sound level in decibels are measured on a sound level meter, conforming as a minimum to the requirements of the American National Standard Specification for Sound Level Meters, S1.4 (1971) Type S2A, and set to use the A-weighted network with slow meter response.

*No exposure to continuous or intermittent in excess of 115 dBA

1969) at 500, 1000, and 2000 Hz, and the limits which are given have been established to prevent a hearing loss in excess of this level.[a] The values should be used as guides in the control of noise exposure and, due to individual susceptibility, should not be regarded as fine lines between safe and dangerous levels.

It should be recognized that the application of the TLV for noise will not protect all workers from the adverse effects of noise exposure. A hearing conservation program with audiometric testing is necessary when workers are exposed to noise at or above the TLV levels.

Continuous or Intermittent

The sound level shall be determined by a sound level meter, conforming as a minimum to the requirements of the American National Standard Specification for Sound Level Meters, S1.4 (1971) Type S2A, and set to use the A-weighted network with slow meter response. Duration of exposure shall not exceed that shown in Table 8.

These values apply to total duration of exposure per working day regardless of whether this is one continuous exposure or a number of short-term exposures and does include the impact and impulsive type of noise that contributes to the sound level meter reading at slow response.

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:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{C_n}{T_n}$$

exceeds unity, then, the mixed exposure should be considered to exceed the threshold limit value. C_1 indicates the total duration of exposure at a specific noise level, and T_1 indicates the total duration of exposure permitted at that level. All on-the-job noise exposures of 80 dBA or greater shall be used in the above calculations.

IMPULSIVE OR IMPACT NOISE

It is recommended that exposure to impulsive or impact noise shall not exceed the limits listed in Table 9 or taken from Figure 7. No exposures in ex-

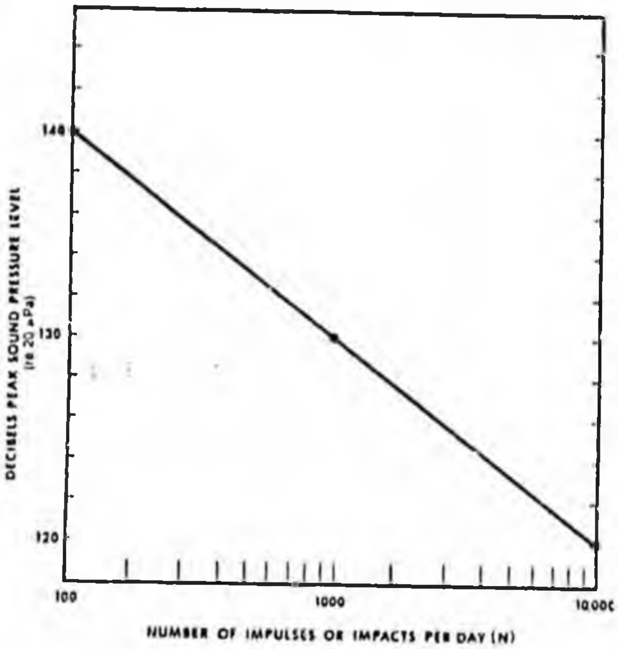

Figure 7 — Threshold Limit Values for Impulse/Impact Noise.

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[a] In 1979, the American Academy of Ophthalmology and Otolargyngology (AAOO) included 3000 hz in their hearing impairment formula.

cess of 140 decibels peak sound pressure level are permitted. Impulsive or impact noise is considered to be those variations in noise levels that involve maxima at intervals of greater than one per second. Where the intervals are less than one second, it should be considered continuous.

Table 9
Threshold Limit Values Impulsive or Impact Noise

Sound Level dB**	Permitted Number of Impulses or Impacts per day
140	100
130	1000
120	10,000

**Decibels peak sound pressure level, re 20 μPa

ULTRAVIOLET RADIATION*

These threshold limit values refer to ultraviolet radiation in the spectral region between 200 and 400 nm and represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. These values for exposure of the eye or the skin apply to ultraviolet radiation from arcs, gas, and vapor discharges, fluorescent, and incandescent sources, and solar radiation, but do not apply to ultraviolet lasers.* These values do not apply to ultraviolet radiation exposure of photosensitive individuals or of individuals concomitantly exposed to photosensitizing agents.(1) These values should be used as guides in the control of exposure to continuous sources where the exposure duration shall not be less than 0.1 sec.

These values should be used as guides in the control of exposure to ultraviolet sources and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values:

The threshold limit value for occupational exposure to ultraviolet radiation incident upon skin or eye where irradiance values are known and exposure time is controlled are as follows:

1. For the near ultraviolet spectral region (320 to 400 nm) total irradiance incident upon the unprotected skin or eye should not exceed 1 mW/cm^2 for periods greater than 10^3 seconds (approximately 16 minutes) and for exposure times less than 10^3 seconds should not exceed one J/cm^2.
2. For the actinic ultraviolet spectral region (200 — 315 nm), radiant exposure incident upon the unprotected skin or eye should not exceed the values given in Table 10 within an 8-hour period.
3. To determine the effective irradiance of a broadband source weighted against the peak of the spectral effectiveness curve (270 nm), the following weighting formula should be used:

$$E_{eff} = \sum E_\lambda S_\lambda \Delta\lambda$$

where:

E_{eff} = effective irradiance relative to a monochromatic source at 270 nm in W/cm^2 (J/s/cm^2)
E_λ = spectral irradiance in W/cm^2/nm
S_λ = relative spectral effectiveness (unitless)
$\Delta\lambda$ = band width in nanometers

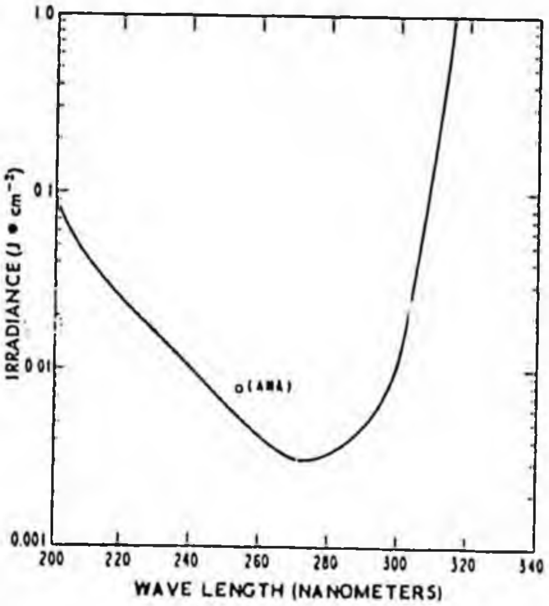

Figure 8 — Threshold Limit Values for Ultraviolet Radiation

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*See Laser TLVs.

TABLE 10
Relative Spectral Effectiveness by Wavelength*

Wavelength (nm)	TLV (mJ/cm²)	Relative Spectral Effectiveness S_λ
200	100	0.03
210	40	0.075
220	25	0.12
230	16	0.19
240	10	0.30
250	7.0	0.43
254	6.0	0.5
260	4.6	0.65
270	3.0	1.0
280	3.4	0.88
290	4.7	0.64
300	10	0.30
305	50	0.06
310	200	0.015
315	1000	0.003

*See Laser TLVs.

TABLE 11
Permissible Ultraviolet Exposures

Duration of Exposure Per Day	Effective Irradiance, E_{eff} (µW/cm²)
8 hrs.	0.1
4 hrs.	0.2
2 hrs.	0.4
1 hr.	0.8
30 min	1.7
15 min	3.3
10 min	5
5 min.	10
1 min.	50
30 sec.	100
10 sec.	300
1 sec	3,000
0.5 sec.	6,000
0.1 sec.	30,000

4. Permissible exposure time in seconds for exposure to actinic ultraviolet radiation incident upon the unprotected skin or eye may be computed by dividing 0.003 J/cm² by E_{eff} in W/cm². The exposure time may also be determined using Table 11 which provides exposure times corresponding to effective irradiances in µW/cm².
5. All the preceding TLVs for ultraviolet energy apply to sources which subtend an angle less than 80°. Sources which subtend a greater angle need to be measured only over an angle of 80°.

Conditioned (tanned) individuals can tolerate skin exposure in excess of the TLV without erythemal effects. However, such conditioning may not protect persons against skin cancer.

Reference:

1. *Sunlight and Man.* Fitzpatrick *et al*, Eds. Univ. of Tokyo Press, Tokyo, Japan (1974).

NOTICE OF INTENDED CHANGES
(1982)

These physical agents, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least one year. If after one year no evidence comes to light that questions the appropriateness of the values herein the values will be reconsidered for the "Adopted" list.

NOTICE OF INTENT TO ESTABLISH THRESHOLD LIMIT VALUES

LASERS

It is proposed that the following footnote be added to Table 7 (Threshold Limit Value for Skin Exposure from a Laser Beam).

The IR-B and IR-C exposures to skin surface areas A(cm²) exceeding 1000 cm², the TLV is 100,000/A mW/cm²; for areas greater than 100,000/A, the TLV is 10 mW/cm².

LIGHT AND NEAR-INFRARED RADIATION

These Threshold Limit Values refer to visible and near-infrared radiation in the wavelength range of 400 nm to 1400 nm and represent conditions under which it is believed that nearly all workers may be exposed without adverse effect. These values should be used as guides in the control of exposure to light and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values:

The Threshold Limit Value for occupational exposure to broad-band light and near-infrared radiation for the eye apply to exposure in any eight-hour workday and require knowledge of the spectral radiance (L_λ) and total irradiance (E) of the source as measured at the position(s) of the eye of the worker. Such detailed spectral data of a white light source is generally only required if the luminance of the source exceeds 1 cd cm^{-2}. At luminances less than this value the TLV would not be exceeded.

TABLE 12

Spectral Weighting Functions for Assessing Retinal Hazards from Broad-Band Optical Sources

Wavelength (nm)	Blue-Light Hazard Function B_λ	Burn Hazard Function R_λ
400	0.10	1.0
405	0.20	2.0
410	0.40	4.0
415	0.80	8.0
420	0.90	9.0
425	0.95	9.5
430	0.98	9.8
435	1.0	10
440	1.0	10
445	0.97	9.7
450	0.94	9.4
455	0.90	9.0
460	0.80	8.0
465	0.70	7.0
470	0.62	6.2
475	0.55	5.5
480	0.45	4.5
485	0.40	4.0
490	0.22	2.2
495	0.16	1.6
500–600	$10^{[(450-\lambda)/50]}$	1.0
600–700	0.001	1.0
700–1049	0.001	$10^{[(700-\lambda)/505]}$
1050–1400	0.001	0.2

The TLV's are:

1. To protect against retinal thermal injury, the spectral radiance of the lamp weighted against the function R (Table 12) should not exceed:

$$\sum_{400}^{1400} L_\lambda R_\lambda \Delta\lambda \leqq 1/\alpha t^{1/2} \qquad (1)^*$$

where L_λ is in W cm^{-2} sr^{-1} and t is the viewing duration (or pulse duration if the lamp is pulsed) limited to 1 μs to 10 s, and α is the angular subtense of the source in radians. If the lamp is oblong, α refers to the longest dimension that can be viewed. For instance, at a viewing distance $r = 100$ cm from a tubular lamp of length $l = 50$ cm, the viewing angle is:

$$\alpha = l/r = 50/100 = 0.5 \text{ rad} \qquad (2)$$

2. To protect against retinal photochemical injury from chronic blue-light exposure the integrated spectral radiance of light source weighted against the blue-light hazard function B_λ (Table 12) should not exceed:

$$\sum_{400}^{1400} L_\lambda t B_\lambda \Delta\lambda \leqq 100 \text{ J}cm^{-2} sr^{-1} \ (t \leqq 10^4 s) \qquad (3a)$$

$$\sum_{400}^{1400} L_\lambda B_\lambda \Delta\lambda \leqq 10^{-2} \text{ W}cm^{-2} sr^{-1} \ (t > 10^4 s) \qquad (3b)$$

The weighted product of L_λ and B_λ is termed L(blue). For a source radiance L weighted against the blue-light hazard function [L(blue)] which exceeds 10 mW/cm^{-2} sr^{-1} in the blue spectral region, the permissible exposure duration t_{max} in seconds is simply:

$$t_{max} = 100 \text{ J } cm^{-2} sr^{-1}/L \text{ (blue)} \qquad (4)$$

The latter limits are greater than the maximum permissible exposure limits for 440 nm laser radiation (see Laser TLV) because a 2–3 mm pupil is assumed rather than a 7 mm pupil for the Laser TLV. For a light source subtending an angle α less than 11 mrd (0.011 radian) the above limits are relaxed such that the spectral irradiance weighted against the blue-light hazard function B_λ [E(blue)] should not exceed:

$$\sum_{400}^{1400} E_\lambda \bullet t \bullet B_\lambda \bullet \Delta\lambda \leqq 10\ \mathrm{mJ} \bullet \mathrm{cm}^{-2}\ (t \leqq 10^4\ \mathrm{s}) \qquad (5a)$$

$$\sum_{400}^{1400} E_\lambda \bullet B_\lambda \bullet \Delta\lambda \leqq 1 \mu\mathrm{W} \bullet \mathrm{cm}^2\ (t \geqq 10^4\ \mathrm{s}) \qquad (5b)$$

For a source where the blue light weighted irradiance E (blue) exceeds 1 μW • cm^{-2} is the maximum permissible exposure duration t_{max} in seconds is:

$$t_{max} = 10 \mathrm{mJ} \bullet \mathrm{cm}^{-2}\ E\ (\mathrm{blue}) \qquad (6)$$

3. *Infrared Radiation:* To avoid possible delayed effects upon the lens of the eye (cataractogenesis), the infrared radiation ($\lambda > 770$ nm) should be limited to 10 mWcm^{-2}. For an infrared heat lamp or any near-infrared source where a strong visual stimulus is absent, the near infrared (770–1400 nm) radiance as viewed by the eye should be limited to:

$$\sum_{770}^{1400} L_\lambda\, \Delta\lambda = 0.6/\alpha \qquad (7)^*$$

for extended duration viewing conditions. This limit is based upon a 7 mm pupil diameter.

AIRBORNE UPPER SONIC AND ULTRASONIC ACOUSTIC RADIATION

These threshold limit values refer to sound pressure levels that represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. The values listed in Table 13 should be used as guides in the control of noise exposure and, due to individual susceptibility, should not be regarded as fine lines between safe and dangerous levels. The levels for the third octave bands centered below 20 kHz are below those which cause subjective effects. Those levels for 1/3 octaves above 20 kHz are for prevention of possible hearing losses from subharmonics of these frequencies.

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[*] Formulae (1) and (7) are empirical and are not, strictly speaking, dimensionally correct. To make the formulae dimensionally correct, one would have to insert a dimensional correction factor k in the right hand numerator in each formula. For formula (1) this would be $k_1 = 1$ W • rad • s$^{1/2}$/(cm^2 • sr), and for formula (7) $k_2 = 1$ W • rad/(cm^2 • sr).

TABLE 13

Permissible Ultrasound Exposure Levels

Mid-Frequency of Third-Octave Band kHz	One-Third Octave — Band Level in dB re 20 μPa
10	80
12.5	80
16	80
20	105
25	110
31.5	115
40	115
50	115

RADIOFREQUENCY/MICROWAVE RADIATION

These Threshold Limit Values (TLVs) refer to radiofrequency (RF) and microwave radiation in the frequency range from 10 kHz to 300 GHz, and represent conditions under which it is believed workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table 14 are selected to limit the average whole body specific absorption rate (SAR) to 0.4 W/kg in any six minutes (0.1 hr) period for 3 MHz to 300 GHz, see Figure 9. Between 10 kHz and 3 MHz the average whole body SAR is still limited to 0.4 W/kg, but the plateau at 100 mW/cm^2 was set to protect against shock and burn hazards.

Since it is usually impractical to measure the SAR, the TLVs are expressed in units that are measurable, viz, squares of the electric and magnetic field strengths, averaged over any 0.1 hour period. This can be expressed in units of equivalent plane wave power density for convenience. The electric field strength (E) squared, magnetic field strength (H) squared, and power density (PD) values are shown in Table 14. For near field exposures PD cannot be measured directly, but equivalent plane wave power density can be calculated from the field strength measurement data as follows:

$$\mathrm{PD\ in\ mW/cm^2} = \frac{E^2}{3770}$$

where:

E^2 is in volts squared (V^2) per meter squared (m^2).

$$\text{PD in mW/cm}^2 = 37.7\ H^2$$

where:

H^2 is in amperes squared (A^2) per meter squared (m^2).

These values should be used as guides in the evaluation and control of exposure to radiofrequency/microwave radiation, and should not be regarded as a fine line between safe and dangerous levels.

Notes:

1. All Radiofrequency Radiation (RFR) exposures should be kept as low as reasonably possible given the current state of knowledge on human effects, particularly non-thermal effects.
2. For fields consisting of a number of frequencies, the fraction of the protection guide incurred within each frequency level should be determined and the sum of all fractions should not exceed unity.
3. For pulsed and continuous wave fields, the power density is averaged over the six minute period.
4. For partial body exposures at frequencies between 10 kHz and 1.0 GHz, the protection guides in Table 14 may be exceeded if the output power of a radiating device is 7 watts or less. For example, if a hand held transmitter operating at 27 MHz has a maximum output of 5 watts, it would be excluded from any further field measurements.
5. The TLVs in Table 14 may be exceeded if the exposure conditions can be demonstrated to produce a SAR of less than 0.4 W/kg as averaged over the whole body and spatial peak SAR values less than 8.0 W/kg as averaged over any 1.0 gram of tissue.

   For example, for frequencies from 3 to 30 MHz, the equivalent power density can be increased by a factor of 10 up to a limit of 100 mW/cm², if it can be assured that exposed individuals are not in contact with the ground plate.
6. At frequencies below 30 MHz, ungrounded objects such as vehicles, fences, etc., can strongly couple to RF fields. For field strengths near the TLV, shock and burn hazards can exist. Care should be taken to eliminate ungrounded objects, to ground such objects, or use insulated gloves when ungrounded objects must be handled.

TABLE 14

Radiofrequency/Microwave Threshold Limit Values

Frequency	Power Density (mW/cm²)†	Electric Field Strength Squared (V²/m²)	Magnetic Field Strength Squared (A²/m²)
10 kHz to 3 MHz	100	377,000	2.65
3 MHz to 30 MHz	$900/f^{2*}$	$3770 \times 900/f^{2*}$	$900/37.7f^{2*}$
30 MHz to 100 MHz	1	3770	0.027
100 MHz to 1000 MHz	$f^*/100$	$3770 \times f^*/100$	$f^*/37.7 \times 100$
1 GHz to 300 GHz	10	37,700	0.265

†mW/cm² = milliwatts per centimeter squared
*f = frequency in MHz

$$\text{PD in mW/cm}^2 = 37.7\ H^2$$

where:

H^2 is in amperes squared (A^2) per meter squared (m^2).

These values should be used as guides in the evaluation and control of exposure to radiofrequency/microwave radiation, and should not be regarded as a fine line between safe and dangerous levels.

Notes:

1. All Radiofrequency Radiation (RFR) exposures should be kept as low as reasonably possible given the current state of knowledge on human effects, particularly non-thermal effects.
2. For fields consisting of a number of frequencies, the fraction of the protection guide incurred within each frequency level should be determined and the sum of all fractions should not exceed unity.
3. For pulsed and continuous wave fields, the power density is averaged over the six minute period.
4. For partial body exposures at frequencies between 10 kHz and 1.0 GHz, the protection guides in Table 14 may be exceeded if the output power of a radiating device is 7 watts or less. For example, if a hand held transmitter operating at 27 MHz has a maximum output of 5 watts, it would be excluded from any further field measurements.
5. The TLVs in Table 14 may be exceeded if the exposure conditions can be demonstrated to produce a SAR of less than 0.4 W/kg as averaged over the whole body and spatial peak SAR values less than 8.0 W/kg as averaged over any 1.0 gram of tissue.

   For example, for frequencies from 3 to 30 MHz, the equivalent power density can be increased by a factor of 10 up to a limit of 100 mW/cm², if it can be assured that exposed individuals are not in contact with the ground plate.
6. At frequencies below 30 MHz, ungrounded objects such as vehicles, fences, etc., can strongly couple to RF fields. For field strengths near the TLV, shock and burn hazards can exist. Care should be taken to eliminate ungrounded objects, to ground such objects, or use insulated gloves when ungrounded objects must be handled.

TABLE 14

Radiofrequency/Microwave Threshold Limit Values

Frequency	Power Density (mW/cm²)†	Electric Field Strength Squared (V²/m²)	Magnetic Field Strength Squared (A²/m²)
10 kHz to 3 MHz	100	377,000	2.65
3 MHz to 30 MHz	$900/f^2$*	$3770 \times 900/f^2$*	$900/37.7f^2$*
30 MHz to 100 MHz	1	3770	0.027
100 MHz to 1000 MHz	f*/100	3770 × f*/100	f*/37.7 × 100
1 GHz to 300 GHz	10	37,700	0.265

†mW/cm² = milliwatts per centimeter squared

*f = frequency in MHz

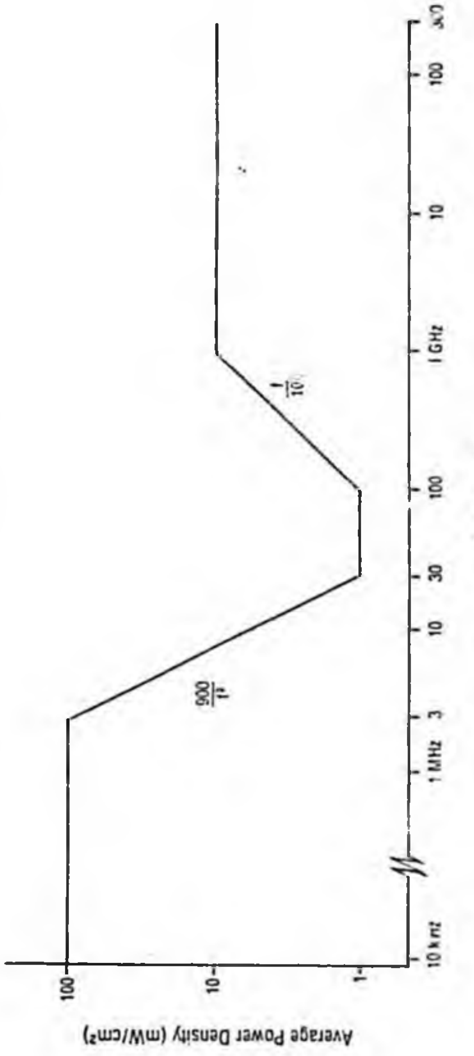


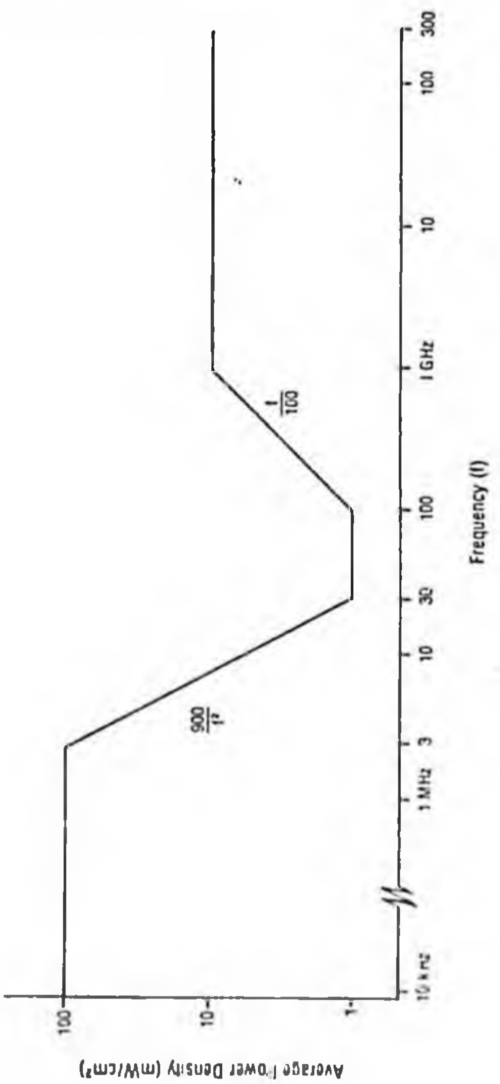
Figure 9 — Threshold Limit Values (TLV) for Radiofrequency/Microwave Radiation in Workplace (Whole Body SAR Less than 0.4 W/kg).

7. No measurement should be made within 5 cm of any object.
8. All exposures should be limited to a maximum (peak) electric field intensity of 100 kV/m.

PHYSICAL AGENTS UNDER STUDY

The Physical Agents Committee of ACGIH has examined the current literature and has not found sufficient information to propose a TLV. However, these agents will remain under study during the coming year to examine new evidence indicating the need and feasibility for establishing a proposed TLV. Comments and suggestions, accompanied by substantive documentation are solicited and should be forwarded to the Executive Secretary, ACGIH. Documentation summarizing the current status of the biological effects literature is available on those agents preceded by an asterisk (*).

1. **Extremely Low Frequency (ELF) Radiation*. Specifically, that portion of the spectrum from 0 to 300 Hz.
2. *Magnetic Fields*. Both pulsed and *continuous.
3. *Laser Radiation*. Specifically laser exposures of less than one (1) nanosecond.
4. *Vibration*. Segmental and whole-body.
5. *Cold Stress*.
6. *Pressure Variations*.



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The American Conference of Governmental Industrial Hygienists was organized in 1938 by a group of governmental industrial hygienists who desired a medium for the free exchange of ideas, experiences and the promotion of standards and techniques in industrial health. The Conference is not an official Government Agency.

It is an organization devoted to the development of administrative and technical aspects of worker health protection. The association has contributed substantially to the development and improvement of official industrial health services to industry and labor. The committees on Industrial Ventilation and Threshold Limit Values are recognized throughout the world for their expertise and contributions to industrial hygiene.

Membership is limited to professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. The more than 2500 members from across the United States and around the world give the organization an international scope.

Richard Shaf

federal register

Friday
March 19, 1982

Part VII

Department of Labor

Occupational Safety and Health Administration

Hazard Communication; Proposed Rule and Public Hearing Announcement

Chemical Fact Sheet* December 1982

GASOLINE

The information in this sheet applies to workplace exposure resulting from processing, manufacturing, storing or handling and is not designed for the population at large. Any generalization beyond occupational exposures should not be made. The best industrial hygiene practice is to maintain concentrations of all chemicals at levels as low as is practical.

Chemical Names: Gasoline, CAS 8006-61

Trade Names: Gasoline, Petrol, Ethyl, Av-Gas and others.

Uses: Gasoline is primarily a fuel for internal combustion engines but is also used as a solvent for rubber adhesives and as a finishing agent for artificial leathers.

Ingredients: Gasoline is a complex mixture of short chain hydrocarbons, aromatic hydrocarbons, and additives such as tetraethyl lead.

PHYSICAL INFORMATION

Appearance: Liquid; gasoline with lead may contain colored dyes, usually red, blue, green, or purple.

Odor: Strong, fairly pleasant.

Behavior in Water: Does not mix with water and will float on surface.

Evaporation: Gasoline evaporates rapidly. The fumes are heavier than air and will sink.

HEALTH HAZARD INFORMATION

OSHA Standard: 120 ppm (Alkanes-component of gasoline).

NIOSH Recommended Limit: 120 ppm (Alkanes-component of gasoline).

ACGIH Recommended Limit: Average 8 hour exposure -- 300 ppm.

Short Term Exposure:

Inhalation: Nose and throat irritation have been reported after exposure to 900 ppm for 1 hour. Drowsiness, dizziness, nausea and numbness may occur at 1,000 ppm after 15 minutes exposure. In animal studies, death occurred after 30,000 ppm for 5 minutes.

Skin: May cause itching and burning of the skin and after a longer exposure, redness and blistering.

Eyes: Moderate irritation of the eye has been reported after one hour exposure to 500 ppm. Mild irritation has been reported after an 8 hour exposure to 140 ppm.

Ingestion: Gasoline causes a burning sensation in the mouth, throat and stomach. Vomiting, diarrhea, drowsiness and intoxication may follow. As little as 3 to 4 ounces may be fatal. Inhalation of liquid gasoline into the lungs following ingestion or vomiting may result in an accumulation of fluid in the lungs, rapid breathing or death.

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*Prepared by the Bureau of Toxic Substance Assessment, New York State Department of Health. For an explanation of the terms and abbreviations used, see "Toxic Substances: How Toxic is Toxic" available from the New York State Department of Health.

Long Term Exposure:

Continuous 8 hour exposure to 200 ppm has resulted in eye irritation only. Long term exposure may produce fatigue, muscle weakness, nausea, vomiting and abdominal pain. Hexane, a component of gasoline, can produce nerve damage resulting in tremors, numbness of hands and feet and loss of muscle control. Benzene, also a gasoline component, has been linked to blood disorders in man, including leukemia. Lead additives can produce nausea, cramps, loss of appetite, sleep problems, headaches and agitation.

EMERGENCY AND FIRST AID INSTRUCTIONS

Inhalation: Move individual to fresh air. Give artificial respiration or oxygen if necessary. Seek medical attention.

Skin: Remove clothing contaminated with gasoline. Wash affected areas with soap and water.

Eyes: Wash eyes with large amounts of running water for 15 minutes. Seek medical attention.

Ingestion: Do not induce vomiting, get medical attention immediately.

FIRE AND EXPLOSION INFORMATION

General: Highly flammable, fumes may spread great distances to flame and flash back. Gasoline will ignite at -50°F (-45°C).

Explosive Limits: Upper - 7.6%, Lower - 1.4%.

Extinguisher: Foam, dry chemical or carbon dioxide.

REACTIVITY

Conditions to Avoid: Avoid contact of liquid or fumes with any source of heat or flame. Strong oxidizers such as chlorine, permanganates and dichromates may cause fire or explosion.

PROTECTIVE MEASURES

Storage and Handling: Keep containers tightly closed and out of direct sunlight. Outdoor or detached storage is preferred. Indoors use a standard cabinet for combustible liquids.

Engineering Controls: Provide adequate ventilation.

Protective Clothing (Should not be substituted for proper handling and engineering controls): Splash proof goggles, gloves, and coveralls are recommended if contact with gasoline is possible.

PROCEDURES FOR SPILLS AND LEAKS

Get all workers out of the spill area. Protect against accidental ignition of liquid or fumes. For final disposal, contact your regional office of the N.Y.S. Department of Environmental Conservation.

For more information:

Contact the Industrial Hygienist or Safety Officer at your worksite or the New York State Department of Health, Bureau of Toxic Substance Assessment, Empire State Plaza, Tower Building, Albany, New York 12237.

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1910

[Docket No. H-112E]

Access to Employee Exposure and Medical Records; Proposed Modification; Request for Comments and Notice of Public Hearing

AGENCY: Occupational Safety and Health Administration, Labor.

ACTION: Notice of proposed rulemaking; request for comments and notice of public hearing.

SUMMARY: OSHA is hereby proposing to modify the Access to Employee Exposure and Medical Records rule, 29 CFR 1910.20. Principally, and as a result of receiving numerous requests, comments and suggestions for changes to the standard, OSHA is proposing to modify: (1) The definition of "employee"; (2) the definition of "exposure"; (3) the definition of "toxic substance"; (4) the preservation requirements for employee exposure and medical records; (5) the prohibition on the microfilm storage of X-rays; and (6) the trade secret protection provisions.

The new regulation would maintain the benefits to occupational health in the current regulation while providing greater flexibility for employers to comply with the standards. This notice solicits comments on the proposed modifications. This notice also announces that OSHA has scheduled an informal public hearing to allow interested parties to present information and data related to the issues raised by the proposed modification.

DATES: Comments and notices of intention to appear at the public hearing must be received on or before September 14, 1982. Statements and any documentary evidence to be presented at the hearing must be submitted by September 21, 1982.

The public hearing is scheduled to begin on October 5, 1982, in Washington, D.C., at 9:30 a.m.

ADDRESSES: Comments should be submitted in quadruplicate to the Docket Office, Docket H-112E, U.S. Department of Labor, Occupational Safety and Health Administration, 200 Constitution Avenue, NW., Room S6212, Washington, D.C. 20210; (202) 523-7894.

Notices of intention to appear at the hearings, statements and documentary evidence should be submitted in quadruplicate to Mr. Tom Hall, Division of Consumer Affairs, U.S. Department of Labor, 200 Constitution Avenue, NW., Room N-3635 Washington, D.C. 20210; (202) 523-8024.

The hearing will be held at the Auditorium, Frances Perkins Department of Labor Building, 200 Constitution Avenue, NW., Washington, D.C.

Written comments received and notices of intention to appear, as well as any other information gathered by the Agency during this rulemaking, will be available for inspection and copying in the Docket Office, Room S-6212 at the above address.

FOR FURTHER INFORMATION CONTACT:

Proposal: Mr. David Welsh, Office of Special Standards Programs, Occupational Safety and Health Administration, 200 Constitution Avenue, NW., Room N-3663, Washington, D.C. 20210; (202) 523-7166.

Hearings: Mr. Thomas Hall, Division of Consumer Affairs, Occupational Safety and Health Administration, 200 Constitution Avenue, NW., N-3635, Washington, D.C. 20210; (202) 523-8024.

SUPPLEMENTARY INFORMATION:

A. Background

On May 21, 1980, the Occupational Safety and Health Administration (OSHA) issued its rule entitled Access to Employee Exposure and Medical Records, 29 CFR 1910.20; 45 FR 35212 *et seq.* The rule imposes three major obligations on employers. First, employers are required to preserve and maintain exposure and medical records pertinent to an employee's occupational exposure to toxic substances or harmful physical agents. 20 CFR 1910.20(d). Generally, employee exposure records and analyses based on exposure or medical records must be retained for thirty years. 29 CFR 1910.20(d)(1)(ii) and (iii). Employee medical records must be retained for the duration of employment plus thirty years. 29 CFR 1910.20(d)(1)(i).

Second, throughout these time periods the employer must ensure access to pertinent exposure records by the exposed employee, fellow employees exposed or potentially exposed to similar job hazards, designated employee representatives, and OSHA. 29 CFR 1910.20(e). Access to medical records must also be ensured to the employee who is the subject of the records and to OSHA. Likewise, access to medical records must be ensured to an employee's designated representative, such as the employee's collective bargaining agent, but, because of the privacy interests involved, only if the employee has provided specific written consent for such access. 29 CFR 1910.20(e)(2)(ii)(B); *cf.* § 1910.20(c)(10). Employee and designated representative access must be provided at a reasonable time, place, and manner, but in no event later than fifteen (15) days after the request is made. 29 CFR 1910.20(e)(1). OSHA access must be provided immediately upon request, 29 CFR 1910.20(e)(3), but because of the personal privacy interests affected by access to medical records, OSHA's access to such records is further conditioned upon compliance with the procedures and protections which were simultaneously promulgated as 29 CFR Part 1913.

Third, upon entering into employment and annually thereafter, employees must be informed by their employers of their rights under the rule and of the requisite procedures for exercising those rights. 29 CFR 1910.20(g).

In issuing the regulation, the Secretary considered its potential impact on trade secrets. 29 CFR 1910.20(f). Although identities of toxic substances, levels of exposure, and health status data may not be withheld, the employer may delete any other trade secret data which discloses manufacturing processes or the percentage of a chemical substance in a mixture. In addition, the provisions of the final rule permit employers to condition access to trade secrets upon basic written agreements not to misuse this information.

On May 21, 1980, the Industrial Union Department, AFL-CIO, petitioned the United States Court of Appeals for the District of Columbia Circut to review the rule pursuant to Section 6(f) of the OSH Act, 29 U.S.C. 655(f), the statute's provision for exclusive court of appeals' pre-enforcement review of occupational safety and health standards, *Industrial Union Dep't AFL-CIO v. Marshall*, No. 80-1550. The Chemical Manufacturers Association and the Chamber of Commerce of the United States later intervened in that lawsuit.

On July 18 and 21, 1980, a number of individuals and two trade associations, the Association of Diving Contractors and the Louisiana Chemical Association, petitioned the Fifth Circuit Court of Appeals under the same section 6(f) review provision. These cases were transferred to the D.C. Circuit under 28 U.S.C. 2112(a) and consolidated with the pending IUD case. Also in the D.C. Circuit, but in abeyance, is *National Constructions Ass'n v. OSHA*, No. 80-1020, a challenge to the standard's application to the construction industry. In addition, there is a challenge to the regulation pending in the United States District Court for the Western District of Louisiana, which the District Court originally dismissed for lack of subject matter jurisdiction, but which has since been remanded to it by the Fifth Circuit Court of Appeals. *Louisiana Chemical Association v. Bingham,* 657 F. 2d. 777 (5th Cir. 1981).

The records access rule expressed OSHA's policy, which became formalized after a full rulemaking proceeding, that employees, their representatives, and OSHA need access to employer maintained exposure and medical information in order to protect employee health and safety, and that this need is a proper subject for OSHA regulation. However, since particular provisions of the rule raised complex policy and legal questions concerning issues which in some cases had been resolved based on a limited rulemaking record and which had not yet been fully reviewed in light of the current administration's policies, OSHA obtained from the D.C. Circuit a six month deferral of the briefing schedule, beginning August 7, 1981. This deferral was later extended to expire in February, 1983. However, the agency has been forced to defend the existing rule in the district court case and a decision is expected before the end of the year.

OSHA has reviewed all aspects of the regulation, including: (1) Current enforcement experience; (2) the issues raised by the litigation; (3) petitions for modification of the standard from trade associations representing the flavor, fragrance, food and feed processing industries; and (4) other comments on the regulation that have been received from numerous interested persons. As a result of this review, OSHA has decided to propose modification of specific provisions of the rule. A draft of this proposal has been reviewed by the Advisory Committee on Construction Safety and Health. The issues involved in the proposed modification are discussed in the "Statement of Significant Issues" section of this preamble.

Legal Authority

By this proposal, OSHA seeks to modify, after rulemaking, its final rule on Access to Employee Exposure and Medical Records, 29 CFR 1910.20 (the "records access rule"). That rule was issued under both section 6(b) "standard-setting" and section 8 "general rulemaking" authority (see 45 FR 35243–48).

The issue of whether the records access rule is properly characterized as an "occupational safety and health standard" within the meaning of section 3(8) and issued under section 6(b) or a "regulation" under section 8(g)(2) has been the subject of litigation. The rule was challenged by both industry and union parties in the courts of appeals under section 6(f), the Act's provision for pre-enforcement review of OSHA "standards." As noted above, these petitions have been consolidated in the Court of Appeals for the District of Columbia, where the briefing schedule has been suspended until February 10, 1983, to allow OSHA this opportunity for reconsideration.

The rule was independently challenged in the U.S. District Court for the Western District of Louisiana. The district court dismissed the challenge for want of subject-matter jurisdiction on the ground that OSHA properly characterized the rule as a standard, which is reviewable only in a court of appeals. The Fifth Circuit Court of Appeals reversed this decision, holding that the rule is a section 8 regulation and not a section 6 standard; therefore the case was remanded to the district court. *Louisiana Chemical Association, et al.* v. *Bingham, et al.,* 657 F. 2d 777 (5th Cir., 1981). The Court of Appeals' reasoning was that Congress apparently intended standards to aim toward correction of specific and already identified hazards, rather than mere inquiry into possible hazards, and that the records access rule, while falling under the more general class of enforcement and detection regulations contemplated by Congress in section 8, does not address a particular hazard. This conclusion was based on the fact that the rule does not require employers to create the records in the first place and that the rule pertains to thousands of substances not all of which are known to pose a significant risk. The agency is currently defending the existing regulation in the district court case and a decision is expected before the end of the year.

Recognizing that this proposed rule can no longer be characterized as an occupational safety and health standard in the Fifth Circuit as a result of this decision, OSHA reaffirms its reliance on its section 8 general rulemaking authority to support the issuance of this proposed amendment (see 45 FR 35245–47). In so doing, the Secretary finds the rule, as proposed to be modified, necessary to carry out his responsibilities under the Act. In particular, the rule directly and indirectly promotes the control and detection of occupational health hazards by requiring the preservation and availability of toxic exposure and employee medical records to employees, their representatives, and to OSHA. As such, it contributes significantly to the protection of employees from toxic substances and harmful physical agents. With it, OSHA acts to fulfill its mandate to "assure so far as possible every working man and woman * * * safe and health working conditions." Section 2(b) of the Act.

In addition, however, OSHA believes that this rule not only falls squarely within the ambit of section 8 but also meets the somewhat more stringent and distinct requirements of section 6(b), as limited by the section 3(8) definition of an "occupational safety and health standard." In OSHA's opinion, the preservation and access requirements clearly satisfy the statutory element of "practices, means, methods * * * reasonably necessary or appropriate to provide safe or healthful employment and places of employment." In this regard, it should be noted that the rule operates not simply by making the record available to OSHA for enforcement purposes but directly to the employees themselves to assist them in achieving more healthful employment and places of employment." Secondly, in our view the rule addresses a significant risk—the risk of acute and chronic adverse health effects from workplace exposure to toxic substances and harmful physical agents. Further, the rule will significantly reduce this risk by providing employees with information necessary to avoid the risks and to correct unsafe conditions to the extent possible.

To the extent that the Fifth Circuit in *Louisiana Chemical Ass'n* v. *Bingham, supra.,* took a narrower view of what constitutes "significant risk," we do not believe that such a result is dictated by the Supreme Court decision in *Industrial Union Department* v. *American Petroleum Institute,* 448 U.S. 607 (1980). That decision, which established a finding of "significant risk" as a threshold condition for all section 6(b) standards, itself observed that Congress had an "information-gathering function" in mind when it enacted section 6(b)(7), and that requirements of this nature may be imposed at lower exposure levels than those that would support the regulation of a specific toxic substance on the basis of a finding of significant risk. This is so because it is necessary to "keep a constant check on the validity of the assumption made in developing the permissible exposure limit, giving it a sound evidentiary basis for decreasing the limit if it was initially set too high," *id.* at 2022, or *a fortiori,* if no permissible exposure limit was set at all. Furthermore, whatever the problems of breadth posed by the original rule which detracted from its status as a standard, we note that the proposed modifications—particularly the toxicological criteria introduced into the "toxic substance" definition and the elimination of the fourth category of "exposure record"—have sharpened the focus of the rule considerably. Thus the rule now covers only actual exposure records pertaining to substances which are known to pose serious toxic hazards and to employees in employments characterized by exposures to such hazards. OSHA therefore believes that, in addition to meeting the legal criteria for a section 8 regulation, the proposed rule is, for purposes of judicial review, a section 6 standard.

In addition, it is important that the records access rule be characterized as an occupational safety and health standard in order to avoid protracted multiple district court litigation, which would result in: (1) General confusion over the applicability of the rule, (2) delays in the resolution of the validity of the rule, and (3) enforcement and compliance problems that would ensue from conflicting or inconsistent judicial decisions. Therefore, to preserve our right to relitigate the jurisdictional issue of section 6(b) authority should be challenged outside the Fifth Circuit, OSHA continues to rely on section 6(b) independent authority for issuance of this rule.

Finally, this proposal provides for modification of the trade secret protections of the rule. These changes are intended to provide for the maximum degree of trade secret protection which the Agency considers to be consistent with its mandate to promote the health and safety of employees. As a matter of legal authority, OSHA has previously taken the position that its mandate requires it to balance and accommodate the interests in occupational safety and health with the protection of trade secrets, but that any unavoidable conflict should be decided in favor of the health interest. (See 45 FR 35248-51, Records Access Preamble.) This position has been based on (1) federal preemption doctrine, which says that state law (i.e., trade secret protection) may be preempted if it burdens or conflicts with federal law; (2) the OSHA statute, whose limited trade secret section (Section 15; 29 U.S.C. 664) itself takes a balanced approach and does not directly restrict OSHA's otherwise broad rulemaking authority in the area of providing access to toxic substance information; and (3) analogous judicial contexts, where the courts have adopted a balancing approach favorable to the health and safety interest. By contrast, industry has argued, based on the Supreme Court decision in *Chrysler* v. *Brown*, 441 U.S. 281 (1979), that OSHA lacks the authority to require the disclosure of any trade secret because the Act does not affirmatively and explicitly give it that authority, but rather is protective of trade secrets as evidenced by Section 15. The argument has also been made that a requirement to disclose trade secrets may result in an unconstitutional "taking" of private property without just compensation violative of the Fifth Amendment. However, in providing protection to trade secret interests, OSHA must be cognizant of the recent cotton dust decision, *American Textile Manufacturers Institute* v. *Donovan*, 101 S Ct. 2744 in which the Supreme Court declared that Congress in passing the OSH Act had made a legislative decision to strike the balance in favor of protecting the health of employees to the extent feasible. In our opinion, the proposed modifications, while providing significantly greater protection to trade secrets than does the current standard, satisfy this statutory mandate.

Statement of Significant Issues

A. *Scope and application.*—1. *General.* The rule currently applies to each general industry, maritime, and construction employer who makes, maintains, contracts for, or has access to employee exposure or medical records, or analyses thereof, pertaining to employees exposed to toxic substances or harmful physical agents. It applies whether or not the covered records are related to specific occupational safety and health standards. Also, the regulation applies to records created prior to the effective date of the regulation, August 21, 1980. The broad scope of the regulation has created certain problems, which we address as follows.

2. *Employees covered.* A literal construction of the rule would indicate that records of employees only marginally exposed to toxic substances and clearly not at health risk from such exposures are covered by the regulation. For example, records of office workers who make only infrequent or sporadic visits to production areas where toxic substances or harmful physical agents are present could be considered subject to the retention and access provisions of the regulation. However, OSHA's original intent was to provide access rights only to workers with significant toxic exposures.

For example, Dr. Leonard Guarrala of the Synthetic Organic Chemical Manufacturers Association (SOCMA) states "(W)e believe this rule covers almost every employer in the general industry, maritime and construction categories because the applicability of the standard pertains to employees exposed to 'toxic' substances or 'harmful' physical agents, but does not depend on any showing that the level of actual exposure is excessive or harmful" (Ex. 58, p.3).

Mr. J. Laurence McCerty (Prudential Insurance) also notes that the definition of "exposure" is "so overly inclusive that the company president on an annual tour walking past an area where a toxic substance is being stored would have to get a notice as an exposed employee since there is 'potential exposure' " (Ex. 31, p.2).

There is merit in this argument and therefore OSHA is proposing explicitly to limit the regulation's coverage to only those employees "whose work directly involve(s) the manufacturing, processing, installation, handling, packaging, transport, disposal, or use of toxic substances, or who (are) subject to harmful physical agents (e.g., noise, ionizing and non-ionizing radiation, hypo- or hyperbaric pressure) in any manner different from non-occupational situations; and includes, but is not limited to, coverage or production, maintenance, transport and construction workers" (paragraph (b)(1)). This modification targets the regulation at those specific employees whose job duties typically involve exposure to toxic substances or harmful physical agents. Production, maintenance, construction, and transport workers are covered if toxic substances or harmful physical agents are present in their workplaces, with no further inquiry necessary on whether each individual is working directly with a toxic substance or harmful physical agent. For instance, an electrician working near a welding operation on a construction site would be covered. At the suggestion of the Advisory Committee for Construction Safety and Health, "installation" was added to clarify the broad coverage of construction workers.

Coverage means that they have a right of access to their medical records and to relevant exposure records, and that these records must be retained in accordance with the rule. "White collar" employees and employees in other industries (e.g., service industries) where exposures to toxic substances or harmful physical agents do not typically occur would not in most cases be covered by the regulation.

However, the regulation would continue to provide for access to exposure and medical records of any general industry, construction or maritime employee not otherwise covered by the standard who is accidentally exposed to a toxic substance or harmful physical agent to a degree sufficient to require medical treatment. Records documenting the extent and treatment of injuries due to accidental exposures have clear occupational health importance and therefore should be subject to the access provisions of this regulation. However, since medical records of accidentally exposed employees would not normally be segregated from medical records of non-exposed employees, medical records related to accidental exposures would not be subject to the retention requirements of the regulation. Otherwise, when an employer of employees not normally covered by the standard disposes of medical records, he would have to make a determination of whether or not each record to be disposed of was related to an accidental exposure, and therefore subject to mandatory retention.

Access to medical records concerning accidental exposures must be provided for as long as the employer does retain the record.

Exposure records relating to accidental exposures would, on the other hand, be subject to thirty year retention. Since exposure records would not normally be kept for employees in that work location, the determination of specific records subject to retention would not be difficult.

This proposed modification is consistent with the original intent of the standard, which was not generally meant to apply to office workers or workers exposed only to safety hazards causing cuts, falls, and traumatic injuries (45 FR 35258 and 35265).

3. *Records created under contract.* The status under the standard of records created under contract was a source of confusion to many affected parties (Ex. 62, pp. 37–40; Ex. 60, p. 3). Therefore, paragraph (b)(3) is being modified to clarify the obligations of employers who contract for exposure or medical services. The proposed modification requires that "each employer shall ensure that the requirements of this section are made known to physicians and others providing medical or industrial hygiene services under contract to the employer and shall make a good faith effort to ensure, by modification of the contract if necessary, that such persons comply with the preservation and access requirements of the section." This modification should alleviate employer concerns that they will be held strictly liable for noncompliance of contract physicians not fully under their control even when they have done everything reasonably possible to assure compliance.

Records of emergency medical treatments for traumatic injuries or illnesses would not be covered if no written contract for medical services was in effect at the time of the accident.

4. *Industries covered.* Several trade groups have argued that certain industries ought to be exempted from coverage. In particular, employer groups in the flavor and fragrance industries (Exs. 44, 45, 47, 48, 50, 52), the grocery manufacturing industry (Exs. 46, 49, 51, 53–56), the feed manufacturing industry (Ex. 26), the construction industry (Exs. 40–43), and the commercial diving industry (Ex.), have argued for limited or full exemption from the provisions of the standard. The flavor and fragrance industries are currently the subject of a partial administrative stay designed to protect its trade secrets (46 FR 40490–91). This stay has been extended to February 15, 1983.

The flavor, fragrance and grocery industries base their justifications for exemption primarily on the following assertions: (1) The broad definition of "toxic substance" includes many food and fragrance substances which, on the basis of objective data, are demonstrated to be safe; (2) the possibility for disclosure under the regulation of valuable trade secret formulas greatly outweighs the benefits of disclosure; and (3) the records access regulation overlaps regulation of these industries by the Food and Drug Administration (FDA) and the Department of Agriculture (USDA).

For example, the Flavor and Extract Manufacturers Association (FEMA) states that "(T)he standard's definition of toxic substances is so broad that many traditional innocuous food ingredients (i.e., sugar, vanilla, and lemon oil) would be considered 'toxic' within the meaning of the standard. The sheer number of substances considered 'toxic' under the standard will make compliance with requests for disclosure both extremely costly and very difficult" (Ex. 44, p. 1). FEMA also notes that "(T)rade secrets are the lifeblood of the flavor industry and are most carefully guarded by flavor manufacturers * * * The disclosure required by the standard would threaten the very existence of the flavor industry without any showing that flavors and flavor materials present significant risks to any worker or that those risks would be lessened or eliminated because of the standard" (Ex. 44, p. 2).

With regard to agency overlap, a statement submitted by the Grocery Manufacturers Association asserts that "(T)he primary intent of the FDA and USDA regulations is to reduce the possibility of microorganisms, chemicals, filth or other contaminants in food. However, one of the obvious effects of these regulations is the reduction of employee exposure to harmful food substances by regulating the proper use, storage, and handling of materials that may be toxic" (Ex. 46, p. 2).

OSHA review of the scientific evidence, however, indicates that many of the materials used in flavor, fragrance and grocery manufacturing could be toxic under workplace conditions. Although FDA regulations ensure that the concentrations of these toxic substances are too low in finished consumer goods to be of health significance, workplace exposures to bulk quantities may nonetheless be toxic to workers unless necessary precautions are taken. Furthermore, the jurisdictions of FDA and USDA do not extend to the protection of workers from exposures to harmful materials during manufacturing processes (Exs. 50, 51).

Therefore, rather than exempt these industries entirely, we have responded to their legitimate concerns through proposed modification of specific provisions of the regulation. In particular, we propose both narrowing the definition of "toxic substance" and modifying the trade secret provisions to substantially reduce the likelihood that the release of trade secrets will be required. In fact, the trade secret modifications basically parallel the current stay for the flavor and fragrance industries, which has evidently satisfied those industries' concerns in this interim period.

The feed manufacturing industry petition seeks a stay of the standard as it applies to employee exposure records (Ex. 26). The industry maintains that " 'Exposure records' have been so broadly defined so as to include nearly every piece of paper generated in many workplaces * * * (we) did not fully realize that the regulation likewise requires retention of literally thousands of routine documents." (Ex. 26, p. 2).

OSHA is responding to these bona fide concerns by narrowing the definition of "employee exposure record" to include only those records traditionally regarded as occupational exposure records.

The diving industry sought a stay of the records access standard as it applied to employees engaged in commercial diving on the grounds that: (1) The standard was improperly promulgated as it applied to them; (2) divers are not exposed to "toxic substances or harmful physical agents"; and (3) the standard jeopardized valuable trade secrets such as proprietary decompression tables (Ex. 86). The Agency, while denying this stay request as lacking merit, issued an official interpretation of recordkeeping obligations in the diving industry which explained the interaction between the records access standard, 29 CFR 1910.20, and the commercial diving standard, 29 CFR 1910.401–441 (Ex. 87). Since employees in the commercial diving industry are subject to occupational illness associated with their workplace exposure (e.g. mixed gases, hyperbaric pressure), OSHA sees no basis for excluding the industry from the proposed records access rule. Certain proposed modifications to the rule—for instance, the proposed limitation on access to "similarly situated" exposure records which gave rise to the industry's concerns about access to proprietary decompression tables—should alleviate the industry's concerns about the rule's impact while assuring their employees the benefits of the standard.

Employers in the construction industry argue that the records access standard poses certain practical compliance difficulties. The industry maintains that: (1) Construction employees are exposed to toxic substances, if at all, for only brief periods since their work requires movement from place to place on the construction site; (2) due to the large number of temporary employees (the typical construction employee annual turnover rate is between 300 and 600 percent), the regulation would require long-term retention of huge numbers of individual records having a negligible degree of occupational health significance; (3) the principal types of employee records generated on a construction site are much different from those generated in general industry—most monitoring is done on an area basis, and records do not reveal the identities of employees who may have been working in those areas; and (4) medical records generated would be primarily those concerned with first-aid and emergency treatment (Docket H-112C; Ex. 2-42A, pp. 4-6).

Because of the construction industry records access issues, OSHA partially stayed the records access regulation with respect to the construction industry (46 FR 23740; April 28, 1980). In that notice, OSHA solicited comments from interested parties concerning the experience of the construction industry under the regulation, and specifically what aspects of the construction industry render the regulation inappropriate. A total of 47 comments were received. Also, the Advisory Committee for Construction Safety and Health (CAC) met June 10–12, 1981, in Washington, D.C. and considered the issue of records access (Exs. 62, 63). OSHA published a summary and analysis of the comments and the Advisory Committee recommendations in the Federal Register on September 15, 1981 (46 FR 45758).

Based on its analysis of the comments and CAC recommendations, OSHA lifted the stay. At the same time, the agency issued interpretations which incorporated most of the CAC recommendations and stated that the construction records access issues would continue to be reviewed as part of the general modification process.

In developing this proposal, three basic alternatives were considered for dealing with construction industry concerns: (1) Exempt the construction industry from the regulation; (2) modify the regulation in accordance with CAC recommendations and the concerns of other industries (recognizing that the records access concerns of construction employers and non-construction employers are often similar); or (3) specifically exempt the construction industry from certain provisions of the regulation.

The alternative of exempting the construction industry from the regulation was not chosen by OSHA since, as has been argued by construction labor unions, construction workers are often exposed to toxic substances and generally are less protected than industrial workers (Docket H-112C; Exs. 24, 31, 33, 41, and 45). We argue that their need for access to records that are kept on toxic exposures or health status is at least as great as industrial workers. Most complaints from affected employers do not challenge, and in fact largely support, the basic premises of the regulation, but instead target certain specific provisions, such as the broad scope of the regulation, as being too burdensome.

OSHA has therefore decided to respond to the construction industry's specific concerns through a combination of both the second (modification of standard) and third (exemption from certain provisions of the standard) alternatives. Specifically, OSHA has decided to propose the following: (1) Exemption of construction industry from medical records retention requirements beyond the duration of employment; (2) modification of the definition of "toxic substance;" (3) removal of records of most first-aid and emergency treatment from the definition of "employee medical record;" (4) elimination of purchase order type records of chemical identity from the definition of "exposure record;" and (5) incorporation of various interpretations which were made in response to the June 11, 1981, CAC recommendations.

A draft of this current proposal was submitted to the Advisory Committee which met on March 3–5, 1982, for its further consideration. The CAC submitted seven additional recommendations, which were considered in developing this proposal (Ex. 77, 78, 82). These recommendations are discussed elsewhere in the preamble in conjunction with the issues to which they pertain.

B. *Definitions.*—1. *Analysis using exposure or medical records.* The paragraph (c)(2) definition of "Analysis using exposure or medical records" is being modified to exclude "research" and "other" studies, thereby including only data compilations or statistical studies based on information contained at least in part in employee exposure or medical records. This modification is meant to conform the language of the regulation closer to the original intent, which was to cover such records as "charts, graphs, tables, industrial hygiene surveys, evaluation of disease experience, and other summaries and evaluations" of exposure and/or medical data (45 FR 35260). For the most part, these records simply represent conclusions that could be drawn by any competent health professional with access to the underlying exposure or medical records. Industrial hygiene surveys are included within the definition because they can provide an overview of where the toxic exposure problems in a plant are, as well as a critical understanding of the methodologies and sampling techniques being used.

On the other hand, the definition is not meant to cover such records as engineering reports or the records of experimental toxicological research, which typically bear only a tenuous relationship to the actual workplace exposures or health of employees. In making this distinction, OSHA is particulary concerned that the standard not act as a disincentive to employers who are inclined to conduct research in the occupational health area beyond routine measuring or monitoring of toxic exposures.

2. *Employee.* Modification of the definition of "employee" (paragraph (c)(4)) is being proposed to be consistent with changes made in the "scope and application" section. "Employee" is now defined as any employee "whose work directly involves the manufacturing, processing, handling, installation,

packaging, transport, disposal, or use of toxic substances, or who is subject to harmful physical agents in any manner different from typical non-occupational situations, and includes, but is not limited to, coverage of production, maintenance, construction and transport workers."

"Employee" also includes any employee exposed to a toxic substance or harmful physical agent to a degree sufficient to require medical attention.

3. *Employee exposure record.* In the absence of more formal exposure records (air contaminant measurement, biological monitoring data, material safety data sheets), paragraph (c)(5) of the current regulation treats any other record which reveals the identity of a toxic substance (e.g. purchase records) as an "exposure record." The requirement to keep and make available this information, when coupled with the current broad definitions for "toxic substance" and "exposure," is the source for much of the concern regarding trade secret disclosure and the practical burdens of complying with the regulation.

Mr. David Bossman (American Feed Manufacturers Association) comments that "(T)he rule, as adopted . . . requires employees to retain for at least 30 years massive quantities of routine documents, including production records, shipping records, invoices, etc., which are not at all directly related to the purpose of the rule" (Ex. 26, p. 7).

OSHA is proposing narrowing the definition of "exposure record" to conform closer to the common meaning of that term. This modification will reduce both the possibility of trade secret disclosure and the employer burdens in complying with the regulation.

The proposal requires retention and access for only the following types of exposure records: (1) Environmental (workplace) monitoring results; (2) biological monitoring results defined as exposure records by OSHA standards (other biological monitoring results would now be treated as medical records, which are entitled to greater confidentiality protection); and (3) material safety data sheets. Other records which reveal the identity of a toxic substance or harmful physical agent are no longer treated as exposure records. However, the employer is still required to inform an employee upon request of the identity of a toxic substance to which the employee is exposed (paragraph (e)(2)(ii)). This requirement will ensure that workers will continue to be able to find out what toxic substances they are currently working with, while reducing the burden on employers of maintaining a voluminous historical record which would provide little information of value concerning past toxic exposures.

This proposed modification responds favorably to the major concerns of many employers, including the construction, flavor and fragrance, food processing and feed manufacturing industries. These industries maintain that this requirement relating to general "exposure" records is especially burdensome, and that access to records such as purchase orders could jeopardize many valuable trade secrets (Ex. 44).

The current paragraph (c)(5) definition of "employee exposure record" includes all records of biological monitoring results that measure employee exposure. The proposed modification excludes records of biological monitoring results not defined as exposure records by specific occupational safety and health standards. This modification is proposed in response to comments that there are some privacy concerns connected with biological monitoring results, which are often kept in medical files. OSHA agrees, and in those instances where non-mandatory biological monitoring is performed, these records should be considered medical records. In cases such as the lead standard, where OSHA decides to require biological monitoring of a toxic substance due to significant health risks associated with exposure, the information does not significantly infringe upon personal privacy interests and is considered of critical importance to similarly or potentially exposed workers. Therefore, it should be readily accessible to those workers, their unions, and OSHA.

4. *Employee medical record.* The definition of "employee medical record" (paragraph (c)(6)) is being narrowed. The current definition includes all employee X-rays, regardless of the purpose for which they were taken. However, X-rays taken to detect and treat broken bones due to falls or other traumatic occurrences do not serve to assist in the detection of occupational diseases. Therefore, the proposal considers only those X-rays taken for the purposes of establishing a baseline or determining specific occupational illness as part of the medical record. The storage of, and access to, X-rays of broken bones and other traumatic injuries would not be regulated by OSHA but rather would be subject to the policies of each individual employer or physician.

The proposal is adding paragraph (c)(6)(ii)(B) to clarify that OSHA does not consider certain first-aid records to be a part of the employee's medical record. Like X-rays of traumatic injuries, first-aid records are not typically used to detect occupational disease. However, if a first-aid record is made by a physician or becomes part of an individual worker's medical record, it is then considered part of the medical record and subject to the regulation's retention and access provisions.

Paragraph (c)(6)(ii)(D) is being added to exclude from the definition of "employee medical record," "records created solely in preparation for litigation which are privileged from discovery under the applicable rules of procedure or evidence." This modification simply incorporates an interpretation that has already been made with respect to the existing standard. The purpose of this exclusion is to make clear that the rule is not meant to provide a way around local rules of discovery or evidence when the claim to which the record in question relates is being litigated and the record itself is a product of the litigation. As we explained when the interpretation was first published:

> The question has been raised whether an employer must provide access to records which are created solely in anticipation of litigation and which are otherwise privileged from discovery under the prevailing rules of procedure or evidence. An example could be a medical opinion prepared for the employer for purposes of aiding the employer's case by a company physician after a workmen's compensation claim has been filed. It has been OSHA's interpretation that the standard does not contemplate coverage of such a record if the record would not otherwise be available to the employee or his attorney in the litigation. On the other hand, the mere fact that a medical record (see definition at 29 CFR 1910.20(c)(6)) not originally created in anticipation of specific litigation will ultimately be used as evidence in a private legal proceeding does not put it outside the scope of the standard. (46 FR 40490)

5. *Exposure.* The paragraph (c)(8) definition of exposure is being to be deleted due to the changes in the scope of the regulation. As discussed earlier in this section, the current regulation covers all "exposed" employees. The proposed scope specifies more particularly which employees are covered, thereby eliminating the necessity to separately define "exposed."

6. *Specific written consent.* The definition of "specific written consent" (proposed paragraph (c)(9)(ii); (c)(10)(ii) in the current regulation) would remain unchanged except for a clarifying modification of the language indicating that "specific written consent" does not authorize the release of medical information not in existence on the date

of the written authorization unless the release of particular future information is expressly authorized.

7. *Toxic substance.* The definition of "toxic substance" (proposed paragraph (c)(10); (c)(11) in the current regulation) is being narrowed to include only those chemicals on the National Institute for Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS) list which meet certain toxicological criteria. The regulation currently requires the retention and disclosure of exposure information regarding any "toxic substance or harmful physical agent." "Toxic substance" was defined broadly, most notably by including any substance listed in the NIOSH RTECS list—a compendium of over 39,000 chemicals including such common substances as sugar and salt. Many affected parties have criticized RTECS as overinclusive.

The current regulation also defines as toxic any substance which "is regulated by any Federal law or rule due to hazard to health." This provision was broadly interpreted by some to mean that all food ingredients are "toxic" since they are substances regulated by the Food and Drug Administration. Mr. Sherwin Gardner (GMA) noted that "this regulation does not discriminate between the few genuine hazards (e.g.: flour dust inhalation) and the vast majority of safe food substances to which workers are exposed" (Ex. 55, p. 1). This was not OSHA's original intent, which was to cover such regulated substances as air and water pollutants and other serious health hazards. The deletion of this provision should not affect occupational health benefits since OSHA believes that the proposed "toxic substance" definition adequately delineates the scope of the regulation and includes the regulated substances which pose a toxic risk to workers.

For instance, many food ingredients will continue to be covered by the regulation since they meet the proposed criteria for "toxic substance." The handling of bulk quantities of dyes, additives, and other food ingredients considered toxic under the proposed definition can represent a potential hazard in food processing operations. FDA regulations do not extend to occupational exposures, but instead require that the concentrations of hazardous ingredients in consumer goods be kept at safe levels.

The "toxic substance" definition also included any substance which "has yielded positive evidence of an acute or chronic health hazard in human, animal, or other biological testing conducted by, or known to, the employer," ((c)(11)(iii)) and any substance which "has a material safety data sheet available to the employer indicating that the material may pose a hazard to human health" ((c)(11)(iv)).

Therefore OSHA is proposing to modify current paragraph (c)(11)(ii) pertaining to the use of RTECS, and to delete the requirements of (c)(11)(i) with regard to substances regulated by other Federal agencies. The aspect of the definition pertaining to positive studies known to the employer is proposed to be modified to incorporate the same toxicity criteria which would now limit the use of RTECS. In other respects, that provision, as well as the one pertaining to material safety data sheets, remains unchanged.

The modification of (c)(11)(ii) (renumbered as (c)(10)(iii)) retains the use of RTECS as a basic source of information, but greatly limits its application by adding specific toxicity criteria which would indicte whether or not a substance is likely to pose an occupational health risk. To come under the definition of "toxic substance" a substance would not only have to be listed in RTECS but would have to fulfill one of the following conditions: (1) Be reported to cause human toxicity at any dose level; (2) be reported to cause cancer or reproductive effects in animals at any dose level; (3) have a reported oral rat LD50 (that does required to kill 50% of the treated animals) of less than 500 milligrams per kilogram of body weight; (4) have a reported rabit skin contact LD50 of less than 1000 milligrams per kilogram of body weight; or (5) have a reported rat inhalation LC50 (that atmospheric concentration required to kill 50% of the exposed animals) of less than 2000 parts per million of gas or vapor, or less than 20 milligrams per liter of mist, fume or dust. Conditions (3), (4) and (5) are adapted from the "toxic chemical" definition in the American National Standards Institute's document, "American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals" (ANSI Z129.1–1976). These toxicological measurements are commonly performed for chemicals used in industrial processes.

NIOSH has generated from RTECS a list containing 3,492 substances which meet these criteria (Ex. 88). This list represents a greater than 90 percent decrease in the number of chemicals specified under the "toxic substance" definition. OSHA intends to make such a list available to affected parties, and to periodically issue an updated list.

In considering the proposed definition of "toxic substance," it should be remembered that, while the definition does in some sense determine the scope of the rule, the rule does not directly regulate any of the substances which falls within the definition. Rather, what is being regulated is access to which records relating to those substances or to employees exposed to those substances and which the employer has chosen to create. Thus, while the definition of "toxic substance" may encompass several thousand chemicals, only a fraction of them is likely to be present in any one workplace. Moreover, while some medical records are likely to be kept on employees who work directly with the covered substances in the workplace, it is less likely that there will be exposure records on all of them. Rather, an employer is likely to have exposure records only for those workplace chemicals which are most common or most hazardous. The scope of the employer's obligation will therefore, in most cases, be considerably narrower than the scope of the "toxic substance" definition would initially suggest.

Alternatives to this proposed modification will also be considered. An option to the proposed "toxic substance" definition is limiting the definition to only those substances which are regulated by OSHA, or to other lists of substances having recognized occupational health significance, such as the ACGIH TLV list (American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment"). The regulation could be further limited to records of employees actually subject to exposures greater than the levels prescribed by OSHA or the ACGIH. For instance, Mr. John Webster (Ohio Gas Association) writes that "[W]e would recommend that OSHA require records to be kept only when there has been exposure to identified harmful physical agents" (Ex. 30, p. 4).

These latter options were not chosen for proposal since the benefits of the regulation largely reside in its role in the detection of occupational diseases, especially those diseases associated with the currently unrecognized hazards of many non-regulated or under-regulated sustances. Limiting the regulation only to the recognized hazards contained in these lists would therefore eliminate the regulation's role in detecting unknown hazards. Also eliminated would be much of the other public health benefits associated with providing workers access to critical information about unregulated toxic exposures and effects.

C. *Retention periods.* The regulation currently requires exposure and analysis records to be kept for thirty years and medical records to be kept for the duration of employment plus thirty years. These periods reflect the latency periods associated with some occupational diseases, most notably cancer.

Affected parties, construction industry employers in particular, have expressed concern over the need and expense of retaining records of short-term employees for the full thirty year periods (See Ex. 30 (American Gas Association); Docket H-112C, Ex. 2–42A (NCA)). They argue that exposure and medical records of short-term employees would likely not be of occupational health benefit, since in twenty or thirty years it would be nearly impossible for a researcher to trace the cause of an occupational disease to short-term employment at a particular job-site when the employee had worked at dozens of essentially similar job sites. It would also be nearly impossible to locate the former employees should follow-up be necessary.

OSHA is therefore proposing exempting from the retention requirements any individually identified medical records of short-term (i.e., less than one year) employees. Although records of short-term employees may often be of future occupational health significance, the total burdens of maintaining these records do not appear to be justified. These employees would instead be given a copy of their records upon termination of employment. Having the record travel with the employee rather than being kept by each of several employers should be of greater overall health benefit to the employee.

Also, based on comments from construction industry employers that due to the nature of construction employment extensive recordkeeping would unduly burden employers (Docket H-112C; Exs. 2–4, 2–6A, 2–14), OSHA is proposing to modify the current standard's retention requirements for medical records generated and maintained by construction industry employers to the duration of an employee's employment provided that the record is turned over to the employee upon termination of employment. This modification would not apply, however, to any medical records retention requirements contained in substance-specific OSHA standards.

In addition, OSHA is proposing changing the retention period for medical records to length of employment plus 5 years, but in no event less than thirty years after the beginning of employment. At the expiration of the retention period the medical record may be discarded. This modification will considerably reduce the burden of the current rule by shortenting the outer limit of how long medical records of permanent employees will have to be kept. At the same time, the proposed retention period is still sufficiently lengthly to achieve the purposes of the rule, e.g., the preservation of worklife health records for research purposes. At the end of this period, an employee can in any event request a copy of the entire record to keep as part of his or her personal medical files. Thus, there should be no diminution of health benefits to the individual employee as a result of this proposed modification.

OSHA is also at this time soliciting information concerning the research benefit of retaining employee medical records beyond the duration of employment. OSHA is specifically interested in whether researchers engaged in current or completed research have made significant use of company-maintained medical records of former or deceased employees. OSHA is also interested in information concerning the number of occupational health investigations currently planned or forseeable which intend to make use of these records. OSHA hopes to determine whether the forseeable research needs for the medical records of former employees justify the expense to employers of maintaining these records.

In addition, OSHA solicits information and suggestions to make the retention requirement cost-effective. For example, epidemiological studies are generally performed in larger workplaces where a sufficient number of workers make up a study population. Therefore, it may be cost effective to require only these larger workplaces to preserve records beyond the duration of employment and to require the smaller firms to preserve records for the duration of employment.

D. *Access to Records.* The current regulation requires that requested records be made available within 15 days of the request. However, several commenters argue that situations may arise where it is not possible to comply with the fifteen day limit (Exs. 27, 28). Records may be stored at locations remote from where the request is made, or extraordinarily large numbers of records may be requested.

The proposed modification of paragraph (e)(1)(i) clarifies OSHA's intent in requiring records to be made available within fifteen working days. The modification allows employers to exceed the 15 day limit providing that: (1) It is not reasonably possible to fulfill the request within 15 days; and (2) within the 15 day period the employer apprises the requesting party of the reasons for the delay and an approximation of when the requested records will be available. The CAC recommended that OSHA explicitly require the 15 day limit with regard to the employer's obligation to notify the requesting party of any reasons for delay.

Paragraph (e)(1)(ii) is being added to indicate that an employer may require of the requesting party reasonable information to assist the employer in the location or identification of requested records. Typically, such information should be limited to only the dates and locations an employee worked during the time period in question. This information will assist employers in locating requested records and will preclude extensive searches of records by employers to determine which specific records are covered by a request. OSHA has also adopted a CAC recommendation that, in this case, only information related to locating the record may be requested by the employer.

The proposal would also add paragraph (e)(1)(iv) to indicate that "in the case of an original X-ray, the employer may restrict access to on-site examination or make other suitable arrangements for the temporary loan of the X-ray." This modification is intended to clarify an employer's responsibility in providing access to X-rays. Under paragraph (e)(1)(iii) of the proposed standard, the employer is required to provide an employee a copy of the record, or make copying facilities available to the requestor. However, in the case of X-rays a copy is not interchangeable with the original. Also, specialized equipment is required for copying X-rays, and this equipment is not normally available to employers. The proposed modification indicates that the copying provisions of the standard are intended to apply to the parts of the employee medical record which can be easily photocopied or reproduced, and not to X-rays.

A clarifying modification is proposed for paragraph (e)(2) concerning employee and designated representative access to records. The current regulation requires employers to provide an employee or designated representative access to exposure records of all employees having exposures similar to those of the subject employee. This provision is capable of overly broad interpretation, suggesting employee and