

ACUTE EXPOSURE GUIDELINES

Fact Sheet

WHAT ARE ACUTE EXPOSURE GUIDELINES?

U.S. Air Force environmental managers involved in emergency response efforts, cleanup projects, and environmental planning now have a new source of reliable data on health risks resulting from airborne exposures to toxic substances. These guidelines, called acute exposure guideline levels (AEGLs), address many of the chemicals of concern in Air Force environmental programs. AEGLs are designed to help risk managers:

- ◆ plan for and respond to chemical emergencies
- ◆ address compliance issues
- ◆ monitor exposures during site remediation efforts.

HOW ARE THE GUIDELINES USED?

In emergency planning and response, AEGLs are used in combination with computer-assisted air dispersion models to estimate “vulnerability zones” associated with releases of chemical substances. Human health risks associated with a chemical release can be estimated by comparing the projected airborne concentrations of the chemical with the exposed populations and AEGL values to determine an appropriate response.

The U.S. Environmental Protection Agency (EPA) and a variety of other agencies are likely to adopt AEGL levels for use in evaluating compliance with Clean Air Act requirements. The chemical-specific information contained in the AEGL documents is also useful in other efforts, such as monitoring exposures during environmental cleanups, and evaluating troop exposures to toxic substances during warfare.

WHAT INFORMATION DO THE GUIDELINES CONTAIN?

AEGLs define the concentration levels at which acutely toxic airborne chemicals begin to cause specific health effects for a one time exposure. Three threshold toxicity levels have been established for each chemical reviewed under the AEGL process including:

- ◆ AEGL-1 (*nondisabling*): notable discomfort, irritation, or certain asymptomatic nonsensory effects. The effects are transient and reversible upon cessation of exposure.
- ◆ AEGL-2 (*disabling*): irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- ◆ AEGL-3 (*lethal*): life-threatening health effects or death.

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Threshold Levels	Effects
Detectability ↓	- Increasing complaints of objectionable odor, taste, sensory irritation or other mild, non-sensory or asymptomatic effects
AEGL-1	
Discomfort ↓	- Increase in notable discomfort - Increasing severity of reversible effects (with or without signs/symptoms)
AEGL-2	
Disabling ↓	- Impairment of ability to escape - Increasing severity of irreversible or other serious long-lasting effects
AEGL-3	
Death	- Increasing likelihood of death

Tables have been established for each chemical that define airborne concentrations and known health effects for five exposure periods including: 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours (see sample table for Arsine).

For every chemical studied under the AEGL process, a detailed document is produced that summarizes the threshold toxicity levels, the exposure studies that have been conducted to date, chemical-specific information, and data on both short-term and long-term exposures.

WHAT CHEMICALS DO THE GUIDELINES ADDRESS?

When the guideline development effort got under way, the EPA coordinated with other federal agencies and stakeholders for their list of priority chemicals. “Chemicals of concern” from the Air Force’s Installation Restoration Program were cross-matched with the priorities of other agencies, resulting in an ordered master list of chemicals that warranted examination. AFIERA/RSRE has developed an AEGL Chemical List as an attachment to this fact sheet to describe the high-priority chemicals that are being examined and the status of their development under the AEGL process (see Attachment 1). Attachment 2 is a list of prospective chemicals proposed for AEGL development.

Summary of AEGL Values for Arsine

Classification	10-minute	30-minute	1-hour	4-hour	8-hour	Endpoint (Reference)
AEGL-1	NR ^a	NR	NR	NR	NR	Not recommended due to steep dose-response relationship, mechanism of toxicity, and because toxicity occurs at or below the odor threshold
AEGL-2	0.30 ppm 0.9 mg/m ³	0.21 ppm 0.7 mg/m ³	0.17 ppm 0.5 mg/m ³	0.04 ppm 0.1 mg/m ³	0.02 ppm 0.06 mg/m ³	Absence of significant hematological alterations in mice consistent with the known continuum of arsine toxicity (Peterson and Bhattacharyya, 1985)
AEGL-3	0.91 ppm 2.9 mg/m ³	0.63 ppm 2.0 mg/m ³	0.50 ppm 1.6 mg/m ³	0.13 ppm 0.4 mg/m ³	0.06 ppm 0.2 mg/m ³	Estimated threshold for lethality in mice (Peterson and Bhattacharyya, 1985)

^aNR: Not recommended. Numeric values for AEGL-1 are not recommended because (1) the lack of available data, (2) an inadequate margin of safety exists between the derived AEGL-1 and the AEGL-2, or (3) the derived AEGL-1 is greater than the AEGL-2. Absence of an AEGL-1 does not imply that exposure below the AEGL-2 is without adverse effects.

References

Peterson, D.P., Bhattacharyya, M.H. 1985. Hematological responses to arsine exposure: quantitation of exposure response in mice. *Fundamental and Applied Toxicology* 5: 499-505.

WHY WERE THE GUIDELINES DEVELOPED?

A 1984 disaster in Bhopal, India involving an accidental release of methyl isocyanate focused attention on the need for governments to identify hazardous substances and to help local communities plan for emergency exposures. In response, the U.S. Environmental Protection Agency identified more than 400 acutely toxic chemicals and initiated a process that culminated in the formation of the National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances (NAC-AEGL). This committee offers a forum in which the military, public, and private sectors can come together to develop and share well-crafted, rigorously derived standards for better protection of the public from exposure to hazardous chemical spills and releases.

AEGL values are intended to protect most individuals in the general population, including infants, children, pregnant women, the elderly, and persons with diseases such as asthma, heart disease, or lung disease.

ABOUT THE NATIONAL ADVISORY COMMITTEE FOR ACUTE EXPOSURE GUIDELINE LEVELS (NAC-AEGL)

The National Advisory Committee for Acute Exposure Guideline Levels (NAC-AEGL) was established to identify, review, and interpret relevant toxicological and other scientific data and to develop acute exposure guideline levels for high-priority, acutely toxic chemicals. U.S. Air Force involvement began in early 1995, when the Department of Defense was formally invited to join. The Air Force,

Army, and Navy are now all represented on the committee.

The committee, chartered in 1995 and deriving its authority from the U.S. Congress under the Federal Advisory Committees Act, has adopted standing operating procedures which adhere to guidelines that were established in a 1993 report entitled *Guidelines for Developing Community Emergency Exposure Levels for Hazardous Substances* sponsored by the EPA and the Agency for Toxic Substances and Disease Registry.

HOW ARE THE GUIDELINES DEVELOPED?

For each chemical under development, a team of experts is chosen from the committee membership. Those experts, in concert with scientists from Oak Ridge National Labs, perform an extensive review of data from peer-reviewed journals, government databases, published materials from the public and private sectors of the United States and foreign countries, as well as unpublished data from industry and other private organizations.

Information gathered for each chemical undergoes a rigorous evaluation, selection, and documentation process. Next, a number of calculations are made to:

- ◆ extrapolate from observed responses in animals to predicted human responses
- ◆ address the variability within the human population
- ◆ adjust for AEGL-specified exposure periods
- ◆ address issues of carcinogenicity.

Finally, technical documents are written that compile data and specify the methodologies used in deriving Acute Exposure Guideline values.

The NAC-AEGL follows the most comprehensive peer review process ever used to establish short-term exposure limits for acutely toxic chemicals. After the full committee reviews a guideline, public comments are solicited and incorporated. The process culminates with final review, concurrence and publication by the National Research Council.

FOR MORE INFORMATION

- ◆ Acute Exposure Guideline (AEGL) levels, NAC-AEGL documents, and information on AEGLs under development are available from the Health Risk Assessment Branch of AFIERA. Contact John Hinz, the Air Force's representative on the NAC-AEGL, at (210) 536-6136, or email john.hinz@brooks.af.mil.

ABOUT AFIERA/RSRE

The Health Risk Assessment Branch (RSRE) of AFIERA is the Air Force resource for environmental risk evaluation and communication. The branch provides a broad range of risk assessment and toxicology support to Air Force installations. For more information on risk assessments and the Health Risk Assessment Branch, contact Cornell Long at (210) 536-6121.

ATTACHMENT 1: HIGH-PRIORITY CHEMICALS ADDRESSED BY THE NATIONAL ADVISORY COMMITTEE FOR ACUTE EXPOSURE GUIDELINES (AEGLs)

I. Final AEGLs

Final AEGLs are those published by the National Research Council, National Academy of Sciences (NRC/NAS) following NRC/NAS peer review.

Aniline
Arsine
Methyl hydrazine
1,1-Dimethyl hydrazine
1,2-Dimethyl hydrazine

II. Interim AEGLs

Interim AEGLs are established by the National Advisory Committee for AEGLs (NAC-AEGL) following review and consideration of public comments on Proposed AEGLs that have been released in the Federal Register. Interim AEGLs are available for use by organizations while awaiting NRC/NAS peer review and publication of Final AEGLs.

Acrylic acid
Agent GA (Tabun)
Agent GB (Sarin)
Agent GD (Soman)
Agent VX
Allyl alcohol
Allyl amine
Boron trichloride
Boron trifluoride
Carbon monoxide
Carbon tetrachloride methanol
Chlorine
Chlorine dioxide
Chlorine trifluoride
Chloromethyl methyl ether
cis-Crotonaldehyde
Cyclohexylamine
Diborane
Dichlorodimethylsilane
Ethylene diamine
Ethylene oxide
Ethyleneimine
Fluorine
Furan
GF Agent

HCFC 141b
HFC 134A
HFE-7100 (Methyl nonafluorobutyl ether and Methyl nonafluoroisobutyl ether)
Hydrazine
Hydrogen chloride
Hydrogen cyanide
Hydrogen fluoride
Hydrogen sulfide
Iron pentacarbonyl
Isobutyronitrile
Methacrylonitrile
Nickel carbonyl
Nitric acid
Otto fuel (mainly Propylene Glycol Dinitrate)
Perchloromethyl mercaptan
Phenol
Phosgene
Phosphine
Propionitrile
Propylene oxide
Propyleneimine
Sulfur mustard
Tetrachloroethylene
Tetranitromethane
Toluene
trans-Crotonaldehyde
Trichloromethyl silane
Uranium hexafluoride
1,1,1-Trichloroethane
cis-1,2-Dichloroethylene
cis- and trans-1,2-Dichloroethylene
2,4-Toluene diisocyanate
2,6-Toluene diisocyanate

III. Proposed AEGLs

Proposed AEGLs are published in the Federal Register for public comment following review and concurrence of Draft AEGLs by the NAC/AEGL.

Acetone cyanohydrin
Acrolein
Ammonia
Bromine
Chloroform
Epichlorohydrin
Jet fuel (JP-8)

Methyl ethyl ketone
Methyl mercaptan
Monochloroacetic acid
N,N-Dimethylformamide
Nitric oxide
Nitrogen dioxide
Peracetic acid
Phosphorus oxychloride
Phosphorus trichloride
Piperidine
Trichloroethylene
Xylenes

IV. Draft AEGLs

Draft AEGLs have been prepared for review by the NAC/AEGL Committee.

Sulfur dioxide
Tetramethyl lead

V. Holding Status AEGLs

Holding Status AEGLs have been reviewed by the NAC/AEGL Committee and found to have insufficient data for the setting of Proposed AEGL values.

Acrylyl chloride
Arsenic trichloride
Cyanogen chloride
Isopropyl chloroformate
Methyl chloroformate
Propyl chloroformate
Sulfur tetrafluoride
Trimethylchlorosilane

VI. Remaining AEGLs

Remaining AEGLs are chemicals from the first priority list that have not yet been prepared for review by the NAC/AEGL Committee.

Benzene
Methylene chloride
Oleum
Sulfur trioxide
Sulfuric acid
Titanium tetrachloride

ATTACHMENT 2: CHEMICALS PROPOSED FOR AEGL DEVELOPMENT

Acid Halides

Acetyl bromide
Acetyl chloride
Allyl chloroformate
Benzene sulfonyl chloride
Benzyl alcohol
Carbonyl fluoride
Chloroacetyl chloride
Chloropivaloyl chloride
Chlorosulfonic acid
Diphosgene
Ethyl chloroformate
Ethylchlorothioformate
Ethylene glycol
Fluosulfonic acid
i-butyl chloroformate
Methanesulfonyl chloride
Methacryloyl chloride
n-butyl chloroformate
Propargyl alcohol
Sulfuryl fluoride
t-butyl alcohol
Thionyl chloride
Thiophosgene
Trichloroacetyl chloride
Trifluoroacetyl chloride
Trimethylacetyl chloride

Aldehydes

Acetaldehyde
Chloroacetaldehyde
Chloroacetonitrile
Formaldehyde
Methacryldehyde
Propionaldehyde

Aluminum Compounds

(not otherwise classified)
Aluminum chloride

Amides

Acrylamide
Antimycin A
Caprolactam
Fluoroacetamide
Formamide

Amines

3,5-dichloro-2,4,5-trifluoropyridine
3-methoxypropylamine
Aldicarb
Amphetamine
Bis(2-chloroethyl)ethylamine
Carbazole
Chlormequat chloride
Diethanolamine
Diethyl amine
Dimethyl amine
Ethyl amine
Hydroxyl amine
Isobenzan
Methyl amine
Monoethanolamine
n-butyl amine
Nicotine
N-Mustard
Paraquat dichloride
Phenylcarbylamine chloride
Pyridine
Strychnine
Thiocarbazine
Thiosemicarbazide
Trimethyl amine

Anhydrides

Acetic anhydride
Maleic anhydride

Anilines

2,4-dinitro aniline
3-trifluoromethylaniline
p-phenyl diamine

Antimony Compounds

(not otherwise classified)
Antimony pentafluoride
Stibine

Arsenic Compounds

(not otherwise classified)
Adamsite
Arsenic and compounds
Arsenic pentoxide
Arsenic trioxide
Copper acetoarsenite
Ethyl dichloroarsine
Lewisite
Lewisite oxide
Methyldichloroarsine
Phenyl arsonic acid
Phenyl dichloroarsine
Sodium arsenate
Sodium arsenite
Sodium cacodylate

Azo

BZ
Diazomethane

Barium Compounds

(not otherwise classified)
Barium and compounds

Beryllium Compounds

(not otherwise classified)
Beryllium and compounds

Boron compounds

(not otherwise classified)
Boron tribromide
Pentaborane

Bromine compounds

(not otherwise classified)

Aluminum bromide
Bromine trifluoride
Bromine pentafluoride
Bromine chloride

Cadmium compounds

(not otherwise classified)

Cadmium and compounds

Carbamate

Carbofuran
Formetanate hydrochloride
Methiocarb
Oxamyl
Tirpate

Carbonate

Triphosgene

Chlorine compounds

(Inorganic, not otherwise classified)

Chlorine pentafluoride

Chlorosilanes

Allyl trichlorosilane
Amyltrichlorosilane
Butyl trichlorosilane
Chloromethyl trichloro silane
Dichloromethyl phenyl silane
Dichlorosilane
Methyl chlorosilane
Methyl dichlorosilane
Tetramethoxy silane
Trichloro(dichlorophenyl) silane
Trichloroethyl silane
Trichlorophenyl silane
Trimethoxysilane

Chromium Compounds

(not otherwise classified)

Chromic chloride

Cobalt Compounds

(not otherwise classified)

Cobalt and compounds

Copper Compounds

(not otherwise classified)

Copper and compounds

Epoxides

1,2-butylene oxide
Heptachlor epoxide

Esters

Beta-propiolactone
Butyl acrylate
Dimethyl phthalate
Diethyl phthalate
Ethyl acetate
Ethyl acrylate
Iso-butyl chloroformate
Isopropyl formate
Methyl 2-chloroacrylate
Methyl methacrylate
n-butyl acetate
Vinyl acetate monomer

Ethers

1,3-dioxolane (diulane)
Bis-chloromethyl ether
Bisphenol A diglycidyl ether
Butyl benzyl phthalate
Butyl vinyl ether
Dichloroethyl ether
Diethyl phthalate
Diethylene glycol monomethyl ether
Diketene
di-n-butyl phthalate
Dioxin
Ethyl ether
Methyl t-butyl ether
Propylene glycol monomethyl ether acetate
Tetrahydrofuran

Fluorine compounds

(not otherwise classified)

Calcium fluoride
Cyanuric fluoride
Oxygen difluoride
Perchloryl fluoride
Sodium fluoroacetate

Germanium Compounds

(not otherwise classified)

Germane

Halogens

1,1-dichloroethane
1,2,4-trichlorobenzene
1,2-dichloroethane
1,2-dichloropropane
1,3-dichloro-5,5-dimethylhydantoin
4,4'-DDT
Allyl chloride
Benzal chloride
Benzoyl chloride
Benzyl chloride
Benzyl trichloride
Bromodiolone
Bromoform
Campheclor
Chlordane
Chlorobenzene
Chloroethane
Chloroethanol
Cyanogens
Dibromoethane
Dichlorobenzene
Dieldrin
Ethylene fluorohydrin
Heptachlor
Hexachlorocyclopentadiene
Hexafluoroacetone
Hexafluoropropylene
Lindane (hexachlorocyclohexane)
Methyl bromide
Methyl chloride
Methyl fluoride
Methyl fluoroacetate
Methyl iodide
Oxetane 3-3bis(chloromethyl)
Perfluoroisobutylene
Polychlorinated biphenyl
Propargyl bromide
Tetrafluoroethylene
Trans-1,4-dichlorobutene
Trifluorochloroethylene
Vinyl chloride
Vinyl fluoride

Hydrides

Lithium hydride

Hydrocarbons

(Aliphatic)

Alpha-pinene

Butadiene

Butane

Cyclohexane

Cyclopentane

Gasoline

Hexane

Methane

Propane

Vinylnorbornene

Hydrocarbons

(Aromatic)

Benzo (a) pyrene

Benzo (k) fluoranthene

Benzola (a) anthracene

Biphenyl

Chrysene

Cumene

Mesitylene

Pyrene

Styrene

Trimethylbenzene

Inorganic acids

Chromic acid

Hydrogen bromide

Hydrogen iodide

Hydrogen selenide

Iodic acid

Phosphoric acid

Isocyanates

4,4'-methylenediphenyldiisocyanate

Cyclohexyl isocyanate

Ethyl isocyanate

Isobutyl isocyanate

Isophorone diisocyanate

Methacryloyloxyethyl isocyanate

Methoxymethyl isocyanate

Methyl isothiocyanate

Methyl thiocyanate

n-butyl isocyanate

n-propyl isocyanate

Phenyl isocyanate

t-butyl isocyanate

Ketones

4-methyl-2-pentanone

Acetone

Bromoacetone

Chloroacetone

Chloroacetophenone

Chlorophacinone

Diphacinone

Hydroquinone

Ketene

Methyl vinyl ketone

Terramycin

Warfarin

Lead Compounds

(not otherwise classified)

Lead and compounds *(including lead phosphate)*

Tetraethyl lead

Manganese Compounds

(not otherwise classified)

Ethyl mercaptan

Manganese,

tricarbonylmethylcyclopentadienyl

Manganese and compounds

n-octyl mercaptan

Phenyl mercaptan

Thiodiglycol

t-octyl mercaptan

Mercury Compounds

(not otherwise classified)

Diethyl mercury

Mercury & compounds *(including methyl mercury)*

Methoxyethyl mercury

Methyl mercury

Phenyl mercuric acetate

Nickel Compounds

(not otherwise classified)

Nickel & compounds

Nickel oxide

Nitriles

0-chlorobenzylidene malononitrile

Acrylonitrile

Adiponitrile

Bromobenzyl cyanide

Cyanogens

Cyanogens bromide

Cyanogens iodide

Formaldehyde cyanohydrin

Lactonitrile

Malononitrile

Sodium cyanide

Nitro Compounds

Benzene, 1-(chloromethyl)-4-nitro

Chloropicrin

Dinitro toluene

Ethyl benzene

Nitrobenzene

Nitrogen Compounds

(not otherwise classified)

Ammonium fluoride

Nitrogen tetroxide

Nitrogen trifluoride

Nitrogen trioxide

Nitrosyl chloride

Nitroso Compounds

Nitosodimethyl amine
Trifluralin

Organic Acids

2,4-dichlorophenoxy acid
Acetic acid
Formic acid
Glycolic acid
Methacrylic acid
Oxalic acid
Propionic acid

Osmium Compounds

(not otherwise classified)

Osmium tetroxide
2-butanone oxime

Oxygen Compounds

(not otherwise classified)

Carbon monoxide
Ozone

Peroxides

Cumene hydroperoxide
Hydrogen peroxide

Phenols

4,6-dinitro-o-cresol
Cresol
o-cresol
p-cresol
Pentachlorophenol
Phenol,2,2'-thiobis(4-chloro-6-methyl)
p-methoxyphenol

Phosphorus Compounds

(not otherwise classified)

Aluminum phosphide
Azinphos-methyl
Coumaphos
Demeton S-methyl
Diazinon
Dichlorovos
Dicrotophos
Dimethoate
Dimethylphosphate
Dimethylphosphorochloridothioate
Disulfoton
Ethion
Ethoprophos
Ethylphosphonodichloridate
Ethylphosphonodithioic dichloride
Ethylphosphonous dichloride
Fenamiphos
Fenitrothion
Fonophos
Hexaethyl tetraphosphate
Isopropyl methyl phosphonic acid
Malathion
Methamidophos
Methidathion
Methomyl
Methyl parathion
Methyl phosphonic acid
Methyl phosphonic dichloride
Methyl phosphonous dichloride
Mevinphos
Monocrotophos
Parathion
Phosmet
Phosphorus
Phosphorus oxybromide
Phosphorus pentabromide
Phosphorus pentachloride
Phosphorus pentafluoride
Terbuphos
Tetraethyl dithiopyrophosphate (Sulfoteb)
Zinc phosphide

Selenium Compounds

(not otherwise classified)

Selenium hexafluoride
Selenium oxychloride

Silicon Compounds

(not otherwise classified)

Silane
Silicon tetrafluoride

Sulfur Compounds

(not otherwise classified)

1,3-propane sultone
Carbon disulfide
Carbonyl sulfide
Dimethyl sulfate
Dimethyl sulfide
Dimethyl sulfide
Disulfur dichloride
Methyl sulfate
Sulfur dichloride
Sulfur monochloride
Sulfuryl chloride

Tantalum Compounds

(not otherwise classified)

Tantalum V fluoride

Tellurium Compounds

(not otherwise classified)

Tellurium hexafluoride

Thallium Compounds

(not otherwise classified)

Thallium sulfate

Titanium Compounds

(not otherwise classified)

Titanium chloride
Titanium III fluoride
Titanium tetrachloride

Tungsten Compounds

(not otherwise classified)

Tungsten hexafluoride

Vanadium Compounds

(not otherwise classified)

Vanadium & compounds

Zinc Compounds

(not otherwise classified)

Zinc & compounds