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Sources and Types of Data for Establishing Spacecraft Water Exposure Guidelines

IN this chapter, the Subcommittee on Spacecraft Water Exposure Guidelines describes the sources and types of data that should be used for establishing spacecraft water exposure guidelines (SWEGs). This information is similar to that described in the National Research Council's (NRC 1992) *Guidelines for Developing Spacecraft Maximum Allowable Concentrations for Space Station Contaminants* (SMACs), but with important differences. First, the major route of exposure considered in SMACs is inhalation, whereas the major expected route of exposure considered in SWEGs is oral, via ingestion of drinking water and food prepared in potable water. Dermal absorption and inhalation could be secondary routes of exposure. Second, the SWEGs should incorporate advances in the understanding of human physiology and metabolism in microgravity that have occurred since the SMACs were published. Third, the duration of the exposures of interest is different for contaminants in drinking water, because exposure can be avoided if necessary by not drinking the water from the potable drinking-water supply of the spacecraft (emergency supplies could be made available for short periods). It is much more difficult to avoid contact with the ambient air in a spacecraft.

Methods For Developing Spacecraft Water Exposure Guidelines

**National Academies of Sciences,
Engineering, and Medicine, Division on
Earth and Life Studies, Board on
Environmental Studies and
Toxicology, Committee on Spacecraft
Exposure Guidelines**

Methods For Developing Spacecraft Water Exposure Guidelines:

Methods for Developing Spacecraft Water Exposure Guidelines National Research Council, Commission on Life Sciences, Board on Environmental Studies and Toxicology, Committee on Toxicology, Subcommittee on Spacecraft Water Exposure Guidelines, 2000-10-18 The National Aeronautics and Space Administration NASA maintains an active interest in the environmental conditions associated with living and working in spacecraft and identifying hazards that might adversely affect the health and well being of crew members Despite major engineering advances in controlling the spacecraft environment some water and air contamination appears to be inevitable Several hundred chemical species are likely to be found in the closed environment of the spacecraft and as the frequency complexity and duration of human space flight increase identifying and understanding significant health hazards will become more complicated and more critical for the success of the missions NASA asked the National Research Council NRC Committee on Toxicology to develop guidelines similar to those developed by the NRC in 1992 for airborne substances for examining the likelihood of adverse effects from water contaminants on the health and performance of spacecraft crews In this report the Subcommittee on Spacecraft Water Exposure Guidelines SWEGs examines what is known about water contaminants in spacecraft the adequacy of current risk assessment methods and the toxicologic issues of greatest concern *Refinements to the Methods for Developing Spacecraft Exposure Guidelines* National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Spacecraft Exposure Guidelines, 2016-04-07 Human spaceflight is inherently risky with numerous potential hazards posed at each phase of a mission Potential health risks during spaceflights include short term health consequences from being in microgravity as well as long term health consequences that arise or continue months or years after a flight Additional health considerations are risks posed by exposure to environmental contaminants onboard spacecraft Because the International Space Station and spacecraft are closed environments that require recirculation of air and water supplies some contamination of the air and water will occur Even with onboard air and water purification systems chemicals will accumulate in the air and water as they recirculate or are recycled onboard Therefore it is necessary for the National Aeronautics and Space Administration NASA to identify hazardous contaminants and determine exposure levels that are not expected to pose a health risk to astronauts NASA uses spacecraft maximum allowance concentrations SMACs and spacecraft water exposure guidelines SWEGs to provide guidance on acceptable exposures to air and water contaminants during normal operations and emergency situations Refinements to the Methods for Developing Spacecraft Exposure Guidelines updates the methods for establishing SMACs and SWEGs and assists NASA with identifying chemicals that need updated SMACs or SWEGs and new chemicals for which these guidelines should be developed *Methods for Developing Spacecraft Water Exposure Guidelines*, 2000 *Spacecraft Water Exposure Guidelines for Selected Contaminants* National Research Council, Division on Earth and Life Studies, Board on

Environmental Studies and Toxicology, Committee on Toxicology, Committee on Spacecraft Exposure Guidelines, 2007-05-02

The International Space Station is a closed and complex environment so some contamination of its internal atmosphere and water system is expected. To protect space crews from contaminants in potable and hygiene water, the National Aeronautics and Space Administration (NASA) requested that the National Research Council (NRC) provide guidance on how to develop water exposure guidelines and review NASA's development of the exposure guidelines for specific chemicals. NASA selects water contaminants for which spacecraft water exposure guidelines (SWEGs) will be established; this involves identifying toxicity effects relevant to astronauts and calculating exposure concentrations on the basis of those end points. SWEGs are established for exposures of 1, 10, 100, and 1,000 days. This report is the second volume in the series *Spacecraft Water Exposure Guidelines for Selected Chemicals*. SWEG reports for acetone, alkylamines, ammonia, barium, cadmium, caprolactam, formate, formaldehyde, manganese, total organic carbon, and zinc are included in this report. The committee concludes that the SWEGs developed for these chemicals are scientifically valid based on the data reviewed by NASA and are consistent with the NRC 2000 report *Methods for Developing Spacecraft Water Exposure Guidelines*. SWEG reports for additional chemicals will be presented in a subsequent volume. [Spacecraft Water Exposure Guidelines for Selected Contaminants](#) National Research Council (U.S.). Subcommittee on Spacecraft Exposure Guidelines, 2004. The first book developed specifically for review and preparation for the Rheumatology Boards; this volume highlights the latest advances in the field and new standards of care, including references to the medical literature. International standards and guidelines are also provided. Designed to convey a maximum amount of information quickly and efficiently, with many helpful schematics, radiographs, and tables. *Comprehensive Rheumatology Board Review* is a must-have reference for rheumatology fellows as well as rheumatology professionals seeking a concise yet thorough review of state-of-the-art rheumatology. **Spacecraft Water Exposure Guidelines for Selected Contaminants** National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Spacecraft Exposure Guidelines, 2008-12-21

NASA maintains an active interest in the environmental conditions associated with living and working in spacecraft and identifying hazards that might adversely affect the health and well-being of crew members. Despite major engineering advances in controlling the spacecraft environment, some water and air contamination is inevitable. Several hundred chemical species are likely to be found in the closed environment of the spacecraft, and as the frequency, complexity, and duration of human space flight increase, identifying and understanding significant health hazards will become more complicated and more critical for the success of the missions. To protect space crews from contaminants in potable and hygiene water, NASA requested that the National Research Council (NRC) provide guidance on how to develop water exposure guidelines and subsequently review NASA's development of the exposure guidelines for specific chemicals. This book presents spacecraft water exposure guidelines (SWEGs) for antimony, benzene, ethylene glycol, methanol, methyl ethyl ketone, and propylene glycol.

Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants, 2008-06-09 U S Navy personnel who work on submarines are in an enclosed and isolated environment for days or weeks at a time when at sea To protect workers from potential adverse health effects due to those conditions the U S Navy has established exposure guidance levels for a number of contaminants In this latest report in a series the Navy asked the National Research Council NRC to review and develop when necessary exposure guidance levels for 11 contaminants The report recommends exposure levels for hydrogen that are lower than current Navy guidelines For all other contaminants except for two for which there are insufficient data recommended levels are similar to or slightly higher than those proposed by the Navy The report finds that overall there is very little exposure data available on the submarine environment and echoes recommendations from earlier NRC reports to expand exposure monitoring in submarines

Fluoride in Drinking Water National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Fluoride in Drinking Water, 2007-01-22 Most people associate fluoride with the practice of intentionally adding fluoride to public drinking water supplies for the prevention of tooth decay However fluoride can also enter public water systems from natural sources including runoff from the weathering of fluoride containing rocks and soils and leaching from soil into groundwater Fluoride pollution from various industrial emissions can also contaminate water supplies In a few areas of the United States fluoride concentrations in water are much higher than normal mostly from natural sources Fluoride is one of the drinking water contaminants regulated by the U S Environmental Protection Agency EPA because it can occur at these toxic levels In 1986 the EPA established a maximum allowable concentration for fluoride in drinking water of 4 milligrams per liter a guideline designed to prevent the public from being exposed to harmful levels of fluoride Fluoride in Drinking Water reviews research on various health effects from exposure to fluoride including studies conducted in the last 10 years

Acute Exposure Guideline Levels for Selected Airborne Chemicals National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Acute Exposure Guideline Levels, 2013-01-28 At the request of the Department of Defense and the Environmental Protection Agency the National Research Council has reviewed the relevant scientific literature compiled by an expert panel and established Acute Exposure Guideline Levels AEGLs for several chemicals AEGLs represent exposure levels below which adverse health effects are not likely to occur and are useful in responding to emergencies such as accidental or intentional chemical releases in community workplace transportation and military settings and for the remediation of contaminated sites Three AEGLs are approved for each chemical representing exposure levels that result in 1 notable but reversible discomfort 2 long lasting health effects and 3 life threatening health impacts Acute Exposure Guideline

Levels for Selected Airborne Chemicals Volume 13 includes AEGLs for boron trifluoride bromoacetone chloroacetone hexafluoroacetone perchloryl fluoride piperidine propargyl alcohol trimethoxysilane and tetramethoxysilane and trimethylbenzenes

Acute Exposure Guideline Levels for Selected Airborne Chemicals National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Acute Exposure Guideline Levels, 2016-09-26 Extremely hazardous substances can be released accidentally as a result of chemical spills industrial explosions fires or accidents involving railroad cars and trucks transporting EHSs Workers and residents in communities surrounding industrial facilities where these substances are manufactured used or stored and in communities along the nation's railways and highways are potentially at risk of being exposed to airborne EHSs during accidental releases or intentional releases by terrorists Pursuant to the Superfund Amendments and Reauthorization Act of 1986 the U S Environmental Protection Agency EPA has identified approximately 400 EHSs on the basis of acute lethality data in rodents Acute Exposure Guideline Levels for Selected Airborne Chemicals Volume 20 reviews and updates the technical support document on acute exposure guideline levels AEGLs for selected chloroformates This update focuses on establishing AEGL 3 values for n propyl chloroformate and isopropyl chloroformate but will also consider whether any new data are available that would affect the proposed values for the other 10 chloroformates AEGLs represent threshold exposure limits exposure levels below which adverse health effects are not likely to occur for the general public and are applicable to emergency exposures ranging from 10 minutes min to 8 h Three levels AEGL 1 AEGL 2 and AEGL 3 are developed for each of five exposure periods 10 min 30 min 1 h 4 h and 8 h and are distinguished by varying degrees of severity of toxic effects This report will inform planning response and prevention in the community the workplace transportation the military and the remediation of Superfund sites

Nineteenth Interim Report of the Committee on Acute Exposure Guideline Levels Committee on Acute Exposure Guideline Levels, Committee on Toxicology, National Research Council, 2011-01-27 The present report is the committee's 19th interim report It summarizes the committee's conclusions and recommendations for improving NAC's AEGL documents for the following chemicals and chemical classes acrylonitrile benzonitrile boron tribromide BZ 3 quinuclidinyl benzilate chloroarsenicals chloroformates bis chloromethylether chloromethylether chlorosilanes 26 selected compounds cyanogen ethyl mercaptan hexafluoroacetone lewisites mercury vapor nitric acid nitric oxide nitrogen dioxide nitrogen tetroxide oleum phenyl mercaptan propargyl alcohol selenium hexafluoride silane sulfur trioxide sulfuric acid tear gas tert octyl mercaptan tetramethoxy silane thionyl chloride trimethoxysilane trimethylbenzenes 1 2 4 1 2 5 and 1 3 5 TMB and vinyl chloride

Managing Health Effects of Beryllium Exposure National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Beryllium Alloy Exposures, 2008-09-29 Beryllium is a lightweight metal that is used for its exceptional strength and high heat absorbing capability Beryllium and its alloys can be found in many

important technologies in the defense and aeronautics industries such as nuclear devices satellite systems radar systems and aircraft bushings and bearings Pulmonary disease associated with exposure to beryllium has been recognized and studied since the early 1940s and an occupational guideline for limiting exposure to beryllium has been in place since 1949 Over the last few decades much has been learned about chronic beryllium disease and factors that contribute to its occurrence in exposed people Despite reduced workplace exposure chronic beryllium disease continues to occur Those developments have led to debates about the adequacy of the long standing occupational exposure limit for protecting worker health This book requested by the U S Air Force to help to determine the steps necessary to protect its workforce from the effects of beryllium used in military aerospace applications reviews the scientific literature on beryllium and outlines an exposure and disease management program for its protecting workers

Combined Exposures to Hydrogen Cyanide and Carbon Monoxide in Army Operations National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Combined Exposures to Hydrogen Cyanide and Carbon Monoxide in Army Operations, 2008-11-15 To determine whether the air quality inside armored vehicle cabins can meet exposure guidelines under deployment conditions the Army assessed possible synergistic toxic effects from potentially harmful substances This book the final of two reports on the subject from the National Research Council addresses whether the approach discussed in the technical context section of the Army's proposed guidance is appropriate or whether an alternative assessment method should be developed Combined Exposures to Hydrogen Cyanide and Carbon Monoxide in Army Operations provides several conclusions and recommendations including the use of alternative instrumentation for monitoring gas conducting experiments on human subjects and seeking advice from additional groups involved with personnel training and field deployment

Review of the Toxicologic and Radiologic Risks to Military Personnel from Exposures to Depleted Uranium During and After Combat National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Toxicologic and Radiologic Effects from Exposure to Depleted Uranium During and After Combat, 2008-06-06 Since the 1980s the U S military has used depleted uranium in munitions and in protective armor on tanks Depleted uranium is a toxic heavy metal and is weakly radioactive Concerns have been raised about the adverse health effects from exposure to depleted uranium that is aerosolized during combat Some think it may be responsible for illnesses in exposed veterans and civilians These concerns led the Army to commission a book Depleted Uranium Aerosol Doses and Risks Summary of U S Assessments referred to as the Capstone Report that evaluates the health risks associated with depleted uranium exposure This National Research Council book reviews the toxicologic radiologic epidemiologic and toxicokinetic data on depleted uranium and assesses the Army's estimates of health risks to personnel exposed during and after combat The book recommends that the Army re evaluate the basis for some of its predictions about health outcomes at low levels of exposure but overall the Capstone Report was judged to provide a reasonable

characterization of the exposure and risks from depleted uranium

Review of the Army's Technical Guides on Assessing and Managing Chemical Hazards to Deployed Personnel National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Subcommittee on the Toxicological Risks to Deployed Military Personnel, 2004-09-03 To guide mission planning military decision makers need information on the health risks of potential exposures to individual soldiers and their potential impact on mission operations To help with the assessment of chemical hazards the U S Army Center for Health Promotion and Preventive Medicine developed three technical guides for characterizing chemicals in terms of their risks to the mission and to the health of the force The report reviews these guides for their scientific validity and conformance with current risk assessment practices The report finds that the military exposure guidelines are appropriate with some modification for providing force health protection but that for assessing mission risk a new set of exposure guidelines is needed that predict concentrations at which health effects would degrade the performance of enough soldiers to hinder mission accomplishment

Review of the Department of Defense Research Program on Low-Level Exposures to Chemical Warfare Agents National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Toxicology, Committee on Toxicologic Assessment of Low-Level Exposures to Chemical Warfare Agents, 2006-01-08 Research related to chemical warfare agents CWAs has historically focused on life threatening battlefield effects caused by high level exposures to the agents not effects associated with exposures to low concentrations of them In this report low level concentrations refers to exposures that may not have any immediate observed health effects but may produce delayed health effects months or years later Recently there has been increased concern about the potential health effects of exposures to CWAs at low concentrations This report reviews the Department of Defense s DOD Research Plan for obtaining toxicologic and other relevant data to assess risk to military personnel The CWAs of concern include the following nerve and vesicant agents tabun sarin soman cyclosarin VX and sulfur mustard The report discusses the health effects of exposure to low levels of these agents and provides guidance to DOD on appropriate risk assessment methods for assessing toxicologic risk to military personnel from low level exposures to CWAs The report concludes that DOD s Research Plan is well planned and many of the proposed research tasks are likely to provide valuable information to DOD in protecting military personnel

Toxicology Principles for the Industrial Hygienist William E. Luttrell, Warren W. Jederberg, Kenneth R. Still, 2008 Focuses on the applications of toxicology principles to the practice of industrial hygiene using case studies as examples

Review of DOD's Approach to Deriving an Occupational Exposure Level for Trichloroethylene National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee to Review DOD's Approach to Deriving an Occupational Exposure Limit for TCE, 2020-01-13 Trichloroethylene TCE is a solvent that is used as a degreasing agent a chemical intermediate in refrigerant manufacture and a component of spot removers and adhesives It is produced in mass quantities

but creates dangerous vapors and is an environmental contaminant at many industrial and government facilities including facilities run by the U S Department of Defense DoD It is important to determine the safe occupational exposure level OEL for the solvent in order to protect the health of workers who are exposed to its vapors However there are concerns that the current occupational standards insufficiently protect workers from these health threats Review of DOD s Approach to Deriving an Occupational Exposure Level for Trichloroethylene makes recommendations to improve the DoD s approach to developing an OEL for TCE strengthen transparency of the process and improve confidence in the final OEL value This report reviews the DoD s approach using a literature review evidence synthesis based on weight of evidence WOE point of departure derivation physiologically based pharmacokinetic modeling extrapolation tools and explores other elements of the process of deriving an OEL for TCE It examines scientific approaches to developing exposure values and cancer risk levels defining the scope of the problem and improving hazard identification

Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals National Research Council, Commission on Life Sciences, Board on Environmental Studies and Toxicology, Committee on Toxicology, Subcommittee on Acute Exposure Guideline Levels, 2001-06-25 Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals contains a detailed and comprehensive methodology for developing acute exposure guideline levels AEGLs for toxic substances from inhalation exposures The book provides guidance on what documents and databases to use toxicity endpoints that need to be evaluated dosimetry corrections from animal to human exposures selection of appropriate uncertainty factors to address the variability between animals and humans and within the human population selection of modifying factors to address data deficiencies time scaling and quantitative cancer risk assessment It also contains an example of a summary of a technical support document and an example of AEGL derivation This book will be useful to persons in the derivation of levels from other exposure routes both oral and dermal as well as risk assessors in the government academe and private industry

Re-evaluation of Drinking-Water Guidelines for Diisopropyl Methylphosphonate National Research Council, Commission on Life Sciences, Board on Environmental Studies and Toxicology, Committee on Toxicology, Subcommittee on the Toxicity of Diisopropyl Methylphosphonate, 2000-11-25 Diisopropyl Methylphosphonate DIMP is a groundwater contaminant at the U S Army s Rocky Mountain Arsenal in Colorado DIMP is a by product created from the manufacture and detoxification of the nerve agent GB which the arsenal produced from 1953 to 1957 For awhile the Army and the State of Colorado disagreed upon the appropriate drinking water contaminant guideline for DIMP A drinking water guideline of 600 micrograms per liter was established by the U S Environmental Protection Agency EPA in 1989 but the State of Colorado promulgated a lower guideline of 8 micrograms per liter The significant difference between the two suggested values arose from the fact that both sides used different studies to determine their values Colorado used one generation reproductive toxicity study in mink whereas EPA used a subchronic toxicity study in

dogs To resolve the disagreement a two generation reproductive study in mink was conducted The Army asked the National Research Council NRC to independently evaluate the 1997 study and re evaluate the drinking water guideline for DIMP This task was assigned to the Committee on Toxicology which established the Subcommittee on the Toxicity of Diisopropyl Methylphosphonate a multidisciplinary group of experts The subcommittee evaluated the two generation reproductive study as well as other studies relevant to the task Data on the use of mink as a predictive model in toxicology were also reviewed Re Evaluation of Drinking Water Guidelines for Diisopropyl Methylphosphonate is the subcommittee s report which shows that neither party was corrected in their DIMP guidelines The report includes the subcommittee s evaluation and recommendations concerning the topic

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