JSC 20584

Spacecraft Maximum Allowable Concentrations for Airborne Contaminants

Human Health and Performance Directorate

Biomedical Research and Environmental Sciences Control Board (BRESCB) Controlled

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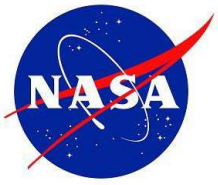

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

NASA APPROVAL SHEET

Spacecraft Maximum Allowable Concentrations for Airborne Contaminants

Human Health and Performance Directorate

PREPARED BY:

Edward Williams
Digitally signed by Edward Williams
Date: 2026.02.04 09:50:47 -06'00'

E. Spencer Williams, Ph.D. DABT
Toxicologist
Environmental Sciences Branch

DATE

CONCURRED:

Daniel Gazda
Digitally signed by Daniel Gazda
Date: 2026.02.04 09:52:45 -06'00'

Daniel B. Gazda, Ph.D.
Chief, Environmental Sciences Branch

DATE

APPROVED:

Teresa Bradshaw
Digitally signed by Teresa Bradshaw
Date: 2026.02.11 10:06:28 -06'00'

Teresa L. Bradshaw
Deputy Chief, Biomedical Research and Environmental Sciences Division

DATE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Lyndon B. Johnson Space Center
Houston, Texas

Martin Perez (affiliate)
Digitally signed by Martin Perez (affiliate)
Date: 2026.02.04 09:15:35 -06'00'

CHANGE HISTORY

Revision/PCN	Date	Authorization/ Originator/Phone	Description
Baseline	09/2017	CR# SA-00308 Valerie E. Ryder 281-483-4989	**NOTE: Previous versions of the document were baselined through the STIC Library and not "BASELINED" through a Board. Therefore, the versioning of the document will start at BASELINE for Configuration Management purposes.** **PREVIOUS INFORMATION FROM STIC BASELINE:** ***Errata*** Correct CAS numbers are below: • 75-69-4 (Freon 11) • 111-30-8 (Glutaraldehyde) • 7647-01-0 (Hydrogen chloride) • 5989-27-5 (Limonene) **CURRENT UPDATES:** Introductory page revised CAS number for Acrolein corrected to 107-02-8 Compound names revised to match published NRC Vol. 5: 1-Butanol to n-Butanol; Unsymmetrical Dimethylhydrazine to Dimethylhydrazine C3-C8 Aliphatic Saturated Aldehydes 7-d, 30-d, 180-d, 1000-d values revised to match NRC Vol. 5 (5 ppm) **Carbon dioxide (CO_2) SMACs have been deleted** – CO_2 does not fit SMAC paradigm and is being managed based on expected performance and health decrements and the associated risks. NASA Standard 3001 is currently under revision to provide guidance on acceptable CO2 levels. Linear Siloxanes group SMACs added Octamethyltrisiloxane SMACs deleted (replaced by Linear Siloxanes)
Revision A	03/2020	CR# SA-02481 Valerie E. Ryder 281-483-4989	Clarification of SMACs for small chain alkanes (C2-C4) versus longer chain alkanes (C5-C9) Revised SMACs for methanol New SMACs for manganese Updated MAPTIS access information

Revision B	11/30/2022	CR # SA-05524 Valerie E. Ryder 281-483-4989	Revised SMACs for propylene glycol New SMACs for n-hexane, hydrogen fluoride, and ethyl acetate
Revision C	6/13/2024	CR# SA-07170 Shannon D. Langford 281-483-2137	Update to acute benzene SMACs Updated toluene SMACs Added new SMACs for hydrogen sulfide Eliminated SMACs for hydrogen and methane which were based on lower explosive limits rather than toxicity Added notation that SMACs are set based on and applicable to ambient conditions (14.7 psi/25°C). Added clarification concerning the hierarchy of this document and specifying that this document is only a reprinting of data published and controlled in other sources. Updated typos for propylene glycol and linear siloxanes.
Revision D	1/6/2026	CR# 20036 E. Spencer Williams 281-483-8921	Added notation for applicability to altered pressure environments; presentation of most SMACs in ppm units only Updated 2-propanol (isopropyl alcohol) SMACs Updated MEK SMACs Updated acetaldehyde SMACs Added 1-propanol SMACs

TABLE OF CONTENTS

1.0 BACKGROUND

SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR AIRBORNE CONTAMINANTS

This document provides a tabular summary of official Spacecraft Maximum Allowable Concentrations (SMACs) for airborne contaminants that have been previously established based on guidelines developed by the National Aeronautics and Space Administration (NASA) and the National Research Council's Committee on Toxicology, externally peer-reviewed, and published. Complete documentation of the rationale used to establish the values summarized here is provided in the reference section below. Based on documented guidance (NRC, 1992; NRC, 2016), NASA has to date established SMACs for 59 chemical compounds and classes that are particularly relevant to atmospheric contamination of the International Space Station (ISS), commercial vehicles, habitats, and suits as well as Exploration-class vehicles, habitats, rovers, and space suits. Some long-term limits (1000-days) have also been established to support deep-space exploration. The limits are based upon experiments conducted at standard pressure and oxygen environments. However, planned Exploration missions are likely to employ altered atmospheres: reduced atmospheric pressure with an appropriate level of oxygen to accommodate more frequent Extra-Vehicular Activities (EVAs) (e.g., 10.2 psia and 26.5% O2). To account for uncertainties in physiological changes that may occur in altered atmospheres, a reasonably conservative approach was reviewed and accepted by the Human Health and Performance Directorate to apply the published values in parts per million (ppm) across all atmospheric scenarios. This approach applies only to chemical compounds that enter the vapor phase (i.e., ideal gases); any contaminant present as a particle or aerosol (e.g., manganese particles or mercury droplets) should be considered in gravimetric terms (mg/m^3).

As a result of that change, SMACs are listed below in only ppm units. When converting to mg/m^3, the atmospheric pressure must be factored into the calculation. At 14.7 psia (i.e., the terrestrial sea level and ISS environment pressure and 25˚C), a mole of gas occupies 24.45 L of volume. However, at 8.2 psia (the planned atmospheric pressure for future lunar missions), a mole of gas occupies 43.9 L of volume. Gravimetric measures of each SMAC will vary by atmospheric pressure and as such are not listed.

To convert from ppm to mg/m^3, the following equation is used:

$$[\frac{mg}{m3}] = \frac{[ppm]*MW\frac{g}{mol}}{y\ L/mol}$$

where y refers to the volume of air occupied by one mole (L/mol) of a substance at the proposed atmospheric pressure (when temperature = 25C). Potential values for y are as follows:

Atmospheric pressure in psia	Volume of one mole of ideal gas (y, in L/mol)
14.7	22.45
10.2	35.2
8.2	43.8
4.3	83.6

Note: values other than 14.7 represent proposed atmospheres for upcoming missions, while 4.3 psia represents nominal pressure for current EVA posture. Actual pressures should be verified prior to SMAC conversion.

Short-term (1- and 24-hour) SMACs apply to off-nominal situations, such as accidental releases aboard a spacecraft. These limits permit risk of minor, reversible effects, such as mild mucosal irritation. In contrast, the long-term SMACs are set to fully protect healthy crewmembers from adverse effects resulting from continuous exposure to specific air pollutants for up to 1000 days. Because allergic reactions or chemical idiosyncrasy to certain airborne pollutants are very difficult to predict, crewmembers with allergies or unusual sensitivity to trace pollutants may not be afforded complete protection, even when long-term SMACs are not exceeded.

Conversely, exceedance of a SMAC does not mean that health impairment is certain (there are many other factors that influence ultimate health outcomes), although it does indicate that the crew may be subject to increased risks that must be closely evaluated. Environmental pollutant control to mitigate exposure will likely be triggered.

These values have been specifically established for human spaceflight and are not intended to apply to other situations, such as ground operations. The SMACs take into account a number of unique factors such as the effect of space-flight stress on human physiology, the uniform good health of the astronauts, and the absence of pregnant or very young individuals.

Crewmember exposures involve a mixture of contaminants, each at a specific concentration (C_n). These contaminants could interact to elicit symptoms of toxicity even though individual contaminants do not exceed their respective SMACs. We assume that the effects of a toxicologically similar group of compounds are additive. The air quality is therefore considered acceptable when the toxicity index (T_{grp}) for each toxicological group of compounds is less than 1, where T_{grp} is calculated as follows:

$$T_{grp} = C_1/SMAC_1 + C_2/SMAC_2 + \ldots + C_n/SMAC_n$$

Toxicological groups are defined according to the target organ and the nature of the toxic response from exposure to the compounds in the group. As shown in the table of SMACs, the target organ and toxic effect can change depending on the duration of exposure.

In addition to official SMACs used for the evaluation of spacecraft air, the JSC Toxicology Group sets interim 7-day SMAC values that are posted to the "MAPTIS" database, which is used to evaluate materials and hardware off-gassing data. Following registration, these values can be accessed at: https://maptis.nasa.gov/. For help with registration or using MAPTIS, contact MAPTIS support at maptissupport@mail.nasa.gov.

2.0 PUBLISHED SMACS

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Acetaldehyde (75-07-0) MW: 44 g/mol	**134**	**50**	**12.5**	**4**	**4**	**4**	Williams and Ryder, 2025
	Effects: Mucosal irritation						
Acetone (67-64-1) MW: 58 g/mol	**500**	**200**	**22**	**22**	**22**	Not set	NRC Vol 4. 2000, p. 17-41
	Effects: CNS fatigue and headache						
Acrolein (107-02-8) MW: 56 g/mol	**0.075**	**0.035**	**0.015**	**0.015**	**0.008**	**0.008**	NRC Vol 5. 2008, p. 13-33
	Effects: Mucosal irritation						
C3-C8 Saturated Aliphatic Aldehydes* (Various CASRN, MW)	**45**	**45**	**5**	**5**	**5**	**5**	NRC Vol 5. 2008, p. 34-47
	Effects: Mucosal irritation						
C5-C9 Alkanes † (Various CASRN, MW)	**150**	**80**	**60**	**20**	**3**	Not set	NRC Vol 5. 2008, p. 85-111
	Effects: CNS depression, eye irritation, ototoxicity						
Ammonia (7664-41-7) MW: 17 g/mol	**30**	**20**	**3**	**3**	**3**	**3**	NRC Vol 5. 2008, p. 48-61
	Effects: Eye irritation, CNS headache						
Benzene (71-43-2) MW: 78 g/mol	**40**	**6.7**	**0.5**	**0.1**	**0.07**	**0.013**	Ryder and Williams, 2023; NRC Vol 5. 2008, p. 62-72
	Effects: CNS depression, immunotoxicity, hematological						
Bromotrifluoromethane (75-63-8) MW: 149 g/mol	**3500**	**3500**	**1800**	**1800**	**1800**	Not set	NRC Vol 3. 1996, p. 21-52
	Effects: Cardiac arrhythmia, CNS depression and cognitive impacts						

* includes propanal, butanal, pentanal, hexanal, octanal; † includes pentane, heptane, octane, nonane, and branched isomers, but excludes n-hexane

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
n-Butanol* (71-36-3) MW: 74 g/mol	**50**	**25**	**25**	**25**	**12**	**12**	NRC Vol 5. 2008, p. 73-84
	Effects: Eye irritation and systemic injury, CNS depression						
tert-Butanol (75-65-0) MW: 74 g/mol	**50**	**50**	**50**	**50**	**40**	Not set	NRC Vol 3. 1996, p. 78-104
	Effects: CNS depression, nephrotoxicity, bladder injury						
Carbon monoxide† (630-08-0) MW: 28 g/mol	**425**	**100**	**55**	**15**	**15**	**15**	NRC Vol 5. 2008, p. 125-143
	Effects: CNS depression, cardiac arrhythmia						
Chloroform (67-66-3) MW: 119 g/mol	**2**	**2**	**2**	**1**	**1**	Not set	NRC Vol 4. 2000, p. 264-306
	Effects: CNS depression, nephrotoxicity, hepatotoxicity						
Decamethylcyclopentasiloxane‡ (541-02-6) MW: 371 g/mol	Not set	Not set	**7**	**5**	**1**	Not set	NRC Vol 4. 2000, p. 151-174
	Effects: Respiratory system injury, gonad toxicity						
Diacetone alcohol (123-42-2) MW: 116 g/mol	**50**	**50**	**20**	**6**	**4**	Not set	NRC Vol 3. 1996, p. 105-116
	Effects: Mucosal irritation, CNS depression, hepatomegaly						
Dichloroacetylene (7572-29-4) MW: 95 g/mol	**0.6**	**0.04**	**0.03**	**0.025**	**0.015**	Not set	NRC Vol 3. 1996, p. 117-134
	Effects: CNS depression, nephrotoxicity, hepatotoxicity						
1,2-Dichloroethane§ (107-06-2) MW: 99 g/mol	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	NRC Vol 5. 2008, p. 144-161
	Effects: GI and liver toxicity						

* odor threshold and noxious odor concentrations are uncertain; † carboxyhemoglobin (COHb) is target; ‡ documented as polydimethylsiloxane; § impairs host defenses against bacteria

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Dimethylhydrazine (57-14-7) MW: 60 g/mol	**3**	**0.12**	**0.03**	**0.017**	**0.003**	Not set	NRC Vol 5. 2008, p. 162-189
	Effects: CNS depression, anemia, hepatotoxicity						
Ethanol (64-17-5) MW: 46 g/mol	**5000**	**5000**	**1000**	**1000**	**1000**	**1000**	NRC Vol 5. 2008, p. 190-205
	Effects: Eye and mucosal irritation, skin flushing, hepatotoxicity						
2-Ethoxyethanol (110-80-5) MW: 90 g/mol	**10**	**10**	**0.8**	**0.5**	**0.07**	Not set	NRC Vol 2. 1996, p. 189-212
	Effects: Mucosal irritation, hematotoxicity, testicular toxicity						
Ethyl acetate (141-78-6) MW: 88 g/mol	**400**	**400**	**117**	**117**	**117**	**39**	Williams and Ryder, 2023
	Effects: Mucosal irritation, body weight reduction						
Ethylbenzene (100-41-4) MW: 106 g/mol	**180**	**60**	**30**	**30**	**12**	Not set	NRC Vol 3. 1996, p. 208-231
	Effects: Mucosal irritation, CNS depression, testicular necrosis						
Ethylene glycol (107-21-1) MW: 62 g/mol	**25**	**25**	**5**	**5**	**5**	Not set	NRC Vol 3. 1996, p. 232-270
	Effects: Mucosal irritation, CNS depression, nephrotoxicity						
Formaldehyde* (50-00-0) MW: 30 g/mol	**0.8**	**0.5**	**0.1**	**0.1**	**0.1**	**0.1**	NRC Vol 5. 2008, p. 206-249
	Effects: Mucosal irritation, nasal cancer						
Freon 11 (75-69-4) MW: 137 g/mol	**140**	**140**	**140**	**140**	**140**	Not set	NRC Vol 4. 2000, p. 211-226
	Effects: Cardiac arrhythmia						

* carcinogen

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Freon 113 (76-13-1) MW: 187 g/mol	**50**	**50**	**50**	**50**	**50**	Not set	NRC Vol 1. 1994, p. 121-138
	Effects: Cardiac arrhythmia						
Freon 12 (75-71-8) MW: 121 g/mol	**540**	**95**	**95**	**95**	**95**	Not set	NRC Vol 4. 2000, p. 227-239
	Effects: Cardiac arrhythmia, tachycardia						
Freon 21 (75-43-4) MW: 103 g/mol	**50**	**50**	**15**	**12**	**2**	Not set	NRC Vol 4. 2000, p. 175-189
	Effects: Tachycardia, hepatotoxicity						
Freon 22 (75-45-6) MW: 86 g/mol	**1000**	**1000**	**1000**	**1000**	**1000**	Not set	NRC Vol 4. 2000, p. 190-210
	Effects: CNS depression, cardiac arrhythmia						
Furan* (110-00-9) MW: 68 g/mol	**4**	**0.4**	**0.025**	**0.025**	**0.025**	Not set	NRC Vol 4. 2000, p. 307-329
	Effects: Hepatotoxicity						
Glutaraldehyde (111-30-8) MW: 100 g/mol	**0.12**	**0.04**	**0.006**	**0.003**	**0.0006**	Not set	NRC Vol 4. 2000, p. 271-291
	Effects: Mucosal irritation, headache, respiratory tract lesions						
Hexamethylcyclotrisiloxane† (541-05-9) MW: 222 g/mol	Not set	Not set	**10**	**5**	**1**	Not set	NRC Vol 4. 2000, p. 151-174
	Effects: Respiratory system injury, CNS depression						
n-Hexane (110-54-3) MW: 86 g/mol	**200**	**30**	**2.4**	**2.4**	**2.4**	**2.4**	Garcia 2021
	Effects: Mucosal irritation, neurotoxicity						

* carcinogen; † documented as polydimethylcyclosiloxane

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Hydrazine* (302-01-2) MW: 32 g/mol	**4**	**0.3**	**0.04**	**0.02**	**0.004**	Not set	NRC Vol 2. 1996, p. 956-961
	Effects: Death, hepatotoxicity, liver and nasal cancer						
Hydrogen chloride (7647-01-0) MW: 36 g/mol	**5**	**2**	**1**	**1**	**1**	Not set	NRC Vol 4. 2000, p. 60-88
	Effects: Mucosal and eye irritation						
Hydrogen cyanide (74-90-8) MW: 27 g/mol	**8**	**4**	**1**	**1**	**1**	Not set	NRC Vol 4. 2000, p. 300-365
	Effects: CNS depression, headache, nausea, testicular toxicity, thyroid effects						
Hydrogen fluoride (7664-39-3) MW: 20 g/mol	**3**	**3**	**0.3**	**0.3**	**0.3**	**0.3**	Lam and Ryder, 2022
	Effects: Respiratory irritation						
Hydrogen sulfide† (7683-06-4) MW: 34 g/mol	**5**	**1.3**	**1.3**	**1.3**	**0.3**	**Not set**	Wimberly and Ryder, 2024
	Effects: Nasal irritation and lesions						
Indole‡ (120-72-9) MW: 117 g/mol	**1**	**0.3**	**0.05**	**0.05**	**0.05**	Not set	NRC Vol 2. 1996, p. 235-249
	Effects: Nausea, hematotoxicity, death						
Isoprene (78-79-5) MW: 68 g/mol	**50**	**25**	**2**	**2**	**1**	Not set	NRC Vol 4. 2000, p. 89-118
	Effects: Mucosal irritation, anemia, neurotoxicity						
Limonene (5989-27-5) MW: 136 g/mol	**80**	**80**	**20**	**20**	**20**	**20**	NRC Vol 5. 2008, p. 250-274
	Effects: Eye and respiratory irritation						

* carcinogen; † Endpoint includes increased anxiety directly related to odor irritation; ‡ Normal turnover of indole was used to establish a lower bound of 0.05 ppm.

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Linear siloxanes* (Various CASRN, MW)	**600**	**100**	**100**	**50**	**50**	**50**	Meyers et al., 2013
	Effects: Lung hemorrhage, neurotoxicity, hepatotoxicity						
Manganese [mg/m³]† (7439-96-5)	**[3]**	**[1]**	**[0.3]**	**[0.3]**	**[0.008]**	**[0.008]**	Romoser et al., 2019
	Effects: Lung irritation/lesions, nasal irritation, neurotoxicity						
Mercury (vapor) (7439-97-6) MW: 200 g/mol	**0.01**	**0.002**	**0.001**	**0.001**	**0.001**	Not set	NRC Vol 2. 1996, p. 251-276
	Effects: Lung irritation, neurotoxicity, nephrotoxicity						
Mercury [particles, mg/m³]† (7439-97-6)	**[0.08]**	**[0.02]**	**[0.01]**	**[0.01]**	**[0.01]**	Not set	NRC Vol 2. 1996, p. 251-276
	Effects: Lung irritation, neurotoxicity, nephrotoxicity						
Methanol (67-56-1) MW: 32 g/mol	**70**	**70**	**20**	**20**	**20**	**10**	Scully et al., 2019
	Effects: Neurotoxicity						
Methyl ethyl ketone (78-93-3) MW: 72 g/mol	**50**	**50**	**10**	**10**	**10**	Not set	Ryder 2025; NRC Vol 2. 1996, p. 307-329
	Effects: Mucosal irritation						
Methyl hydrazine‡ (60-34-4) MW: 46 g/mol	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	Not set	NRC Vol 4. 2000, p. 119-136
	Effect: Nasal lesions						
4-Methyl-2-pentanone (108-10-1) MW: 100 g/mol	**35**	**35**	**35**	**35**	**35**	Not set	NRC Vol 4. 2000, p. 240-263
	Effects: CNS depression, mucosal irritation						

* includes hexamethyldisiloxane, octamethyltrisiloxane, decamethyltetrasiloxane, and dodecamethylpentasiloxane; † [] indicate SMAC values that are set in mg/m3; ‡ carcinogen

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Methylene chloride* (75-09-2) MW: 85 g/mol	**100**	**35**	**14**	**7**	**3**	**1**	NRC Vol 5. 2008, p. 289-313
	Effects: CNS depression, hepatotoxicity, nephrotoxicity						
Nitromethane (72-52-5) MW: 61 g/mol	**25**	**15**	**7**	**7**	**5**	Not set	NRC Vol 2. 1996, p. 331-350
	Effects: Anemia						
Octamethylcyclotetrasiloxane† (556-67-2) MW: 297 g/mol	Not set	Not set	**23**	**5**	**1**	Not set	NRC Vol 4. 2000, p. 151-174
	Effects: Gonad toxicity, CNS depression						
Perfluoropropane and Other Aliphatic Perfluoroalkanes‡ (Various CASRN, MW)	**11000**	**11000**	**11000**	**11000**	**11000**	Not set	NRC Vol 4. 2000, p. 137-150
	Effects: CNS symptoms						
1-Propanol (67-63-0) MW: 60 g/mol	**205**	**100**	**60**	**35**	**35**	**35**	Yap and Ryder, 2025
	Effects: CNS depression, mucosal irritation, male infertility						
2-Propanol (67-63-0) MW: 60 g/mol	**400**	**100**	**60**	**60**	**60**	Not set	Ryder 2026; NRC Vol 2. 1996,p. 351-371
	Effects: CNS/PNS depression, mucosal irritation, hepatotoxicity						
Propylene glycol (57-55-6) MW: 76 g/mol	**64**	**32**	**32**	**32**	**32**	**32**	Ryder and Williams, 2022; NRC Vol. 5 2008, p. 314-328
	Effects: Mucosal and eye irritation, fatigue/headache, Hb incr.						
Toluene (108-88-3) MW: 92 g/mol	**40**	**40**	**40**	**40**	**4**	**4**	Tapia et al., 2024; NRC Vol 5. 2008, p. 329-347
	Effects: CNS depression, ototoxicity, ocular toxicity, decreased hormones						

* CO formation, carcinogen; † documented as polydimethylcyclosiloxane; ‡ CAS and MW listed for PFP only, excludes perfluorocycloalkanes

SMACs

Spaceflight Maximum Allowable Concentrations

Chemical	1 hour	24 hour	7 day	30 day	180 day	1000 day	Citation
	off-nominal		nominal				
	ppm	ppm	ppm	ppm	ppm	ppm	
Trichloroethylene* (79-01-6) MW: 131 g/mol	**50**	**11**	**9**	**4**	**2**	Not set	NRC Vol 3. 1996, p. 292-320
	Effects: CNS depression, arrhythmia, nephro- and hepatotoxicity						
Trimethylsilanol (1066-40-6) MW: 90 g/mol	**15**	**2**	**1**	**1**	**1**	**1**	NRC Vol 5. 2008, p. 348-355
	Effects: CNS depression						
Vinyl chloride (75-01-4) MW: 62 g/mol	**130**	**30**	**1**	**1**	**1**	Not set	NRC Vol 1. 1994, p. 185-219
	Effects: Hepatotoxicity, headache, CNS depression, testicular necrosis						
Xylenes† (1330-20-7) MW: 106 g/mol	**50**	**17**	**17**	**17**	**8.5**	**1.5**	NRC Vol 5. 2008, p. 356-386
	Effects: Mucosal and eye irritation, headache, neuro- and ototoxicity						

* See dichloroacetylene is alkali scrubber is present; † applies to each xylene isomer and mixtures of isomers

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APPENDIX A ACRONYMS AND ABBREVIATIONS

CASRN	Chemical Abstract Service Registry Number
C_n	Specific Concentration
CNS	Central Nervous System
DCD	Decreased Color Discrimination
EVA	Extra-Vehicular Activity
GI	Gastrointestinal
ISS	International Space Station
JSC	Johnson Space Center
NASA	National Aeronautics and Space Administration
NRC	National Research Council
PNS	Peripheral Nervous System
ppm	Parts Per Million
RespSys	Respiratory System
SMACs	Spacecraft Maximum Allowable Concentrations
T_{grp}	Toxicity Index