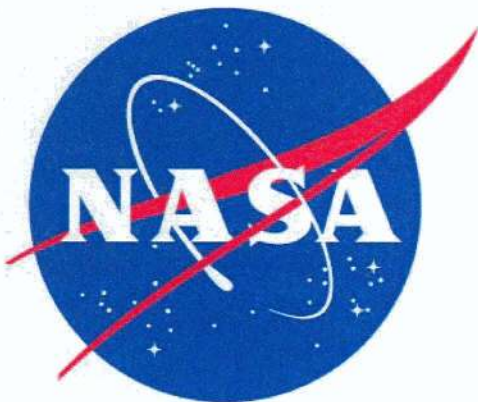


Spacecraft Maximum Allowable Concentrations for Airborne Contaminants

**Toxicology Group
Environmental Factors Office
Habitability and Environmental Factors Division
Space Life Sciences Directorate**

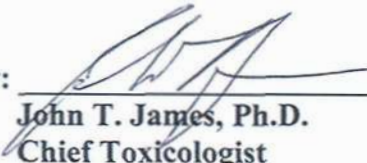
November 2008





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

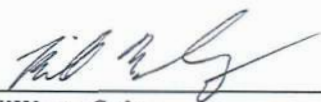
SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS
FOR AIRBORNE CONTAMINANTS


2008

Compiled by:  10-16-08
John T. James, Ph.D.
Chief Toxicologist

Concurred By:  10/17/08
Crystal Haddock
Chief, Environmental Factors Branch

 10/21/08
Mike Duncan, MD
Chief, Space Medicine Division

 10/20/08
William Seitz
Chief, Habitability and Environmental Factors Division


Jeff Davis, MD
Director, Space Life Sciences



Errata

Correct CAS numbers are below:

Freon 11	75-69-4
Glutaraldehyde	111-30-8
Hydrogen chloride	7647-01-0
Limonene	5989-27-5

SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR AIRBORNE CONTAMINANTS 2008

The enclosed table lists official spacecraft maximum allowable concentrations (SMACs), which are guideline values set by the NASA/JSC Toxicology Group in cooperation with the National Research Council Committee on Toxicology (NRCCOT). These values should not be used for situations other than human space flight without careful consideration of the criteria used to set each value. 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. Documentation of the values is given in a 5 volume series of books entitled "Spacecraft Maximum Allowable Concentrations for Selected Airborne Contaminants" published by the National Academy Press, Washington, D.C. These books can be viewed electronically at http://books.nap.edu/openbook.php?record_id=9786&page=3.

Short-term (1 and 24 hour) SMACs are set to manage accidental releases aboard a spacecraft and 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. Crewmembers with allergies or unusual sensitivity to trace pollutants may not be afforded complete protection, even when long-term SMACs are not exceeded.

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. The air quality is 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:

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

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.

Early editions of this document contained many SMACs "developed" before 1990 when the cooperative effort between NASA and the NRCCOT began. These values had been considered official; however, an effort to determine how these values were set revealed that there was not an adequate document trail to continue to consider these old values as official SMACs. These old values will continue to be posted in the "MAPTIS" database, which is used to evaluate materials and hardware offgassing data, but they have been deleted from the present edition of this document. Many unofficial SMACs for groups of compounds with structural similarities (e.g. aliphatic ethers, aliphatic ketones) have been set with limited documentation and no review by the NRCCOT. These unofficial group SMACs can be obtained from the JSC Toxicology Group.



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Acetaldehyde Synonyms: NRC Vol. #: 1 CAS #: 75-07-0 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i> Carcinogen	10	(18)	6	(10)	2	(4)	2	(4)	2	(4)	Not Set	(Not Set)
	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u>	<u>Effect</u>
Acetone Synonyms: 2-Propanone NRC Vol. #: 4 CAS #: 67-64-1 Year SMAC was Set/ Reviewed: 1994 <i>Remarks:</i>	500	(1200)	200	(500)	22	(52)	22	(52)	22	(52)	Not Set	(Not Set)
	<u>Organ</u> CNS	<u>Effect</u> Fatigue	<u>Organ</u> CNS	<u>Effect</u> Fatigue	<u>Organ</u> CNS	<u>Effect</u> Fatigue Headache	<u>Organ</u> CNS	<u>Effect</u> Fatigue Headache	<u>Organ</u> CNS	<u>Effect</u> Fatigue Headache	<u>Organ</u>	<u>Effect</u>
Acrolein Synonyms: Propenal NRC Vol. #: 5 CAS #: 107-02-08 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i> Ceiling values	0.075	(0.2)	0.035	(0.08)	0.015	(0.03)	0.015	(0.03)	0.008	(0.02)	0.008	(0.02)
	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation	<u>Organ</u> Mucosa	<u>Effect</u> Irritation
C2-C9 Aliphatic Alkanes Synonyms: NRC Vol. #: 5 CAS #: various Year SMAC was Set/ Reviewed: 2005 <i>Remarks:</i>	150	(varies)	80	(varies)	60	(varies)	20	(varies)	3	(varies)	Not Set	(Not Set)
	<u>Organ</u> CNS Eye Nose	<u>Effect</u> Depression Irritation Irritation	<u>Organ</u> CNS Eye Nose	<u>Effect</u> Depression Irritation Irritation	<u>Organ</u> CNS	<u>Effect</u> Depression Ototoxicity	<u>Organ</u> CNS	<u>Effect</u> Depression Ototoxicity	<u>Organ</u> CNS	<u>Effect</u> Ototoxicity	<u>Organ</u>	<u>Effect</u>

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
C3-C8 Aliphatic Saturated Aldehydes Synonyms: NRC Vol. #: 5 CAS #: various Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	45	(varies)	45	(varies)	4.5	(varies)	4.5	(varies)	4.5	(varies)	4.5	(varies)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Nasal Cavity	Injury	Liver Nasal Cavity	Hepatotoxicity Injury	Liver Nasal Cavity	Hepatotoxicity Injury	Nasal Cavity	Injury
Ammonia Synonyms: NRC Vol. #: 5 CAS #: 7664-41-7 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i> Ceiling values	30	(20)	20	(14)	3	(2)	3	(2)	3	(2)	3	(2)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation
Benzene Synonyms: NRC Vol. #: 5 CAS #: 71-43-2 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i> Leukemogen	10	(35)	3	(10)	0.5	(1.5)	0.1	(0.3)	0.07	(0.2)	0.013	(0.04)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Blood	Immunotoxicit ..	Blood	Immunotoxicit ..	Blood	Immunotoxicit ..	Blood	Immunotoxicit ..	Blood Blood	Immunotoxicit .. Leukemia	Blood	Hematological
Bromotrifluoromethane Synonyms: Halon 1301 NRC Vol. #: 3 CAS #: 75-63-8 Year SMAC was Set/ Reviewed: 1993 <i>Remarks:</i>	3500	(21000)	3500	(21000)	1800	(11000)	1800	(11000)	1800	(11000)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Heart	Arrhythmia	Heart	Arrhythmia	CNS	Depression	CNS	Depression	CNS	Depression		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
1- Butanol Synonyms: n-butanol NRC Vol. #: 5 CAS #: 71-36-3 Year SMAC was Set/ Reviewed: 2007 Remarks:	50	(150)	25	(80)	25	(80)	25	(80)	12	(40)	12	(40)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation
	CNS	Depression				Systemic fatigue		Systemic fatigue		Systemic fatigue		Systemic fatigue
tert- Butanol Synonyms: 2-Methyl-2-propanol NRC Vol. #: 3 CAS #: 75-65-0 Year SMAC was Set/ Reviewed: 1995 Remarks:	50	(150)	50	(150)	50	(150)	50	(150)	40	(120)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
							CNS	Depression	CNS	Depression		
									U. Blad	Injury		
Carbon dioxide Synonyms: CO ₂ NRC Vol. #: 5 CAS #: 124-38-9 Year SMAC was Set/ Reviewed: 2006 Remarks:	20000	(35000)	13000	(23000)	7000	(13000)	7000	(13000)	7000	(13000)	5000	(9000)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Hyperventilation	CNS	Hyperventilation	CNS	Hyperventilation	CNS	Hyperventilation	CNS	Hyperventilation	CNS	Headache
	CNS		CNS		CNS		CNS		CNS			
	CNS	Headache	CNS	Headache		Headache		Headache		Headache		
		Visual disturbance		Visual disturbance								
Carbon monoxide Synonyms: CO NRC Vol. #: 5 CAS #: 630-08-0 Year SMAC was Set/ Reviewed: 2008 Remarks: Carboxyhemoglobin target	425	(485)	100	(114)	55	(63)	15	(17)	15	(17)	15	(17)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression
	CV	Arrhythmia	CV	Arrhythmia	CV	Arrhythmia	CV	Arrhythmia	CV	Arrhythmia	CV	Arrhythmia

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Chloroform Synonyms: Trichloromethane NRC Vol. #: 4 CAS #: 67-66-3 Year SMAC was Set/ Reviewed: 1999 Remarks:	2	(10)	2	(10)	2	(10)	1	(5)	1	(5)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity		
	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
Decamethylcyclotrisiloxane Synonyms: NRC Vol. #: 4 CAS #: 541-02-6 Year SMAC was Set/ Reviewed: 1998 Remarks: Documented as a polydimethylcyclotrisiloxane	Not Set	(Not Set)	Not Set	(Not Set)	7	(100)	5	(75)	1	(15)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
					RspSys	Injury	RspSys	Injury	RspSys	Injury		
					Gonad	Toxicity	Gonad	Toxicity	Gonad	Toxicity		
Diacetone alcohol Synonyms: NRC Vol. #: 3 CAS #: 123-42-2 Year SMAC was Set/ Reviewed: 1995 Remarks:	50	(250)	50	(250)	20	(100)	6	(30)	4	(20)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Liver	Hepatomegaly		
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
Dichloroacetylene Synonyms: NRC Vol. #: 3 CAS #: 7572-29-4 Year SMAC was Set/ Reviewed: 1992 Remarks:	0.6	(2.4)	0.04	(0.16)	0.03	(0.12)	0.025	(0.10)	0.015	(0.06)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
	Liver	Hepatotoxicity	Liver	Hepatotoxicity								

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
1,2- Dichloroethane Synonyms: NRC Vol. #: 5 CAS #: 107-06-2 Year SMAC was Set/ Reviewed: 2007 <i>Remarks:</i> Impairs host defenses against bacteria.	0.4	(1.6)	0.4	(1.6)	0.4	(1.6)	0.4	(1.6)	0.4	(1.6)	0.4	(1.6)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	G.I.	GI Toxicity	G.I.	GI Toxicity	G.I.	GI Toxicity	G.I.	G.I. Toxicity	G.I.	G.I. Toxicity	G.I.	G.I. Toxicity
											Liver	Hepatotoxicity
Ethanol Synonyms: Ethyl alcohol NRC Vol. #: 5 CAS #: 64-17-5 Year SMAC was Set/ Reviewed: 2007 <i>Remarks:</i>	5000	(10000)	5000	(10000)	1000	(2000)	1000	(2000)	1000	(2000)	1000	(2000)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation
	Skin	Flushing	Skin	Flushing	Skin	Flushing	Skin	Flushing	Skin	Flushing	Skin	Flushing
					Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity
2- Ethoxyethanol Synonyms: NRC Vol. #: 2 CAS #: 110-80-5 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i>	10	(40)	10	(40)	0.8	(3)	0.5	(2)	0.07	(0.3)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Blood	Hematotoxicit	Blood	Hematotoxicity	Blood	Hematotoxicity	Blood	Hematotoxicity	Blood	Hematotoxicity		
	Mucosa	Irritation	Mucosa	Irritation								
Ethylbenzene Synonyms: NRC Vol. #: 3 CAS #: 100-41-4 Year SMAC was Set/ Reviewed: 1993 <i>Remarks:</i>	180	(800)	60	(250)	30	(130)	30	(130)	12	(50)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Testes	Necrosis		
	CNS	Depression	CNS	Depression	Testes	Necrosis	Testes	Necrosis				

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System
GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Ethylene glycol Synonyms: NRC Vol. #: 3 CAS #: 107-21-1 Year SMAC was Set/ Reviewed: 1993 <i>Remarks:</i>	25	(60)	25	(60)	5	(13)	5	(13)	5	(13)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation		
			CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
					Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
Formaldehyde Synonyms: NRC Vol. #: 5 CAS #: 50-00-0 Year SMAC was Set/ Reviewed: 2005 <i>Remarks:</i> Ceiling values, Carcinogen	0.8	(1.0)	0.5	(0.6)	0.1	(0.12)	0.1	(0.12)	0.1	(0.12)	0.1	(0.12)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation
											Nose	Cancer
Freon 11 Synonyms: Trichlorofluoromethane NRC Vol. #: 4 CAS #: 75-69-6 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i>	140	(790)	140	(790)	140	(790)	140	(790)	140	(790)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia		
Freon 113 Synonyms: 1,1,2-trichloro- 1,2,2-trifluoro-ethane NRC Vol. #: 1 CAS #: 76-13-1 Year SMAC was Set/ Reviewed: 1991 <i>Remarks:</i>	50	(400)	50	(400)	50	(400)	50	(400)	50	(400)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Freon 12 Synonyms: Dichlorodifluoromethane NRC Vol. #: 4 CAS #: 75-71-8 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i>	540	(2600)	95	(470)	95	(470)	95	(470)	95	(470)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Heart	Tachycardia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia		
Freon 21 Synonyms: Dichlorofluoromethane NRC Vol. #: 4 CAS #: 75-43-4 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i>	50	(210)	50	(210)	15	(63)	12	(50)	2	(8)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Heart	Tachycardia	Heart	Tachycardia	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity		
Freon 22 Synonyms: Chlorodifluoromethane NRC Vol. #: 4 CAS #: 75-45-6 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i>	1000	(3500)	1000	(3500)	1000	(3500)	1000	(3500)	1000	(3500)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia	Heart	Arrhythmia		
Furan Synonyms: 1,4-Epoxy-1,3-butadiene NRC Vol. #: 4 CAS #: 110-00-9 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i>	4	(11)	0.36	(1)	0.025	(0.07)	0.025	(0.07)	0.025	(0.07)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Cancer	Liver	Cancer	Liver	Cancer		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Glutaraldehyde Synonyms: 1,5-Pentanedial NRC Vol. #: 3 CAS #: 111-308 Year SMAC was Set/ Reviewed: 1993 Remarks:	0.12	(0.50)	0.04	(0.08)	0.006	(0.025)	0.003	(0.012)	0.0006	(0.002)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	RspSys	Lesions	RspSys	Lesions	RspSys	Lesions		
	CNS	Headache	CNS	Headache								
Hexamethylcyclotrisiloxane Synonyms: NRC Vol. #: 4 CAS #: 541-05-9 Year SMAC was Set/ Reviewed: 1998 Remarks: Documented as a polydimethylcyclotrisiloxane	Not Set		Not Set		10	(90)	5	(45)	1	(9)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
					RspSys	Injury	RspSys	Injury	RspSys	Injury		
					CNS	Depression	CNS	Depression				
Hydrazine Synonyms: Diamine NRC Vol. #: 2 CAS #: 302-01-2 Year SMAC was Set/ Reviewed: 1993 Remarks: Carcinogen.	4	(5)	0.3	(0.4)	0.04	(0.05)	0.02	(0.03)	0.004	(0.005)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
		Death	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity		
							Liver	Hyperplasia	Nose	Cancer		
							Nose	Cancer				
Hydrogen Synonyms: NRC Vol. #: 1 CAS #: 1333-74-0 Year SMAC was Set/ Reviewed: 1990 Remarks: Ceiling values are 10% of the Lower Explosive Limit	4100	(340)	4100	(340)	4100	(340)	4100	(340)	4100	(340)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
		Explosion		Explosion		Explosion		Explosion		Explosion		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Hydrogen chloride Synonyms: HCl NRC Vol. #: 4 CAS #: 7647-01-1 Year SMAC was Set/ Reviewed: 1998 Remarks:	5	(8)	2	(3)	1	(1.5)	1	(1.5)	1	(1.5)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation		
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation		
Hydrogen cyanide Synonyms: HCN NRC Vol. #: 4 CAS #: 74-90-8 Year SMAC was Set/ Reviewed: 1998 Remarks:	8	(9)	4	(4.5)	1	(1.1)	1	(1.1)	1	(1.1)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	CNS	Headache	CNS	Headache	CNS	Headache	CNS	Headache	CNS	Headache		
	CNS	Nausea	CNS	Nausea	CNS	Nausea	CNS	Nausea	CNS	Nausea		
Indole Synonyms: NRC Vol. #: 2 CAS #: 120-72-9 Year SMAC was Set/ Reviewed: 1992 Remarks: Normal turnover of indole was used to establish a lower bound of 0.05 ppm.	1.0	(5)	0.3	(1.5)	0.05	(0.25)	0.05	(0.25)	0.05	(0.25)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Nausea	CNS	Nausea	CNS	Nausea	CNS	Nausea	CNS	Nausea		
			Blood	Hematotoxicity	Blood	Hematotoxicity	Blood	Hematotoxicity	Blood	Hematotoxicity		
Isoprene Synonyms: 2-Methyl-1,3-butadiene NRC Vol. #: 4 CAS #: 78-79-5 Year SMAC was Set/ Reviewed: 1998 Remarks:	50	(140)	25	(70)	2	(6)	2	(6)	1	(3)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Lung	Injury		
					Blood	Anemia	Blood	Anemia	Blood	Anemia		
									CNS	Neurotoxicity		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

POTENTIAL EXPOSURE DURATION

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Limone Synonyms: NRC Vol. #: 5 CAS #: 2008 Year SMAC was Set/ Reviewed: <i>Remarks:</i>	80	(450)	80	(450)	20	(115)	20	(115)	20	(115)	20	(115)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation	Eye	Irritation
	Lung	Irritation	Lung	Irritation	Lung	Irritation	Lung	Irritation	Lung	Irritation	Lung	Irritation
Mercury Synonyms: Quicksilver NRC Vol. #: 2 CAS #: 7439-97-6 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i>	0.01	(0.1)	0.002	(0.02)	0.001	(0.01)	0.001	(0.01)	0.001	(0.01)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Lung	Irritation	Lung	Irritation	CNS	Neurotoxicity	CNS	Neurotoxicity	CNS	Neurotoxicity		
					Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
Methane Synonyms: Natural gas NRC Vol. #: 1 CAS #: 74-82-8 Year SMAC was Set/ Reviewed: 1990 <i>Remarks:</i> Ceiling values are 10% of the Lower Explosive Limit. Methane is a non-toxic simple asphyxiant.	5300	(3500)	5300	(3500)	5300	(3500)	5300	(3500)	5300	(3500)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
		Explosion		Explosion		Explosion		Explosion		Explosion		
Methanol Synonyms: Wood alcohol NRC Vol. #: 5 CAS #: 67-56-1 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	200	(260)	70	(90)	70	(90)	70	(90)	70	(90)	23	(30)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Visual disturbance	Eye	Visual disturbance	Eye	Visual disturbance	Eye	Visual disturbance	Eye	Visual disturbance	Eye	Visual disturbance

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Methyl Ethyl Ketone Synonyms: 2-Butanone NRC Vol. #: 2 CAS #: 78-93-3 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i> Ceiling values	50	(150)	50	(150)	10	(30)	10	(30)	10	(30)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation		
Methyl hydrazine Synonyms: Monomethylhydrazine NRC Vol. #: 4 CAS #: 60-34-4 Year SMAC was Set/ Reviewed: 1991 <i>Remarks:</i> Carcinogen	0.002	(0.004)	0.002	(0.004)	0.002	(0.004)	0.002	(0.004)	0.002	(0.004)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Nose	Lesions	Nose	Lesions	Nose	Lesions	Nose	Lesions	Nose	Lesions		
4- Methyl-2-pentanone Synonyms: Methyl isobutylketone, MIBK NRC Vol. #: 4 CAS #: 108-10-1 Year SMAC was Set/ Reviewed: 1994 <i>Remarks:</i>	35	(140)	35	(140)	35	(140)	35	(140)	35	(140)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation		
Methylene chloride Synonyms: Dichloromethane NRC Vol. #: 5 CAS #: 75-09-2 Year SMAC was Set/ Reviewed: 2007 <i>Remarks:</i> CO formation, Carcinogen	100	(350)	35	(120)	14	(49)	7	(24)	3	(10)	1	(3.5)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Kidney	Nephrotoxicity

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

POTENTIAL EXPOSURE DURATION

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Nitromethane Synonyms: NRC Vol. #: 2 CAS #: 75-52-5 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i>	25	(65)	15	(40)	7	(18)	7	(18)	5	(13)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Blood	Anemia	Blood	Anemia	Blood	Anemia	Blood	Anemia	Blood	Anemia		
Octamethylcyclotetrasiloxane Synonyms: NRC Vol. #: 4 CAS #: 556-67-2 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i> Documented as a polydimethylcyclsiloxane	Not Set		Not Set		23	(280)	5	(60)	1	(12)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
					RspSys	Injury	RspSys	Injury	Gonad	Toxicity		
					CNS	Depression	Gonad	Toxicity	RspSys	Injury		
					Gonad	Toxicity						
Octamethyltrisiloxane Synonyms: MDM NRC Vol. #: 1 CAS #: 107-51-7 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i> Based on structure activity relationships	400	(4000)	200	(2000)	100	(1000)	20	(200)	4	(40)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
		Death		Death	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Hepatotoxicity		
			Liver	Hepatotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity		
			Kidney	Nephrotoxicity								

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Perfluoropropane (Aliphatic Perfluoroalkanes) Synonyms: Octafluoropropane NRC Vol. #: 4 CAS #: 76-19-7 Year SMAC was Set/ Reviewed: 1998 <i>Remarks:</i> This group SMAC is not applicable to perfluorocycloalkanes. SMACs in mg/m ³ apply only to perfluoropropane.	11,000	(85,000)	11,000	(85,000)	11,000	(85,000)	11,000	(85,000)	11,000	(85,000)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Symptoms	CNS	Symptoms	CNS	Symptoms	CNS	Symptoms	CNS	Symptoms		

Chemical	400		100		60		60		60		Not Set	
	ppm	(1000)	ppm	(240)	ppm	(150)	ppm	(150)	ppm	(150)	ppm	(Not Set)
2- Propanol Synonyms: Isopropanol NRC Vol. #: 2 CAS #: 67-63-0 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i>	400	(1000)	100	(240)	60	(150)	60	(150)	60	(150)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression		
	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation	Mucosa	Irritation		
			Liver	Hepatotoxicity	Liver	Hepatotoxicity	PNS	Decr. cond'n. velocity				

Chemical	32		17		9		3		1.5		1.5	
	ppm	(102)	ppm	(54)	ppm	(29)	ppm	(9.6)	ppm	(4.8)	ppm	(4.8)
Propylene glycol Synonyms: 1,2-Propanediol; Methyl glycol NRC Vol. #: 5 CAS #: 57-55-6 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	32	(102)	17	(54)	9	(29)	3	(9.6)	1.5	(4.8)	1.5	(4.8)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Eye	Irritation	Eye	Irritation	Eye	Discharge	Eye	Discharge	Nose	Epithelium thickening	Nose	Epithelium thickening
	Throat	Irritation	Throat	Irritation	Nose	Hemorrhage	Nose	Hemorrhage				
	Lung	Irritation	Lung	Irritation								

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Toluene Synonyms: Methyl benzene NRC Vol. #: 5 CAS #: 108-88-3 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	16	(60)	16	(60)	4	(15)	4	(15)	4	(15)	4	(15)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Dizziness	Ear	Ototoxicity	Ear	Ototoxicity	Ear	Ototoxicity	Ear	Ototoxicity
					Eye	DCD	Eye	DCD	Eye	DCD	Eye	DCD
									Gonads	Hormone	Gonads	Hormone
Trichloroethylene Synonyms: NRC Vol. #: 3 CAS #: 79-01-6 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i> See dichloroacetylene if alkali scrubber is present. Possible carcinogen.	50	(270)	11	(60)	9	(50)	4	(20)	2	(10)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Multi.	Cancer		
	Heart	Arrhythmia			Liver	Hepatotoxicity	Liver	Hepatotoxicity	Kidney	Nephrotoxicity		
									Liver	Hepatotoxicity		
Trimethylsilanol Synonyms: Trimethylhydroxysilane NRC Vol. #: 5 CAS #: 1066-40-6 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	15	(55)	2	(7)	1	(4)	1	(4)	1	(4)	1	(4)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression	CNS	Depression
Unsymmetrical Dimethylhydrazine Synonyms: 1,1-Dimethylhydrazine, UDMH NRC Vol. #: 5 CAS #: 57-14-7 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i>	3	(7.5)	0.12	(0.3)	0.03	(0.075)	0.017	(0.0425)	0.003	(0.0075)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	CNS		CNS		Blood	Anemia	Blood	Anemia	Liver	Hepatotoxicity		

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System



SMACs (Spacecraft Maximum Allowable Concentrations)

P O T E N T I A L E X P O S U R E D U R A T I O N

Chemical

Chemical	1 hr		24 hr		7 d		30 d		180 d		1000 d	
	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)	ppm	(mg/m ³)
Vinyl chloride Synonyms: Chloroethene; chloroethylene NRC Vol. #: 1 CAS #: 75-01-4 Year SMAC was Set/ Reviewed: 1992 <i>Remarks:</i> Carcinogen	130	(330)	30	(77)	1	(2.6)	1	(2.6)	1	(2.6)	Not Set	(Not Set)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Testes	Necrosis	Testes	Necrosis	Testes	Necrosis		
	CNS	Headache	CNS	Headache	Liver	Hepatotoxicity	Liver	Hepatotoxicity	Liver	Cancer		
	CNS	Depression	CNS	Depression								
Xylene Synonyms: Dimethylbenzene, xylol NRC Vol. #: 5 CAS #: 1330-20-7 Year SMAC was Set/ Reviewed: 2008 <i>Remarks:</i> Applies to each individual xylene isomer and mixtures of xylene isomers.	50	(215)	17	(73)	17	(73)	17	(73)	8.5	(37)	1.5	(6.5)
	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>
	Mucosa	Irritation	Mucosa	Irritation	CNS	Neurotoxicity	CNS	Neurotoxicity	Ear	Ototoxicity	Ear	Ototoxicity
	CNS	Depression	CNS	Depression								
	Eye	Irritation	Eye	Irritation								

Abbreviations: CNS: Central Nervous System
CV: Cardiovascular

DCD: Decreased Color Discrimination
RespSys: Respiratory System

GI: Gastrointestinal tract
U.Blad: Urinary bladder

NRC: National Research Council

PNS: Peripheral Nervous System