SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR AIRBORNE CONTAMINANTS

TOXICOLOGY GROUP Medical Operations Branch Medical Sciences Division Space and Life Sciences Directorate

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

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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 astronauts, and the absence of pregnant or very young individuals. Documentation of he values is given in a 4 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://www.nap.edu/info/browse.htm by selecting "Space Science."

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 180 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:

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

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.

Previous editions of the document contained many SMACs "developed" before 1900 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.



POTENTIAL EXPOSURE DURATION

		1 hr		24 hı	r		7 d			30 d		1	80 d		
Chemical Name	ppm	l (mg/m³)	ppr	n (m	g/m³)	pp	m (r	mg/m³)	pp	m (mg	g/m³)	ppn	n (mg	/m³)	Remarks
Acetaldehyde	1	2 (22)		6	(10)		2	(4)		2	(4)		2	(4)	Carcinogen
Synonyms:		<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>		
NRC Vol. #: 1 CAS #: 75-07-0	Mucosa	Irritation	Mucosa	Irritatio	n	Mucosa	Irritatio	n	Mucosa	Irritation		Mucosa	Irritation		
Year SMAC was Set/ Reviewed: 1992															
Acetone	50	(1200)	2	00	(500)		22	(52)		22	(52)	2	22	(52)	
Synonyms: 2-Propanone		<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>		
NRC Vol. #: 4 CAS #: 67-64-1	CNS	Depression	CNS	Depres	sion	CNS	Depres	ssion	CNS	Depress	ion	CNS	Depressi	on	
Year SMAC was Set/ Reviewed: 1994															
Acrolein	0.07	(0.2)	0.0	35	(80.0)	0.0)15	(0.03)	0.0)15	(0.03)	0.01	15	(0.03)	Ceiling values
Synonyms: Propenal	<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>		
NRC Vol. #: 2 CAS #: 107-02-08	Mucosa	Irritation	Mucosa	Irritatio	n	Mucosa	Irritatio	n	Mucosa	Irritation		Mucosa	Irritation		
Year SMAC was Set/ Reviewed: 1992															
C3-C8 Aliphatic Saturated Aldehydes	5	(125-250)		50 (1:	25-250)		6	(15-30)		1.5	(4-8)	1	.5	(4-8)	The range of values listed in mg/m3 is due to differences
Synonyms:	<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>		in the molecular weights of
NRC Vol. #: 4 CAS #: various	Mucosa	Irritation	Mucosa	Irritatio	n	Mucosa Liver	Irritatio		Liver	Hepatoto	oxicity	Liver	Hepatoto	xicity	the various aldehydes.
Year SMAC was Set/ Reviewed: 1998						Livei	перац	otoxicity							
Ammonia	3	(20)		20	(14)		10	(7)		10	(7)	1	10	(7)	Ceiling values
Synonyms:	<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>		
NRC Vol. #: 1 CAS #: 7664-41-7	Mucosa	Irritation	Mucosa	Irritatio	n	Mucosa	Irritatio	n	Mucosa	Irritation		Mucosa	Irritation		
Year SMAC was Set/ Reviewed: 1991															
Benzene	1	0 (35)		3	(10)		0.5	(1.5)		0.1	(0.3)	0.0)7	(0.2)	Leukemogen
Synonyms:	<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>		
NRC Vol. #: 2 CAS #: 71-43-2	Blood	Immunotoxicity	Blood	Immun	otoxicity	Blood	Immun	otoxicity	Blood	Immunot	toxicity	Blood Blood	Immunot Leukemia	•	
Year SMAC was Set/ Reviewed: 1993												Dioou	LOUNCHIN	J	



POTENTIAL EXPOSURE DURATION

		1 hr		24 hr		7 d		30 d	1	80 d	
Chemical Name	ppr	n (mg/m³)	pp	mg/m³)	pp	m (mg/m³)	pp	m (mg/m³)	ppn	n (mg/m³)	Remarks
Bromotrifluoromethane	35	00 (21000)	3	500 (21000)	1	800 (11000)	1	800 (11000)	180	(11000)	
Synonyms: Halon 1301	<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>	
NRC Vol. #: 3 CAS #: 75-63-8	Heart	Arrhythmia	Heart	Arrhythmia	CNS	Depression	CNS	Depression	CNS	Depression	
Year SMAC was Set/ Reviewed: 1993											
1- Butanol		50 (150)		25 (80)		25 (80)		25 (80)	1	12 (40)	
Synonyms:	<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>	
NRC Vol. #: 3 CAS #: 71-36-3 Year SMAC was Set/ Reviewed: 1994	Eye CNS	Irritation Depression	Eye	Irritation	Eye	Irritation Systemic Injury	Eye	Irritation Systemic Injury		Systemic Injury	
tert- Butanol		50 (150)		50 (150)		50 (150))	50 (150)		10 (120)	
Synonyms: 2-Methyl-2-propanol	<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>	
NRC Vol. #: 3 CAS #: 75-65-0	CNS	Depression	CNS	Depression	CNS	Depression	Kidney CNS	Nephrotoxicity Depression	Kidney CNS	Nephrotoxicity Depression	
Year SMAC was Set/ Reviewed: 1995							CNS	Depression	U. Blad	Injury	
Carbon dioxide	130	00 (23000)	13	000 (23000)	7	000 (13000)	7	(13000)	700	(13000)	
Synonyms:	<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>	
NRC Vol. #: 2 CAS #: 124-38-9	CNS CNS	Hyperventil'n Visual	CNS CNS	Hyperventil'n Visual	CNS	Hyperventil'n	CNS	Hyperventil'n	CNS	Hyperventil'n	
Year SMAC was Set/ Reviewed: 1992	ONS	- · ·	ONO	- · ·							
Carbon monoxide		55 (63)		20 (23)		10 (11))	10 (11)	1	10 (11)	Carboxyhemoglobin target
Synonyms:	<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>	
NRC Vol. #: 1 CAS #: 630-08-0	CNS Heart	Depression Arrhythmia	CNS Heart	Depression Arrhythmia	CNS Heart	Depression Arrhythmia	CNS Heart	Depression Arrhythmia	CNS Heart	Depression Arrhythmia	
Year SMAC was Set/ Reviewed: 1991	750.1			,				,		j	



POTENTIAL EXPOSURE DURATION

		1 hr		24 hr		7 d			30 d		18	180 d		
Chemical Name	ppr	n (mg/m³)	pp	mg/m³)	pp	m (mg	g/m³)	ppı	m (mg	J/m³)	ppn	ា (mg	/m³)	Remarks
Chloroform		2 (1	0)	2 (10)	2	(10)		1	(5)		1	(5)	
Synonyms: Trichloromethane	<u>Organ</u> CNS	Effect Depression	<i>Organ</i> CNS	Effect Depression	<u>Organ</u> CNS	<u>Effect</u> Depressi	ion	<u>Organ</u> CNS	<u>Effect</u> Depress	on	<i>Organ</i> CNS	Effect Depress	ion	
NRC Vol. #: 4 CAS #: 67-66-3 Year SMAC was Set/ Reviewed: 1999	Liver	Hepatotoxicity Nephrotoxicity	y Liver	Hepatotoxicity Nephrotoxicity	Liver	Hepatoto Nephroto	oxicity	Liver Kidney	Hepatoto Nephroto	xicity	Liver	Hepatoto Nephroto	oxicity	
Decamethylcyclopentasiloxane	N.	.S.	, , ,	N.S.		7	(100)		5	(75)		1	(15)	Documented as a
Synonyms: NRC Vol. #: 4 CAS #: 541-02-6 Year SMAC was Set/ Reviewed: 1998	<u>Organ</u>	<u>Effect</u>	<u>Organ</u>	<u>Effect</u>	Organ RspSys Gonad	Effect Injury Toxicity		Organ RspSys Gonad	Effect Injury Toxicity		RspSys	Effect Injury Toxicity		polydimethylcyclosiloxane
Diacetone alcohol		50 (25)	0)	50 (250)	20	(100)		6	(30)		4	(20)	
Synonyms: NRC Vol. #: 3 CAS #: 123-42-2 Year SMAC was Set/ Reviewed: 1995	Organ Mucosa CNS	Effect Irritation Depression	Organ Mucosa CNS	Effect Irritation Depression	Organ Mucosa CNS	Effect Irritation Depressi	ion	<u>Organ</u> Mucosa CNS	Effect Irritation Depress	on	Liver	Effect Hepatom Depress	0 3	
Dichloroacetylene	().6 (2.4)	4) ().04 (0.16) (0.03	(0.12)	0.0)25	(0.10)	0.01	5	(0.06)	
Synonyms: NRC Vol. #: 3 CAS #: 7572-29-4 Year SMAC was Set/ Reviewed: 1992	Organ CNS Kidney Liver	Effect Depression Nephrotoxicit Hepatotoxicit	,	Effect Depression Nephrotoxicity Hepatotoxicity		Effect Depressi Nephroto		<u>Organ</u> CNS Kidney	Effect Depress Nephroto		CNS	Effect Depress Nephroto		
1,2- Dichloroethane	().4 (:	2)	0.4 (2)	0.4	(2)		0.4	(2)	0.	2	(1)	Carcinogen; impairs host
Synonyms: NRC Vol. #: 3 CAS #: 107-06-2	Organ G.I.	Effect GI Toxicity Immunotoxici	Organ G.I. ty .	Effect GI Toxicity Immunotoxicit	Organ G.I.	Effect Gl Toxici Immunot	,	<u>Organ</u> G.I.	Effect GI Toxic Immunot	•	Various	Effect Cancer		defenses against bacteria.

NASA

Spacecraft Maximum Allowable Concentrations

POTENTIAL EXPOSURE DURATION

		1 hr		24 hr		7 d			30 d	18	30 d	
Chemical Name	ppm) (mg/m³)	pp	m (mg/m³)	pp	m (mg/m	1³)	ppn	n (mg/m³)	ppm	(mg/m³)	Remarks
Ethanol	200	(4000)	20	(4000)	10	000 (20	00)	100	(2000)	100	0 (2000)	Skin "flushing" is a
Synonyms: Ethyl alcohol	<u>Organ</u>	Effect Irritation	<u>Organ</u>	<u>Effect</u> Irritation	<u>Organ</u>	Effect			Effect		Effect	- cardiovascular effect.
NRC Vol. #: 3 CAS #: 64-17-5 Year SMAC was Set/ Reviewed: 1994	Eye Mucosa Skin	Irritation Irritation Flushing	Eye Mucosa Skin		Eye Mucosa Skin Liver	Irritation Irritation Flushing Hepatotoxic		Mucosa Skin	Irritation Irritation Flushing Hepatotoxicity	Mucosa Skin	Irritation Irritation Flushing Hepatotoxicity	
2- Ethoxyethanol	1	(40))	10 (40)		8.0	(3)	0	0.5 (2)	0.0	7 (0.3)	
Synonyms: NRC Vol. #: 2 CAS #: 110-80-5 Year SMAC was Set/ Reviewed: 1992	Organ Blood Mucosa	Effect Hematotoxicity Irritation	Organ Blood Mucosa	Effect Hematotoxicity Irritation	Organ Blood	Effect Hematotoxio	city		Effect Hematotoxicity		Effect Hematotoxicity	
Ethylbenzene	18	(800))	60 (250)		30 (1:	30)		30 (130)	1.	2 (50)	
Synonyms: NRC Vol. #: 3 CAS #: 100-41-4 Year SMAC was Set/ Reviewed: 1993	<u>Organ</u> Mucosa CNS	Effect Irritation Depression	<u>Organ</u> Mucosa CNS	Effect Irritation Depression	Organ Mucosa Testes	Effect Irritation Necrosis		Mucosa	Effect Irritation Necrosis		Effect Necrosis	
Ethylene glycol	2	(60))	25 (60)		5 (13)		5 (13)		5 (13)	
Synonyms: NRC Vol. #: 3 CAS #: 107-21-1 Year SMAC was Set/ Reviewed: 1993	<u>Organ</u> Mucosa	Effect Irritation	<u>Organ</u> Mucosa CNS	Effect Irritation Depression	Organ Mucosa CNS Kidney	Effect Irritation Depression Nephrotoxic		Mucosa CNS	Effect Irritation Depression Nephrotoxicity	Mucosa CNS	Effect Irritation Depression Nephrotoxicity	
Formaldehyde	0.	.4 (0.5))	0.1 (0.12)	0	.04 (0.	05)	0.0	(0.05)	0.0	4 (0.05)	Ceiling values, Carcinogen
Synonyms: NRC Vol. #: 1 CAS #: 50-00-0 Year SMAC was Set/ Reviewed: 1991	<u>Organ</u> Mucosa	Effect Irritation	<u>Organ</u> Mucosa	Effect Irritation	<u>Organ</u> Mucosa	Effect Irritation			<u>Effect</u> Irritation		Effect Irritation	



POTENTIAL EXPOSURE DURATION

		1 hr			24 h	<u>r </u>		7	d		30 d			180 d		
Chemical Name	ppn	ា (mg/n	n³)	ppı	m (r	mg/m³)	pp	m	(mg/m³)	pp	m (n	ng/m³)	pp	m (r	ng/m³)	Remarks
Freon 11	14	40	(790)	1	140	(790)		140	(790)		140	(790)		40	(790)	
Synonyms: Trichlorofluoromethane	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 4 CAS #: 75-69-6	Heart	Arrhythmia	a	Heart	Arrhyt	hmia	Heart	Arrh	ythmia	Heart	Arrhyth	nmia	Heart	Arrhy	thmia	
Year SMAC was Set/ Reviewed: 1998																
Freon 113	ļ	50	(400)		50	(400)		50	(400)		50	(400)		50	(400)	
Synonyms: 1,1,2-trichloro- 1,2,2-trifluoro- ethane	<u>Organ</u> Heart	Effect Arrhythmia		<i>Organ</i> Heart	<u>Effect</u> Arrhyt		<u>Organ</u> Heart	<u>Effe</u> Arrh	<u>ct</u> ythmia	<u>Organ</u> Heart	Effect Arrhyth	nmia	<u>Organ</u> Heart	<u>Effect</u> Arrhy		
NRC Vol. #: 1 CAS #: 76-13-1																
Year SMAC was Set/ Reviewed: 1991																
Freon 12	54	40 (2	2600)		95	(470)		95	(470)		95	(470)		95	(470)	
Synonyms: Dichlorodifluoromethane NRC Vol. #: 4 CAS #: 75-71-8	<u>Organ</u> Heart	Effect Tachycard		<u>Organ</u> Heart	<u>Effect</u> Arrhyt		<u>Organ</u> Heart	<u>Effe</u> Arrh	<u>ct</u> ythmia	<u>Organ</u> Heart	Effect Arrhyth	ımia	<u>Organ</u> Heart	<u>Effect</u> Arrhyt		
Year SMAC was Set/ Reviewed: 1998																
Freon 21	ļ	50	(210)		50	(210)		15	(63)		12	(50)		2	(8)	
Synonyms: Dichlorofluoromethane	<u>Organ</u> Heart	Effect Tachycard		<i>Organ</i> Heart	Effect	r cardia	<u>Organ</u> Liver	Effe Hen	<u>ct</u> atotoxicity	<u>Organ</u> Liver	Effect Henato	otoxicity	<i>Organ</i> Liver	Effect	totoxicity	
NRC Vol. #: 4 CAS #: 75-43-4	ricart	racitycarc	ша	ricart	racity	caruia	LIVEI	пер	atotoxicity	LIVEI	Перац	noxicity	LIVEI	Пера	lotoxicity	
Year SMAC was Set/ Reviewed: 1998																
Freon 22	100)0 (3	3500)	10	000	(3500)	10	000	(3500)	10	000	(3500)	10	000	(3500)	
Synonyms: Chlorodifluoromethane	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 4 CAS #: 75-45-6 Year SMAC was Set/ Reviewed: 1998	CNS Heart	Depressio Arrhythmia		CNS Heart	Depre Arrhyt		CNS Heart		ression ythmia	CNS Heart	Depres Arrhyth		CNS Heart	Depre Arrhy		



POTENTIAL EXPOSURE DURATION

		1 hr			24 hr			7 (<u>t</u>		30 d		18	80 d		
Chemical Name	ppn	n (mg/	m³)	ppm) (mg/m³	3)	ppn	n (mg/m³)	ppı	m (n	ng/m³)	ppn	1 (m	g/m³)	Remarks
Furan		4	(11)	0.3	6 ((1)	0.02	25	(0.07)	0.0)25	(0.07)	0.02	5	(0.07)	
Synonyms: 1,4-Epoxy-1,3-butadiene	<u>Organ</u>	<u>Effect</u>			<u>Effect</u>	- 1-	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 4 CAS #: 110-00-9	Liver	Hepatoto	xicity	Liver	Hepatotoxici	ty L	Liver	Canc	er	Liver	Cance	r	Liver	Cancer		
Year SMAC was Set/ Reviewed: 1998																
Glutaraldehyde	0.	12	(0.50)	0.0	4 (0.0	8)	0.00	06	(0.025)	0.0	003	(0.012)	0.000	6	(0.002)	
Synonyms: 1,5-Pentanedial	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>(</u>	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
	Mucosa	Irritation		Mucosa	Irritation	F	RspSys	Lesio	ns	RspSys	Lesion	S	RspSys	Lesions	3	
	CNS	Headach	е	CNS	Headache											
Year SMAC was Set/ Reviewed: 1993	N.	c		N.S	2		1	10	(00)		5	(45)		1	(9)	Documented as a
Hexamethylcyclotrisiloxane									(90)	0	-	(45)			(9)	polydimethylcyclosiloxane
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	- 1-		Effec	-	Organ	Effect			Effect		
NRC Vol. #: 4 CAS #: 541-05-9								Injury		RspSys CNS	Injury Depres	ccion	RspSys	II IJUI Y		
Year SMAC was Set/ Reviewed: 1998							SINO	Dehic	2331011	CNS	Depies	331011				
Hydrazine		4	(5)	0.	3 (0.	4)	0.0	04	(0.05)	0	.02	(0.03)	0.00	4	(0.005)	Carcinogen.
Synonyms: Diamine	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>(</u>	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 2 CAS #: 302-01-2		Death		Liver	Hepatotoxici	ty L	_iver	Нера	totoxicity	Liver	Hepato	otoxicity	Liver	Hepato	toxicity	
										Liver	Hyperp	olasia	Nose	Cancer		
Year SMAC was Set/ Reviewed: 1993				1						Nose	Cance	r				
Hydrogen	41	00	(340)	410	0 (34	0)	410	00	(340)	41	100	(340)	410	0	(340)	Ceiling values are 10% of
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>(</u>	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		the Lower Explosive Limit
NRC Vol. #: 1 CAS #: 1333-74-0		Explosio	n		Explosion			Explo	sion		Explos	sion		Explosi	on	
Year SMAC was Set/ Reviewed: 1990																
Hydrogen chloride		5	(8)		2 ((3)		1	(1.5)		1	(1.5)		1	(1.5)	
	<u>Organ</u>	Effect	(0)		Effect (Organ	Effec	. ,	<u>Organ</u>	Effect			<u>' </u> Effect	(1.3)	
Synonyms:	Eye	Irritation			<u>Errect</u> Irritation	- 1-		Irritati	-	Eye	Irritatio			<u>Errect</u> Irritation	า	
NRC Vol. #: 4 CAS #: 7647-01-1	Mucosa	Irritation		"	Irritation		,	Irritati		Mucosa	Irritatio		"	Irritation		
Year SMAC was Set/ Reviewed: 1998									- * *			•				
" (' 🙃 '														_	_	

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POTENTIAL EXPOSURE DURATION

		1 hr			24 hr			7 d			30 d		18	0 d	_	
Chemical Name	ppr	n (mg/	′m³)	pp	m (mg	g/m³)	pp	m (m	g/m³)	ppı	n (m	g/m³)	ppm	(mg/m ³)	Remarks
Hydrogen cyanide		8	(9)		4	(4.5)		1	(1.1)		1	(1.1)	1	(1	.1)	
Synonyms:	<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>E</u>	Effect		
NRC Vol. #: 4 CAS #: 74-90-8	CNS	Depressi		CNS	Depress	ion	CNS	Depress		CNS	Depress	sion		Depression		
Year SMAC was Set/ Reviewed: 1998	CNS	Headach		CNS	Headach		CNS	Headac		CNS	Headacl	he		Headache		
Teal Siviac was Sell Revieweu. 1996	CNS	Nausea		CNS	Nausea		CNS	Nausea		CNS	Nausea			Vausea		
Indole	•	1.0	(5)		0.3	(1.5)	0.	.05	(0.25)	0.	.05	(0.25)	0.05	(0.2	.0)	turnover of indole ed to establish a
Synonyms:	<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>E</u>	Effect		ound of 0.05 ppm.
NRC Vol. #: 2 CAS #: 120-72-9	CNS	Nausea		CNS	Nausea		CNS	Nausea		CNS	Nausea			Vausea		
Year SMAC was Set/ Reviewed: 1992				Blood	Hematot	oxicity	Blood	Hemato	toxicity	Blood	Hemato	toxicity	Blood I	Hematotoxic	ity	
Isoprene		50	(140)		25	(70)		2	(6)		2	(6)	1		(3)	
	Organ	Effect	(1.10)	Organ	Effect	(, 0)	Organ	Effect	(0)	Organ	Effect	(0)	Organ E	Effect		
Synonyms: 2-Methyl-1,3-butadiene	Mucosa			Mucosa			Mucosa	Irritation	ı	Mucosa	Irritation			njury		
NRC Vol. #: 4 CAS #: 78-79-5							Blood	Anemia		Blood	Anemia			Anemia		
Year SMAC was Set/ Reviewed: 1998													CNS I	Veurotoxicity	,	
Mercury	0.	01	(0.1)	0.0	002	(0.02)	0.0	01	(0.01)	0.0	01	(0.01)	0.001	(0.0)1)	
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		Organ <u>E</u>	<u> Effect</u>		
	Lung	Irritation		Lung	Irritation		CNS	Neuroto	xicity	CNS	Neuroto	xicity	CNS 1	Veurotoxicity	<i>i</i>	
NRC Vol. #: 2 CAS #: 7439-97-6							Kidney	Nephrot	oxicity	Kidney	Nephrot	oxicity	Kidney 1	Nephrotoxic	ty	
Year SMAC was Set/ Reviewed: 1992	Г	00	(0000)	F *	200	(0000)	Г	000	(0000)	Г	000	(0.0.0.)	F200	1 (0.04	o Coiling	values are 100/ of
Methane			(3800)			(3800)		800	(3800)			(3800)	5300	<u> </u>		values are 10% of er Explosive Limit.
Synonyms: Natural gas	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	Effect			Effect	Methan	e is a non-toxic
NRC Vol. #: 1 CAS #: 74-82-8		Explosio	n		Explosio	n		Explosio	on		Explosio	on	l	Explosion	simple a	asphyxiant.
Year SMAC was Set/ Reviewed: 1990																



POTENTIAL EXPOSURE DURATION

		1 hr			24	hr		7	d		30 d		1	80 d		
Chemical Name	ppn	ា (mg/m³)	ppr	n	(mg/m³)	pp	m	(mg/m³)	ppı	m (m	g/m³)	ppı	n (m	ng/m³)	Remarks
Methanol	3	30 (40)	,	10	(13)		7	(9)		7	(9)		7	(9)	
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 1	Eye	Visual Disturbance		Eye	Visu Dist	urbances	Eye	Visu Dist	al urbances	Eye	Visual Disturba	ances	Eye	Visual Disturb	oances	
Methyl Ethyl Ketone	Ę	50 (1	50)		50	(150)		10	(30)		10	(30)		10	(30)	Ceiling values
Synonyms: 2-Butanone	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	<u>ect</u>	<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 2 CAS #: 78-93-3	Mucosa	Irritation		Mucosa	Irrita	ation	Mucosa	Irrita	ition	Mucosa	Irritatior	1	Mucosa	Irritatio	n	
Year SMAC was Set/ Reviewed: 1992	2.20	20		2.2	00						200		0.0	20		
Methyl hydrazine	0.00	(4.4	04)	0.0		(0.004)	0.0		(0.004)	0.0		(0.004)	0.0		(0.004)	Carcinogen
Official submonior incurry in your azine	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effe</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 4 CAS #: 60-34-4	Nose	Lesions		Nose	Lesi	ons	Nose	Lesi	ons	Nose	Lesions	•	Nose	Lesion	S	
Year SMAC was Set/ Reviewed: 1991																
4- Methyl-2-pentanone	3	35 (1	40)		35	(140)		35	(140)		35	(140)		35	(140)	
Synonyms: Welliyi isobutyketone, Wildk	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	_	<u>Organ</u>	<u>Effe</u>		<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NPC Vol. #- 1	CNS	Depression Irritation		CNS	Depi Irrita		CNS	Dep Irrita	ression	CNS	Depres: Irritation		CNS	Depres Irritatio		
Year SMAC was Set/ Reviewed: 1994	Mucosa	IIIIIalioii		Mucosa	IIIIId	111011	Mucosa	IIIIIc	IIIOH	Mucosa	IIIIIaliUI	1	Mucosa	IIIIalio)I I	
Methylene chloride	10)0 (3	50)	,	35	(120)		15	(50)		5	(20)		3	(10)	CO formation, Carcinogen
Synonyms: Dichloromethane	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 2 CAS #: 75-09-2	CNS	Depression		CNS	Dep	ression	CNS	Dep	ression	Liver	Hepato	toxicity	Liver	Hepato	otoxicity	
Year SMAC was Set/ Reviewed: 1992																
Nitromethane	2	25 (65)	,	15	(40)		7	(18)		7	(18)		5	(13)	
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 2 CAS #: 75-52-5	Blood	Anemia		Blood	Anei	mia	Blood	Ane	mia	Blood	Anemia		Blood	Anemia	a	
Year SMAC was Set/ Reviewed: 1992																



POTENTIAL EXPOSURE DURATION

		1 hr			24 hr			7 c			30	d	1	80 d		
Chemical Name	ppr	n (mg/	m³)	ppr	n (mg/m ³	3)	ppı	m (ı	mg/m³)	ppı	m	(mg/m³)	ppr	n (m	g/m³)	Remarks
Octamethylcyclotetrasiloxane	N.	S.		N.	S.			23	(280)		5	(60)		1	(12)	Documented as a
Synonyms:	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>Or</u>	gan	<u>Effect</u>		<u>Organ</u>	<u>Effec</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		polydimethylcyclosiloxane
NRC Vol. #: 4 CAS #: 556-67-2							pSys	Injury		RspSys	Injur		Gonad	Toxicity	/	
Year SMAC was Set/ Reviewed: 1998						CN		Depre		Gonad	Toxi	city	RspSys	Injury		
1	1 4	00	(2	00 (000		nad	Toxici	,		20	(2.2.2)	1	4	(1.5)	Based on structure activity
Octamethyltrisiloxane			(4000)		(200	-		100	(1000)		20	(200)		4	(40)	relationships
Synonyms: MDM	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		gan	<u>Effect</u>		<u>Organ</u>	<u>Effec</u>		<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 1 CAS #: 107-51-7		Death			Death	Liv		•	otoxicity	Liver		atotoxicity	Liver	•	toxicity	
Year SMAC was Set/ Reviewed: 1992				Liver Kidney	Hepatotoxici Nephrotoxici	·	dney	ivepnr	otoxicity	Kidney	ічер	hrotoxicity	Kidney	ivepnro	toxicity	
1	44.0	00 (5)		,	<u>.</u>	,	44.0	200		44.6	200		44.04	00		This man CNAC is not
Perfluoropropane and Other	11,0	,	5,000)	11,00	` '	-	11,0		(85,000)	11,0		(85,000)	11,00		(85,000)	This group SMAC is not applicable to
Aliphatic Perfluoroalkanes	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>		gan	<u>Effect</u>		<u>Organ</u>	<u>Effec</u>	_	<u>Organ</u>	<u>Effect</u>		perfluorocycloalkanes.
Synonyms: Octafluoropropane	CNS	Sympton	าร	CNS	Symptoms	CN	IS	Symp	toms	CNS	Sym	ptoms	CNS	Sympto	oms	
NRC Vol. #: 4 CAS #: 76-19-7																
Year SMAC was Set/ Reviewed: 1998																
2- Propanol	4	00	(1000)	10	00 (24	0)		60	(150)		60	(150)		60	(150)	
Synonyms: sopropanol	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>Or</u>	gan	<u>Effect</u>		<u>Organ</u>	<u>Effec</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 2 CAS #: 67-63-0	CNS	Depressi	on	CNS	Depression	CN	IS	Depre	ssion	CNS	Dep	ression	CNS	Depres	sion	
	Mucosa	Irritation		Mucosa	Irritation	Mι	ıcosa			Mucosa	Irrita		Mucosa	Irritatio	n	
Year SMAC was Set/ Reviewed: 1992				Liver	Hepatotoxici	ty Liv	er	Hepat	otoxicity	PNS		r. cond'n.				
											velo	city				
Toluene		16	(60)	•	16 (6	0)		16	(60)		16	(60)		16	(60)	
Synonyms: Methyl benzene	<u>Organ</u>	<u>Effect</u>		<u>Organ</u>	<u>Effect</u>	<u>Or</u>	gan	<u>Effect</u>		<u>Organ</u>	<u>Effec</u>	<u>ct</u>	<u>Organ</u>	<u>Effect</u>		1
NRC Vol. #: 2 CAS #: 108-88-3	CNS	Depressi	on	CNS	Depression	CN	IS	Depre	ssion	CNS	Dep	ression	CNS	Depres		
Year SMAC was Set/ Reviewed: 1992						Mι	ıcosa	Irritatio	on	Mucosa	Irrita	tion	Mucosa	Irritatio	n	
Tour Sivino was Jol/ Noviewou. 1772																



POTENTIAL EXPOSURE DURATION

		1 h	r		24	hr		7	d		30	d	1	80 d		
Chemical Name	ppn	1 (r	mg/m³)	pp	m	(mg/m³)	ppı	m	(mg/m³)	pp	m	(mg/m³)	ppı	n (mg	g/m³)	Remarks
Trichloroethylene	į	50	(270)		11	(60)		9	(50)		4	(20)		2	(10)	See dichloroacetylene if
Synonyms:	<u>Organ</u>	<u>Effec</u>		<u>Organ</u>	<u>Effe</u>	<u>ect</u>	<u>Organ</u>	<u>Effec</u>	_	<u>Organ</u>	<u>Effec</u>	_	<u>Organ</u>	<u>Effect</u>		alkali scrubber is present. Possible carcinogen.
NRC Vol. #: 3 CAS #: 79-01-6	CNS Heart		ession rthmia	CNS	Dep	ression	Kidney Liver	•	nrotoxicity ntotoxicity	Kidney Liver	•	nrotoxicity ntotoxicity	Multi. Kidney	Cancer Nephrot	ovicity	
Year SMAC was Set/ Reviewed: 1992	Пеан	Allily	шшша				Livei	пера	iluluxicity	Livei	пера	iloloxicity	Liver	Hepatot	,	
Trimethylsilanol	1!	50	(550)		20	(74)		10	(37)		10	(37)		10	(37)	
Synonyms: Trimethylhydroxysilane	<u>Organ</u>	<u>Effec</u>	_	<u>Organ</u>	<u>Effe</u>	<u>oct</u>	<u>Organ</u>	<u>Effec</u>	<u>:t</u>	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 1 CAS #: 1066-40-6	CNS	Depre	ession	CNS	Dep	ression	CNS	Depr	ession	CNS	Depr	ession	CNS	Depress	sion	
Year SMAC was Set/ Reviewed: 1991																
Vinyl chloride	13	30	(330)		30	(77)		1	(2.6)		1	(2.6)		1	(2.6)	Carcinogen
Synonyms: Chloroethene; chloroethylene	<u>Organ</u>	<u>Effec</u>		<u>Organ</u>	<u>Effe</u>	<u>ect</u>	<u>Organ</u>	<u>Effec</u>	<u>:t</u>	<u>Organ</u>	<u>Effec</u>	_	<u>Organ</u>	<u>Effect</u>		
NRC Vol. #: 1	Liver	•	,	Liver		atotoxicity	Testes	Necr		Testes	Necr		Testes	Necrosi	S	
Year SMAC was Set/ Reviewed: 1992	CNS CNS	Head Depre		CNS CNS		dache ression	Liver	Нера	ntotoxicity	Liver	Нера	ntotoxicity	Liver	Cancer		
Xylene	10	00	(430)	1	100	(430)		50	(220)		50	(220)		50	(220)	Applies to each individual
Synonyms: Dimethylbenzene, xylol	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effe</u>	<u>ct</u>	<u>Organ</u>	<u>Effec</u>	<u>:t</u>	<u>Organ</u>	<u>Effec</u>	<u>t</u>	<u>Organ</u>	<u>Effect</u>		xylene isomer and mixtures of xylene isomers.
NRC Vol. #: 3 CAS #: 1330207	Mucosa CNS	Irritat Depre		Mucosa CNS		ation ression	Mucosa	Irritat	tion	Mucosa	Irrita	tion	Mucosa	Irritation	1	
Year SMAC was Set/ Reviewed: 1992																

Abbreviations: CNS - Central Nervous System

GI - Gastrointestinal System NRC - National Research Council

N.S. - Not Set

PNS - Peripheral Nervous System

RBC - Red Blood Cells RspSys - Respiratory System