

# Chemical Warfare Agent Characteristics

Agent Type	PHYSICAL AND CHEMICAL PROPERTIES													PHYSIOLOGICAL ACTION					CWC Schedule			
	Chemical Agent; Symbol Chemical Structure	Molecular Weight	State @ 20°C	Odor	Vapor Density (Air = 1)	Liquid Density (g/cc)	Freezing/Melting Point (°C)	Boiling Point (°C)	Vapor Pressure (mm <sup>2</sup> Hg)	Volatility (mg/m <sup>3</sup> )	Heat of Vaporization (cal/g)	Decomposition Temperature (°C)	Flash Point	Stability	Median Lethal Dose (LD <sub>50</sub> ) (mg-min/m <sup>3</sup> )	Median Incapacitating Dose (ID <sub>50</sub> )	Eye & Skin Toxicity	Rate of Action		Physiological Action	Detoxification Rate	
NERVE	Tabun; <b>GA</b> C <sub>2</sub> H <sub>5</sub> OPO(CN)N(CH <sub>3</sub> ) <sub>2</sub>	162.3	Colorless to brown liquid	Faintly fruity; none when pure	5.63	1.073 at 25°C	-5	240	0.037 @ 20°C	610 @ 25°C	79.56	150	78°C	Stable in steel at normal temperatures	15,000 by skin (vapor) or 1500 (liquid); 70 inhaled	<50 inhaled	Very high	Very Rapid	Cessation of breath -- death may follow	Slight, but definite	1.A.(2)	
	Sarin; <b>GB</b> CH <sub>3</sub> PO(F)OCH(CH <sub>3</sub> ) <sub>2</sub>	140.1	Colorless liquid	Almost none when pure	4.86	1.0887 at 25°C	-56	158	2.9 @ 25°C; 2.10 @ 20°C	22,000 @ 25°C; 16,090 @ 20°C	80	150	Non-flammable	Stable when pure	10,000 by skin (vapor) or 1700 (liquid); 35 inhaled	25 inhaled	Very high	Very rapid	Cessation of breath – death may follow	cumulative	1.A.(1)	
	Soman; <b>GD</b> CH <sub>3</sub> PO(F)OCH(CH <sub>3</sub> )C(CH <sub>3</sub> ) <sub>3</sub>	182.178	Colorless liquid	Fruity; camphor when impure	6.33	1.0222 at 25°C	-42	198	0.4 @ 25°C	3,900 @ 25°C	72.4	130	High enough not to interfere w/ military use	Less stable than GA or GB	2,500 by skin (vapor) or 350 (liquid); 35 inhaled	25 inhaled	Very high	Very rapid	Cessation of breath – death may follow	Low, essentially cumulative	1.A.(1)	
	(Cyclo-sarin); <b>GF</b> CH <sub>3</sub> PO(F)OC <sub>6</sub> H <sub>11</sub>	180.2	Liquid	Sweet; musty; peaches; shellac	6.2	1.1327 at 20°C	-30	239	0.044 @ 20°C	438 @ 20°C	90.5	---	---	94°C	Relatively stable in steel	2,500 by skin (vapor) or 350 (liquid); 35 inhaled	25 inhaled	Very high	Very rapid	Cessation of breath – death may follow	Low	1.A.(1)
	<b>VX</b> (C <sub>2</sub> H <sub>5</sub> O)(CH <sub>3</sub> O)P(O)S(C <sub>2</sub> H <sub>4</sub> )N[C <sub>2</sub> H <sub>2</sub> (CH <sub>3</sub> ) <sub>2</sub> ] <sub>2</sub>	267.38	Colorless to amber liquid	None	9.2	1.0083 at 20°C	below -51	298	0.0007 @ 20°C	10.5 @ 25°C	78.2 @ 25°C	Half-life of 36 hr at 150	159°C	Relatively stable at room temperature	150 by skin (vapor) or 5 (liquid); 15 inhaled	25 by skin (vapor) or 2.5 (liquid); 10 inhaled	Very high	Very rapid	Produces casualties when inhaled or absorbed	low, essentially cumulative	1.A.(3)	
<b>Vx</b> ("V sub x")	211.2	Colorless liquid	None	7.29	1.062 at 20°C	---	256	0.007 @ 25°C; 0.004 @ 20°C	75 @ 25°C; 48 @ 20°C	67.2	---	---	---	Relatively stable	---	---	Very high	Rapid	Produces casualties when inhaled or absorbed	low, essentially cumulative		
BLISTER	Distilled Mustard; <b>HD</b> (ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> S	159.08	Colorless to pale yellow liquid	Garlic or horseradish	5.4	1.268 @ 25°C; 1.27 @ 20°C	14.45	217	0.072 @ 20°C	610 @ 20°C	94	149 – 177	105°C; ignited by large explosive charges	Stable in steel or aluminum	900 (inhaled); 5,000 by skin (vapor) or 1,400 (liquid)	500 (skin); 100 (inhaled); 25 (eyes or nose)	Eyes very susceptible; skin less so	Delayed: hours to days	Blisters; destroys tissue; injures blood cells	Very low – cumulative	1.A.(4)	
	Nitrogen Mustard; <b>HN-1</b> (ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> NC <sub>2</sub> H <sub>5</sub>	170.08	Dark liquid	Fishy or musty	5.9	1.09 @ 20°C	-34	194	0.24 @ 25°C	1,520 @ 20°C	77	Decomposes before boiling is reached	High enough not to interfere w/ military use	Adequate	1,500 (inhaled); 20,000 (skin)	200 by eye; 9,000 by skin	Eyes susceptible to low concentration; skin less so	Delayed: 12 hours or longer	Blisters; affects respiratory tract; destroys tissue; injures blood cells	Not detoxified; cumulative	1.A.(6)	
	Nitrogen Mustard; <b>HN-2</b> (ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> NCH <sub>3</sub>	156.07	Dark liquid	Soapy (low concentrations); Fruity (high)	5.4	1.15 @ 20°C	-65 to -60	75 at 15mmHg	0.29 @ 20°C	3,580 @ 25°C	78.8	Below boiling; polymerizes with heat generation	High enough not to interfere w/ military use	Unstable	3,000 (inhaled)	<HN-1 & >HN-3; 100 by eye	Toxic to eyes; blisters skin	Skin – delayed 12 hrs or more; Eyes – faster than HD	Similar to HD; bronchopneumonia possible after 24 hours	Not detoxified; cumulative	1.A.(6)	
	Nitrogen Mustard; <b>HN-3</b> N(CH <sub>2</sub> CH <sub>2</sub> Cl) <sub>3</sub>	204.54	Dark liquid	None, if pure	7.1	1.24 @ 20°C	-37	256	0.0109 @ 25°C	121 @ 25°C	74	Below boiling point	High enough not to interfere w/ military use	Stable	1,500 (inhaled); 10,000 by skin (est.)	200 by eye; 2,500 by skin (est.)	Eyes very susceptible; skin less so	Serious effects same as HD; minor effects sooner	Similar to HN-2	Not detoxified – cumulative	1.A.(6)	
	Phosgene oximedichloroformoxime; <b>CX</b> CCl <sub>2</sub> NOH	113.94	Colorless solid or liquid	Sharp, penetrating	3.9	--	35 to 40	53 –54 at 28mmHg	11.2 @ 25°C (solid); 13 @ 40°C (liquid)	1,800 @ 20°C	101 at 40°C	Decomposes slowly at normal temperature	---	Decomposes slowly	3,200 (inhaled)	very low	Powerful irritant to eyes and nose; liquid corrosive to skin	Immediate effects on contact	Violently irritates mucous membranes, eyes, and nose; forms wheals rapidly	---		
	Lewisite; <b>L</b> ClCHCHAsCl <sub>2</sub>	207.35	Colorless to brownish	Varies; may resemble geraniums	7.1	1.89 @ 20°C	-18	190	0.394 @ 20°C	4,480 @ 20°C	58 at 0°C to 190°C	>100	None	Stable in steel and glass	1,200–1,500 (inhaled); 100,000 (skin)	<300 by eye; >1,500 to 2,000 by skin	Severe eye damage; skin less so	Rapid	Similar to HD, plus may cause systemic poisoning	Not detoxified	1.A.(5)	
	Mustard-Lewisite mixture; <b>HL</b>	186.4	Dark, oily liquid	Garlic	6.5	1.66 @ 20°C	-25.4 (pure)	<190	0.248 @ 20°C	2,730 @ 20°C	58 to 94	>100	High enough not to interfere w/ military use	Stable in lacquered steel	15,000 (inhaled); >10,000 (skin)	200 by eye; 1,500 to 2,000 by skin	Very high	Prompt stinging; blistering agent about 13 hours	Similar to HD, plus may cause systemic poisoning	Not detoxified	1.A.(4); 1.A.(5)	
	Phenyldichlorarsine; <b>PD</b> C <sub>6</sub> H <sub>5</sub> AsCl <sub>2</sub>	222.91	Colorless liquid	None	7.7	1.65 @ 20°C	-20	252 to 255	0.033 @ 25°C	390 @ 25°C	69	Stable to boiling point	High enough not to interfere w/ military use	Very stable	2,600 (inhaled)	16 as vomiting agent; 1,800 as blister	633 mg-min/m <sup>3</sup> produces eye casualty; less toxic to skin	Immediate eye effects; skin effects in 30 to 60 minutes	Irritates; causes nausea, vomiting and blisters	Probably rapid		
	Ethylidichlorarsine; <b>ED</b> C <sub>2</sub> H <sub>5</sub> AsCl <sub>2</sub>	174.88	Colorless liquid	Fruity, but biting; irritating	6.0	1.66 @ 20°C	-65	156	2.09 @ 20°C	20,000 @ 20°C	52.5	Stable to boiling point	High enough not to interfere w/ military use	Stable in steel	3,000–5,000 (inhaled); 100,000 (skin )	5 to 10 by inhalation	Vapor harmful on long exposure; liquid blisters <L	Immediate irritation; delayed blistering	Damages respiratory tract; effects eyes; blisters; can cause systemic poisoning	Rapid		
Methylidichlorarsine; <b>MD</b> CH <sub>3</sub> AsCl <sub>2</sub>	160.86	Colorless liquid	None	5.5	1.836 @ 20°C	-55	133	7.76 @ 20°C	74,900 @ 20°C	49	Stable to boiling point	High enough not to interfere w/ military use	Stable in steel	3,000 – 5,000 (est.)	25 by inhalation	Eye damage possible; blisters less than HD	Immediate irritation; delayed blistering	Irritates lungs and eyes; Causes systemic poisoning	Rapid			
BLOOD	Hydrogen cyanide; <b>AC</b> HCN	27.02	Colorless gas or liquid	Bitter almonds	0.990 @ 20°C	0.687 @ 20°C	-13.3	25.7	742 @ 25°C; 612 @ 20°C	1,080,000 @ 25°C	233	>65.5	0°C; ignited 50% of time when disseminated by artillery shells	Stable if pure; can burn on explosion	Varies widely with concentration	Varies with concentration	Moderate	Very rapid	Interferes with body tissues' oxygen use; accelerates rate of breathing	Rapid: 0.017 mg/kg/min	3.A.(3)	
	Cyanogen chloride; <b>CK</b> CNCl	61.48	Colorless gas or liquid	Pungent, biting; Can go unnoticed	2.1	1.18 @ 20°C	-6.9	12.8	1,000 @ 25°C	2,600,000 @ 20°C	103	100	None	Tends to polymerize; may explode	11,000	7,000	Low; lacrimatory and irritating	Very rapid	Chokes, irritates, causes slow breathing rate	Rapid: 0.02 to 0.1 mg/kg/min	3.A.(2)	
	Arsine; <b>SA</b> AsH <sub>3</sub>	77.93	Colorless gas	Mild garlic	2.69	1.34 @ 20°C	-116	-62.5	11,100 @ 20°C	30,900,000 @ 20°C	53.7 @ -62.5°C	280	Below detonation temp.; mixtures w/ air may explode spontaneously	Not stable in uncoated metal containers	5,000	2,500	None	Delayed 2 hours to 11 days	Damages blood, liver, and kidneys	Low		
CHOKING	Phosgene; <b>CG</b> COCl <sub>2</sub>	98.92	Colorless gas	New-mown hay; green corn	3.4	1.37 @ 20°C	-128	7.6	1.173 @ 20°C	4,300,000 @ 20°C	59	800	None	Stable in steel if dry	3,200	1,600	None	Immediate to 3 hr. depending on conc.	Damages and floods lungs	Not detoxified – cumulative	3.A.(1)	
	Diphosgene; <b>DP</b> ClCOOCCl <sub>2</sub>	197.85	Colorless gas	New-mown hay; green corn	6.8	1.65 @ 20°C	-57	127–128	4.2 @ 20°C	45,000 @ 20°C	57.4	300 to 350	None	Unstable; tends to convert to CG	3,200	1,600	Slightly lacrimatory	Immediate to 3 hr. depending on conc.	Damages and floods lungs	Not detoxified – cumulative	3.A.(1)	
VOMITING	Diphenylchloroarsine; <b>DA</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> AsCl	264.5	White to brown solid	None	Forms little vapor	1.387 @ 50°C	41 to 44.5	333	0.0036 @ 45°C	48 @ 45°C	56.6	300	350	Stable if pure	15,000 (est.)	12 (>10 minutes)	Irritating; not toxic	Very rapid	Like cold symptoms, plus headache, vomiting, nausea	Moderate		
	Adamsite; <b>DM</b> C <sub>6</sub> H <sub>4</sub> (AsCl)(NH)C <sub>6</sub> H <sub>4</sub>	277.57	Yellow to green solid	None	Forms little vapor	1.65 (solid) @ 20°C	195	410	Negligible	Negligible	80	>boiling point	None	Stable in glass or steel	Variable; avg.: 11,000	22 (1 min.); 8 (60 min. exposure)	Irritating; relatively not toxic	Very rapid	Like cold symptoms, plus headache, vomiting, nausea	Rapid in small amounts		
	Deiphenylcyanoarsine; <b>DC</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> AsCN	255.0	White to pink solid	Bitter almond-garlic mixture	Forms little vapor	1.3338 @ 35°C	31.5 to 35	350	0.0002 @ 20°C	2.8 @ 20°C	71.1	300 (25% decomposed)	Low	Stable at normal temperatures	10,000 (est.)	30 (30 sec); 20 (5 min. exposure)	Irritating; not toxic	More rapid than DM or DA	Like cold symptoms, plus headache, vomiting, nausea	Rapid		
Incapacitating	<b>BZ</b>	337.4	White crystal	None	11.6	Bulk 0.51 solid; Crystal 1.33	167.5	320	0.03 @ 70°C	0.5 @ 70°C	62.9	begins at 170°C	246°C	Adequate	200,000 (est.)	112	---	Delayed: 1 to 4 hours depending on exposure	Fast heart beat, vomiting, dry mouth, blurred vision, stupor, increasing random activity	---	2.A.(3)	
TEAR	Chloroacetophenone; <b>CN</b> C <sub>6</sub> H <sub>5</sub> COCH <sub>2</sub> Cl	154.59	Solid	Apple blossoms	5.3	1.318 (solid) @ 20°C	54	248	0.0041 @ 20°C	34.3 @ 20°C	98	Stable to boiling point	High enough not to interfere w/ military use	Stable	7,000 to 14,000	80	Temporarily severe eye irritation; mild skin irritation	Instantaneous	Causes tearing; irritates eyes and respiratory tract	Rapid		
	Chloroacetophenone in Chloroform; <b>CNC</b>	128.17	Liquid	Chloroform	4.4	1.40 @ 20°C	0.23	variable, 60 to 247	127 @ 20°C	Indeterminate	n/a	Stable to boiling point	None	Adequate	11,000 (est.)	80	Temporarily severe eye irritation; mild skin irritation	Instantaneous	Cause tearing; irritates eyes and respiratory tract	Rapid		
	Chloroacetophenone and Chloropicrin in Chloroform; <b>CNS</b>	141.78	Liquid	Flypaper	-5	1.47 @ 20°C	2	variable, 60 to 247	78 @ 20°C	610,000 @ 20°C (includes solvent)	n/a	Stable to boiling point	None	Adequate	11,400	60	Irritating; not toxic	Instantaneous	Vomiting and choking agent as well as a tear agent	Slow because of effect of PS		
	Chloroacetophenone in Benzene and Carbon Tetrachloride; <b>CNB</b>	119.7	Liquid	Benzene	-4	1.14 @ 20°C	-7 to -30	variable 75 to 247	variable; mostly solvent vapor	Indeterminate	n/a	>247	<4.44°C	Adequate	11,000 (est.)	80	Temporarily severe eye irritation; mild skin irritation	Instantaneous	Powerfully lacrimatory	Rapid		
	Bromobenzylcyanide; <b>CA</b> BrC <sub>6</sub> H <sub>4</sub> CH <sub>2</sub> CN	196	Yellow or solid liquid	Soured fruit	6.7	1.47 @ 25°C	25.5	Decomposes at 242	0.011 @ 20°C	115 @ 20°C	79.5 @ 20°C	60 to 242	None	Fairly stable in glass, lead, or enamel	8,000 to 11,000 (est.)	30	Irritating; not toxic	Instantaneous	Irritates eyes and respiratory passages	Rapid in low dosage		
	O-chlorobenzylmalonitrile; <b>CS</b> ClC <sub>6</sub> H <sub>4</sub> CHC(CN) <sub>2</sub>	188.5	Colorless solid	Pepper	---	1.04 @ 20°C	93 to 95	310 to 315	0.00034 @ 20°C	0.71 @ 25°C	53.6	---	197°C	Stable	61,000	10 to 20	Highly irritating; not toxic	Instantaneous	Highly irritating; not toxic	Rapid		
	<b>CR</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> O(N)CH	195.25	Yellow powder in solution	Burning sensation	6.7	---	72	335	0.00059 @ 20°C	0.63 @ 25°C	---	---	188°C	Stable	---	0.15	Highly irritating; not toxic	Instantaneous	Irritates skin, eyes, nose, and throat	Moderate		
Chloropicrin; <b>PS</b> Cl <sub>3</sub> CNO <sub>2</sub>	164.38	Liquid	Stinging; pungent	5.6	1.66	-69	112	18.3 @ 20°C	165,000 @ 20°C	---	>400	Not flammable	Adequate; unstable in light	2,000	9	Highly irritating	Instantaneous	Acts as tear, vomiting, and choking agent	Slow	3.A.(4)		