

# NERVE AGENTS

# GA (Tabum)

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## Impact of GA

- Nerve Agent
- Primary Usage: Quick-action casualty agent
- Enters body primarily through respiratory tract, but can also enter through skin and digestive track
- Symptoms: Difficulty breathing, drooling, nausea, vomiting, cramps,. Involuntary defecation and urination, twitching, jerking, staggering, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure to nerve agent

# GA (Tabum)

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## Toxicity Data

- Respiratory ICt50 (mild): 85mg-min/m<sup>3</sup>
- Respiratory ICt50 (severe): 110mg-min/m<sup>3</sup>  
300mg-min/m<sup>3</sup> for resting person  
1-10 minutes to effect
- Respiratory LCT50: 400mg-min/m<sup>3</sup>  
10-15 minutes to effect
- Percutaneous LD50: 1 to 1.5 mg per person
- Rate of detoxification: Low, essentially cumulative

# GA (Tabum)

## Agent Persistency Information (in hours)

Temperature		Terrain	
C	F	Sandy terrain	Grassy terrain
-30	-22	>1.42	>1.42
-20	-4	>1.42	>1.42
-10	14	>1.42	>1.42
0	32	>1.42	>1.42
10	50	1.42	0.57
20	68	0.71	0.28
30	86	0.33	0.13
40	104	0.25	0.10
50	122	0.25	0.10
55	131	0.25	0.10

- Heavily splashed liquid persists one to two days under average weather conditions
- GA evaporates about 20 times more slowly than water
- GA will contaminate surfaces for a sufficiently long time to provide a relevant contact hazard

# GA (Tabum)

## Chemical and Physical Properties

•Physical State:	Brownish to colorless liquid that gives off a colorless vapor
•Odor:	Faintly fruity, none when pure
•Freezing point:	-5°C
•Melting point:	-50°C
•Boiling point:	220°C to 246°C at 760 mm HG
•Volatility	610 mg/m <sup>3</sup> at 25°C
•Flash point	78°C
•Decomposition temp:	Completely decomposes at 150°C after 3 1/4 hours, GA undergoes considerable decomposition when explosively disseminated
•Stability in storage	GA is stable for several years when store in steel containers at ordinary temperatures
•Molecular weight:	162.3

# GA (Tabum)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
  - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - Flush eyes with vapor immediately
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate equipment using calcium hypochlorite (HTH), Super tropical bleach (STB), household bleach, caustic soda, dilute alkali solutions, or decontaminating solution number 2 (DS2)
  - Use steam and ammonia or hot soapy water in confined area

# GA (Sarin)

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## Impact of GB

- Nerve agent
- Primary usage: Quick-action casualty agent
- Enters body primarily through respiratory tract, but also can enter through skin and digestive tract
- Symptoms: Difficulty breathing, drooling, sweating, nausea, vomiting, cramps, jerking, staggering, involuntary defecation and urination, twitching, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure

# GB (Sarin)

## Toxicity Data

- Threshold eye effects 1mg-min/m<sup>3</sup>
- Respiratory ICt50 (mild): 15mg-min/m<sup>3</sup>  
1-10 minutes to effect
- Respiratory ICt50 : 55mg-min/m<sup>3</sup>
- Respiratory LCT50: 100mg-min/m<sup>3</sup> for resting person  
2-15 minutes to effect
- Percutaneous ICt50: 8,000mg-min/m<sup>3</sup>
- Percutaneous LD50: 12,000mg-min/m<sup>3</sup>  
2-15 minutes to effect
- Rate of detoxification: Low, essentially cumulative



UNCLASSIFIED

# GB (Sarin)

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## Agent Persistency Information (in hours)

### Temperature

### Terrain

<u>C</u>	<u>F</u>	<u>Sandy terrain</u>	<u>Grassy terrain</u>
-30	-22	496.53	193.10
-20	-4	203.67	79.21
-10	14	90.41	35.16
0	32	42.48	16.52
10	50	21.15	8.23
20	68	11.03	4.29
30	86	6.08	2.36
40	104	3.42	1.33
50	122	1.98	0.77
55	131	1.53	0.60

- GB evaporates at the approximately same rate as water or kerosene and is less persistent than GA. Duration depends upon munitions used and the weather

UNCLASSIFIED

# GB (Sarin)

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## Chemical and Physical Properties

- Physical state: Colorless liquid
- Odor: Almost none when pure
- Boiling point: 220° to 246°C at 760 mm HG
- Freezing point: -56 °C
- Flash point: Nonflammable
- Heat of vaporization: 80 cal/g
- Volatility: 22,000 mg/m<sup>3</sup> at 25°C
- Decomposition temp: Complete decomposition after 2 1/2 hours at 150°C
- Stability in storage: Fairly stable in steel containers at 65°. Stability improves with increasing purity
- Molecular weight: 162.13

# UNCLASSIFIED GB (Sarin)

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## Other Data

- Means of detection in the field:
  - - M18A2, M256A1 and M8A1 alarms
  - - M8 and M9 paper
- Protection required: MOPP 4
  - - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - - Flush eyes with vapor immediately
  - - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - - Decontaminate equipment using calcium hypochlorite (HTH), Super tropical bleach (STB), household bleach, caustic soda, dilute alkali solutions, or decontaminating solution number 2 (DS2)
  - - Use steam and ammonia or hot soapy water in confined area

# UNCLASSIFIED GD (Soman)

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## Impact of GD

- Nerve agent
- Primary usage: Quick-action casualty agent
- Enters body primarily through respiratory tract, but also can enter through skin and digestive tract
- Symptoms: Difficulty breathing, drooling, sweating, nausea, vomiting, cramps, jerking, staggering, involuntary defecation and urination, twitching, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure to nerve agent; after a few minutes antidotes are not as effective for GD poisoning as they are for other nerve agents

# UNCLASSIFIED GD (Soman)

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## Toxicity Data

- Threshold eye effects 0.16mg-min/m<sup>3</sup>
- Respiratory ICt50 : 25mg-min/m<sup>3</sup>  
1-10 minutes to effect
- Respiratory LCt50 : 70mg-min/m<sup>3</sup>  
1-15 minutes to effect
- Percutaneous LCt50: 10,000mg-min/m<sup>3</sup>
- Rate of detoxification: Low, essentially cumulative

# UNCLASSIFIED GD (Soman)

## Agent Persistency Information (in hours)

### Temperature

C      F

-30   -22

-20   -4

-10   14

0     32

10    50

20    68

30    86

40   104

50   122

55   131

### Terrain

Sandy terrain

Grassy terrain

496.53

193.10

203.67

79.21

90.41

35.16

42.48

16.52

21.15

8.23

11.03

4.29

6.08

2.36

3.42

1.33

1.98

0.77

1.53

0.60

UNCLASSIFIED

# GD (Soman)

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## Weaponization Data

- (U) Thickened GD is mainly a vapor hazard, although GD forms large droplets that provide a greater concentration reaching the ground and a greater contact hazard than the from which have not thickened

# UNCLASSIFIED GD (Soman)

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## Chemical and Physical Properties

- Physical state: Colorless liquid
- Odor: Fruity, camaphor when impure
- Boiling point: 198° at 760 mm HG
- Freezing point: -42 °C
- Flash point: N/A
- Heat of vaporization: 72.4 cal/g
- Volatility: 3,900 mg/m<sup>3</sup> at 25°C
- Decomposition temp: Stabalized-200hrs@130°C  
Unstabalized-4hrs@130°C
- Stability in storage: Less stable than GA or GB
- Molecular weight: 182.178



UNCLASSIFIED

# GD (Soman)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
  - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - Flush eyes with vapor immediately
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate equipment using calcium hypochlorite (HTH), Super tropical bleach (STB), household bleach, caustic soda, dilute alkali solutions, or decontaminating solution number 2 (DS2)
  - Use steam and ammonia or hot soapy water in confined area

## Impact of GF

- Nerve agent
- Primary usage: Quick-action casualty agent
- Enters body primarily through respiratory tract, but also can enter through skin and digestive tract
- Symptoms: Difficulty breathing, drooling, sweating, nausea, vomiting, cramps, jerking, staggering, involuntary defecation and urination, twitching, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure

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## Toxicity Data

- Respiratory IC<sub>50</sub> : 20mg-min/m<sup>3</sup>
- Respiratory LC<sub>50</sub> : 75mg-min/m<sup>3</sup>
- Percutaneous IC<sub>50</sub>: 7,500mg-min/m
- Percutaneous LC<sub>50</sub>: 15,000mg-min/m<sup>3</sup>
- Rate of detoxification: Low

## Agent Persistency Information (in hours)

### Temperature

C      F

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

-30   -22

-20   -4

-10   14

0      32

10     50

20     68

30     86

40   104

50   122

55   131

### Terrain

Sandy terrain

Grassy terrain

>1.42

>1.42

>1.42

>1.42

>1.42

>1.42

>1.42

>1.42

1.42

0.57

0.71

0.28

0.33

0.13

0.25

0.10

0.25

0.10

0.25

0.10

- Heavily splashed liquid persists one to two days under average weather conditions
- GF evaporates approx. twenty times as slowly as water, and has same persistency as GA

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## Chemical and Physical Properties

- Physical state: Liquid
- Odor: Sweet, musty, peaches
- Boiling point: 239° at 760 mm HG
- Freezing point: -30 °C
- Flash point: 94°
- Heat of vaporization: 90.5 cal/g
- Volatility: 438 mg/m<sup>3</sup> at 25°C
- Stability in storage: Stable in steel at normal temps.
  
- Molecular weight: 180.2

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## Other Data

- Means of detection in the field:
  - - M18A2, M256A1 and M8A1 alarms
  - - M8 and M9 paper
- Protection required: MOPP 4
  - - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - - Flush eyes with vapor immediately
  - - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - - Decontaminate equipment using calcium hypochlorite (HTH), Super tropical bleach (STB), household bleach, caustic soda, dilute alkali solutions, or decontaminating solution number 2 (DS2)
  - - Use steam and ammonia or hot soapy water in confined area



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## Impact of VX

- Nerve Agent
- Primary Usage: Quick-action casualty agent
- Enters body primarily through skin, but can also enter through skin and respiratory tract and digestive tract. VX has low volatility, and liquid droplets on the skin do not evaporate, thereby increasing absorption. VX by percutaneous route is estimated to be more than 100 times as toxic as GB, VX by inhalation is estimated to be twice as toxic as GB
- Symptoms: Difficulty breathing, drooling, nausea, vomiting, cramps, . Involuntary defecation and urination, twitching, jerking, staggering, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure to nerve agent



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## Toxicity Data

- Threshold eye effects: 0.04mg-min/m<sup>3</sup>
- Respiratory ICt50 : 50 mg-min/m<sup>3</sup>  
1-10 minutes to effect
- Respiratory LCt50: 100mg-min/m<sup>3</sup>  
4-10 mins to effect
- Percutaneous LCt50: 115mg-min/m<sup>3</sup>
- Rate of detoxification: Low, essentially cumulative





## Agent Persistency Information (in hours)

Temperature		Terrain	
C	F	Sandy terrain	Grassy terrain
		496.53	193.10
		203.67	79.21
-30	-22	90.41	35.16
-20	-4	42.48	16.52
-10	14	21.15	8.23
0	32	11.03	4.29
10	50	6.08	2.36
20	68	3.42	1.33
30	86	1.98	0.77
40	104	1.53	0.60
50	122		
55	131		

- Depends upon munitions used and the weather
- Heavily splashed liquid persists for long periods under avg. weather conditions, in cold weather VX can persist for months

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## Chemical and Physical Properties

- Physical state: Amber colored, oily
- Odor: None
- Boiling point: 298° at 760 mm HG
- Freezing point: -39 °C
- Flash point: 159°C
- Heat of vaporization: 78.2 cal/g
- Volatility: 10.5 mg/m<sup>3</sup> at 25°C
- Decomposition temp: Half life-36hrs@150°C  
1.6hours@200°C  
4min@250°C  
36sec@295°C
- Stability in storage: Relatively stable
- Molecular weight: 267.38



## Other Data

- Means of detection in the field:
  - - M18A2, M256A1 and M8A1 alarms
  - - M8 and M9 paper
- Protection required: MOPP 4
  - - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - - Flush eyes with vapor immediately
  - - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - - Decontaminate individual equipment with M280 individual equipment decontamination kit



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## Impact of V

- Nerve Agent
- Primary Usage: Quick-action casualty agent
- Enters body primarily through respiratory tract, but can also enter through skin and digestive track
- Symptoms: Difficulty breathing, drooling, nausea, vomiting, cramps,. Involuntary defecation and urination, twitching, jerking, staggering, headache, confusion, drowsiness, coma, convulsions, death
- Treatment: Use of nerve agent antidote (atropine and 2-PAM chloride); pretreatment with pyridostigmine bromide (PB) increase survivability when antidote is used after exposure to nerve agent



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## Toxicity Data

- |                           |  |
|---------------------------|--|
| • Rate of detoxification: | Low, essentially cumulative  |
| • Eye toxicity:           | Extremely toxic  |
| • Skin toxicity:          | Extremely toxic by skin absorption<br>does not injure skin but rapidly<br>penetrates |
| • Time to effect:         | Rapid  |



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## Chemical and Physical Properties

- Physical state: Amber colored, oily liquid
- Odor: None
- Boiling point: 256° at 760 mm HG
- Heat of vaporization: 67.2 cal/g
- Volatility: 75.5 mg/m<sup>3</sup> at 25°C
- Molecular weight: 211.2

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
  - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - Flush eyes with vapor immediately
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# BLISTER AGENTS (VESICANTS)



# H (Sulfur Mustard)

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## Impact of H

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Inflammation of the eyes, inflammation of the nose, throat, trachea, bronchi, and lung tissue; redness of the skin, blister or ulceration; more "at ease" attitude, vomiting; and fever, beginning about same time as skin reddening

# H (Sulfur Mustard)

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## Toxicity Data

- Eye injury (ECt50) 100-200mg-min/m<sup>3</sup>
- Respiratory ICt50 : 200mg-min/m<sup>3</sup>  
4-6 hours to effect
- Respiratory LCt50 : 1500mg-min/m<sup>3</sup>  
4-24 hours to effect

### COOL/DRY SUBJECT

- Percutaneous ICt50: 10,000mg-min/m
- Percutaneous LCt50: 10,000mg-min/m<sup>3</sup>

### HOT/WET SUBJECT

- Percutaneous ICt50: 150 mg-min/m<sup>3</sup>
- Percutaneous LCt50: 10,000 mg-min/m<sup>3</sup>
- Rate of detoxification Very low; even very small, repeated exposures oh HD are cumulative in their effect

# H (Sulfur Mustard)

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## Chemical and Physical Properties

- Physical state: Oily, colorless to amber liquid
- Odor: Garlic or horseradish smell
- Boiling point: 227.8° at 760 mm HG
- Freezing point: 14.45 °C
- Flash point: 105°C
- Heat of vaporization: 94 cal/g
- Volatility: 610 mg/m<sup>3</sup> at 25°C
- Decomposition temp: 149°C to 177°C
- Stability in storage: Stable in steel or aluminum cont.
- Molecular weight: 159.08

# H (Sulfur Mustard)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# HD (Distilled Mustard)

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## Impact of HD

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Inflammation of the eyes, inflammation of the nose, throat, trachea, bronchi, and lung tissue; redness of the skin, blister or ulceration; more "at ease" attitude, vomiting; and fever, beginning about same time as skin reddening

# HD (Distilled Mustard)

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## Toxicity Data

- Eye injury (ECt50) 100-200mg-min/m<sup>3</sup>
- Respiratory ICt50 : 200mg-min/m<sup>3</sup>
- 4-6 hours to effect
- Respiratory LCt50 : 1500mg-min/m<sup>3</sup>
- 4-24 hours to effect
- Percutaneous LCt50: 1,500mg-min/m<sup>3</sup>
- 4-24 hours to effect
- Rate of detoxification Very low; even very small, repeated exposures oh HD are cumulative in their effect

# UNCLASSIFIED HD (Distilled Mustard)

## Agent Persistency Information (in hours)

Temperature		Terrain	
		<u>Sandy terrain</u>	<u>Grassy terrain</u>
<u>C</u>	<u>F</u>	**	**
-30	-22	**	**
-20	-4	**	**
-10	14	**	**
0	32	12	4.8
10	50	6.33	2.53
20	68	2.8	1.12
30	86	2	0.8
40	104	1	0.4
50	122	1	0.40
55	131		

\*\* Agent is in a frozen state and will not evaporate or decay

- Depends upon amount of contamination by liquid, munitions used, nature of the rain and soil, and weather

# HD (Distilled Mustard)

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## Chemical and Physical Properties

- Physical state: Oily, colorless to amber liquid
- Odor: Garlic or horseradish smell
- Boiling point: 227.8° at 760 mm HG
- Freezing point: 14.45 °C
- Flash point: 105°C
- Heat of vaporization: 94 cal/g
- Volatility: 610 mg/m<sup>3</sup> at 25°C
- Decomposition temp: 149°C to 177°C
- Stability in storage: Stable in steel or aluminum cont.
  
- Molecular weight: 159.08



# HD (Distilled Mustard)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# HN-1 (Nitrogen Mustard)

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## Impact of HN-1

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Redness of the skin, causing irritation and itching, blisters in red area, irritation of the nose and throat, hoarseness progressing to loss of voice, persistent cough , fever, labored breathing, bronchial pneumonia after 24 hours; severe diarrhea ; nausea; vomiting

# HN-1 (Nitrogen Mustard)

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## Toxicity Data

- |                          |                              |
|--------------------------|------------------------------|
| • Eye injury (Ict50)     | 200mg-min/m <sup>3</sup>     |
| • Respiratory LCt50      | 1500mg-min/m <sup>3</sup>    |
| • Vapor ICt50            | 9000mg-min/m <sup>3</sup>    |
| • Vapor LCt50:           | 20,000 mg-min/m <sup>3</sup> |
| • Rate of detoxification | Not detoxified; cumulative   |

# HN-1 (Nitrogen Mustard)

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## Chemical and Physical Properties

- Physical state: Oily, colorless to yellow
- Odor: Garlic or horseradish smell
- Boiling point: 194° at 760 mm HG
- Freezing point: -34 °C
- Flash point: N/A
- Heat of vaporization: 77 cal/g
- Volatility: 127 mg/m<sup>3</sup> at -10°C
- Decomposition temp: Decomposes before boiling
- Stability in storage: Adequate for use in munitions.
  
- Molecular weight: 170.08

# HN-1 (Nitrogen Mustard)

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- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
  - Clothing gives off G-agents for approximately 30 minutes after contact with vapor
- Decontamination:
  - STB, fire, or DS2
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# HN-2 (Nitrogen Mustard)

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## Impact of HN-1

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Redness of the skin, causing irritation and itching, blisters in red area, irritation of the nose and throat, hoarseness progressing to loss of voice, persistent cough , fever, labored breathing, bronchial pneumonia after 24 hours; severe diarrhea ; nausea; vomiting

# HN-2 (Nitrogen Mustard)

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## Toxicity Data

- Respiratory LCt50 : 3000mg-min/m<sup>3</sup>
- Vapor ICt50: 2,500 - 9,000mg-min/m<sup>3</sup>
- Rate of detoxification: Not detoxified; cumulative

# HN-2 (Nitrogen Mustard)

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## Chemical and Physical Properties

• Physical state:	Dark liquid
• Odor:	Fruity, soft soap
• Boiling point:	75° at 760 mm HG
• Freezing point:	65-60 °C
• Flash point:	N/A
• Heat of vaporization:	78.8 cal/g
• Volatility:	3,580 mg/m <sup>3</sup> at 25°C
• Decomposition temp:	N/A
• Stability in storage:	Not stable
• Molecular weight:	156.07



# HN-2 (Nitrogen Mustard)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# HN-3 (Nitrogen Mustard)

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## Impact of HN-3

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. It damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Redness of the skin, causing irritation and itching, blisters in red area, irritation of the nose and throat, hoarseness progressing to loss of voice, persistent cough, fever, labored breathing, bronchial pneumonia after 24 hours; severe diarrhea; nausea; vomiting

# HN-3 (Nitrogen Mustard)

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## Toxicity Data

- Respiratory LCt50 : 1500mg-min/m<sup>3</sup>
- Percutaneous ICt50: 2,500mg-min/m<sup>3</sup>
- Percutaneous LCt50: 10,000mg-min/m<sup>3</sup>
- Rate of detoxification: Not detoxified; cumulative

# HN-3 (Nitrogen Mustard)

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## Chemical and Physical Properties

- Physical state: Oily liquid
- Odor: None when pure
- Boiling point: 256° at 760 mm HG
- Freezing point: -3.7 °C
- Flash point: N/A
- Heat of vaporization: 74 cal/g
- Volatility: 13 mg/m<sup>3</sup> at 0°C
- Decomposition temp: N/A
- Stability in storage: Stable for bomb use..
- Molecular weight: 204.54

# HN-3 (Nitrogen Mustard)

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## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# Mustard-T Mixture (HT)

---

## Impact of HT

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Redness of the skin, causing irritation and itching, blisters in red area, irritation of the nose and throat, hoarseness progressing to loss of voice, persistent cough , fever, labored breathing, bronchial pneumonia after 24 hours; severe diarrhea ; nausea; vomiting

# Mustard-T Mixture (HT)

---

## Toxicity Data

- Eye Injury ECt50 : 100-200mg-min/m<sup>3</sup>
- Respiratory LCt50: 200mg-min/m<sup>3</sup>
- Rate of detoxification: Very low; even very small, repeated exposures are cumulative in their effects however

# Mustard-T Mixture (HT)

---

## Chemical and Physical Properties

- Physical state: Clear, yellowish, highly viscous
- Odor: Garlic or horseradish smell
- Boiling point: 228° at 760 mm HG
- Freezing point: 0.0 to 1.3 °C for 60:40 mixture
- Flash point: 105°C
- Heat of vaporization: N/A
- Volatility: 831 mg/m<sup>3</sup> at 185°C
- Decomposition temp: 165°C to 185°C
- Stability in storage: Pressure develops in steel
- Molecular weight: 189.4



# Mustard-T Mixture (HT)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2, HTH, household bleach
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# L (Lewisite)

---

## Impact of L

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. H damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Immediate burning sensation in the eyes; permanent loss of sight if not decontaminated within 3 minutes with large amounts of water; immediate and strong stinging sensation to the skin; reddening of the skin starts within 30 minutes; blistering does not appear until after about 13 hours; skin burns are much deeper than those caused by HD

# L (Lewisite)

---

## Toxicity Data

- Eyes effects (ED) : 300mg-min/m<sup>3</sup> very susceptible to low concentrations; 1,500mg-min/m<sup>3</sup> produces severe and probably permanent corneal damage to the eyes.
- Respiratory ICt50: 1,200-1,500mg-min/m<sup>3</sup>
- Percutaneous ICt50: +1,500mg-min/m<sup>3</sup>
- Percutaneous LCt50: 100,000mg-min/m<sup>3</sup>
- Rate of detoxification: None

# L (Lewisite)

---

## Chemical and Physical Properties

- Physical state: Colorless to brown
- Odor: Like geraniums, little odor when pure
- Boiling point: 190°C at 760 mm HG
- Freezing point: 18°- 0.1C
- Flash point: None
- Heat of vaporization: 58 cal/g
- Volatility: 1060 mg/m<sup>3</sup> at 0°C, 4,480 mg/m<sup>3</sup> at 20°C, 8,620 mg/m<sup>3</sup> at 30°C
- Decomposition temp: Above 100°C
- Stability in storage: Stable in steel or glass containers
  
- Molecular weight: 207.35

# L (Lewisite)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2, HTH, household bleach
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# Mustard-Lewisite Mixture (HL)

## Impact of HL

- Blister agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through skin, respiratory tract and digestive tract. HL damages any tissue it contacts: severity directly relates to the concentration of the agent and the duration of contact with skin
- Symptoms: Immediate stinging sensation in the skin; reddening of the skin starts within 30 minutes; blistering does not appear until after about 13 hours; skin burns are much deeper than those caused by HD; fluid in chest cavity and lungs; increase capillary permeability which causes shock and death because of loss of fluid from the bloodstream

# Mustard-Lewisite Mixture (HL)

---

## Toxicity Data

- LCt50 (Respiratory): 1,500mg-min/m<sup>3</sup>
- LCt50 (Percutaneous):: 10,000mg-min/m<sup>3</sup>
- ICt50 (eye injury): 200mg-min/m<sup>3</sup>
  
- Rate of detoxification: None
- Eye and skin toxicity: Very high
- Time to effect: Produces immediate stinging of the skin and redness within 30 minutes; blistering delayed about 3 hours

# Mustard-Lewisite Mixture

## (HL)

### Chemical and Physical Properties

- Physical state: Liquid
- Odor: Garlic like
- Boiling point: Indefinite but below 190°C at 760 mm HG
- Freezing point: -42°C for plant purity HL -25.4°C when pure
- Flash point: N/A
- Heat of vaporization: Immediate between the heats of vaporization of the components
- Volatility: 240 mg/m<sup>3</sup> at -11°C, 2,730 mg/m<sup>3</sup> at 20°C, 10,270 mg/m<sup>3</sup> at 30°C
- Decomposition temp: Above 100°C
- Stability in storage: Stable in laquered steel containers
- Molecular weight: 186.4



# Mustard-Lewisite Mixture (HL)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8A1 alarms
  - M8 and M9 paper
- Protection required: MOPP 4
- Decontamination:
  - STB, fire, or DS2, or caustic soda
  - Use M258A1, M258 or M291 skin decontaminating kit for liquid agent on the skin
  - Decontaminate individual equipment with M280 individual equipment decontamination kit

# CHOKING AGENTS

# Phosgene Oxime (CX)

---

## Impact of CX

- Choking agent
- Primary usage: Rapid acting casualty agent
- Enters body through respiratory tract
- Symptoms: Immediate severe burning sensation; intense pain; feeling of numbness; swelling; immediate pain varying from mild prickling to almost intolerable pain resembling a severe bee sting; violent irritation to mucous membranes of eyes and nose, skins becomes pale and red rings surron the area; wheal forms in about 30 minutes; blanched area turns brown in about 24 hours; scabs form in about a week; scab usually falls off about three weeks later; healing can take longer than two months

# Phosgene Oxime (CX)

---

## Toxicity Data

- Respiratory irritation threshold: 1mg-min/m<sup>3</sup>
- Unbearable respiratory irritation: 3mg-min/m<sup>3</sup>
- Respiratory LCt50: 3,200mg-min/m<sup>3</sup>
- Rate of detoxification: Unknown

# Phosgene Oxime (CX)

---

## Chemical and Physical Properties

- Physical state: Liquid above 39°C solid below 35°C
- Odor: Intense, penetrating, disagreeable, and violently irritating
- Boiling point: 129°C at 760 mm HG(with decomposition)
- Freezing point: 35°- 40°C
- Flash point: N/A
- Heat of vaporization: 101 cal/g at 40°C
- Volatility: 1,800 mg/m<sup>3</sup> at 20°C, 76,000 mg/m<sup>3</sup> at 40°C,
- Decomposition temp: Below 128°C
- Stability in storage: Extremely unstable in presence of traces of metal or other impurities, even traces of iron chloride may cause explosion. Pure material is stable only for one to two months in glass vessels at 20°C, and is most stable in aromatic solvents
- Molecular weight: 113.9

# Phosgene Oxime (CX)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256A1 and M8 alarms
- Protection required: MOPP 4
- Decontamination:
  - Use large amounts of water
  - Because of the rapid reaction of CX with the skin, decontamination will not be effective after pain occurs
  - Nevertheless, decontaminate as rapidly as possible by flushing the area with large amounts of water to remove any agent that has not reacted with the skin

# Phosgene (CG)

---

## Impact of CG

- Choking agent
- Primary usage: Delayed -action casualty agent
- Enters body through respiratory tract
- Very small dosages of phosgene are extremely corrosive to lung tissue
- Symptoms: Initially only minor irritation to the eyes and throat; after latent period of 4-8 hours, discoloration of the lips, break out in a cold, sticky, sweat, long lasting lesions on lung, quantities of fluid escape from bloodstream into lungs, literally drowning the victim who dies from a lack of oxygen

# Phosgene (CG)

---

## Toxicity Data

- ICt50: 1,600 mg-min/m<sup>3</sup>  
3-12 hours to effect during which time lungs are filling with fluid)
- LCt50: 3,200mg-min/m<sup>3</sup>  
3-24 hours to effect (during which time lungs are filling with liquid)
- Rate of detoxification: Not detoxified, cumulative



# Phosgene (CG)

---

## Chemical and Physical Properties

- Physical state: Colorless gas
- Odor: New mown grass or hay
- Boiling point: 7.6°C at 760 mm
- Freezing point: -128°C
- Flash point: N/A
- Heat of vaporization: 59 cal/g at
- Volatility: 4,300,000 mg/m<sup>3</sup> at 7.6°C,  
2,200,000mg/m<sup>3</sup> at -10°C,  
528,000mg/m<sup>3</sup> at -40°C,
- Decomposition temp: 800°C
- Stability in storage: Stable in steel containers if CG is dry
- Molecular weight: 98.92

# Phosgene (CG)

---

## Other Data

- Means of detection in the field:
  - M18A2
- Protection required: Protective mask
- Decontamination:
  - Confined areas, aeration
  - Not required in the field
- Persistency
  - Short; vapor may persist for some time in low places under calm or light winds and stable atmospheric conditions ( approximately 30 minutes in summer; and 3 hours at -20 degrees

# Diphosgene (DP)

---

## Impact of DP

- Choking agent
- Primary usage: Delayed-action casualty
- Enters primarily through respiratory tract
- Symptoms: Initially only minor irritation to eyes and throat; after latent period of 4-8 hours, discoloration of the lips, breaking out in a cold, sticky sweat, systemic damage, especially to liver and kidneys, long lasting lesions on lungs develop, quantities of fluid escape from bloodstream into lungs, literally drowning the victim who dies from a lack of oxygen.
- Those who survive may suffer trauma and suddenly expire, or they may suffer after effects in the following years

# Diphosgene (DP)

---

## Toxicity Data

- ICt50: 1,600mg-min/m<sup>3</sup>  
3-12 hours to effect (during which lungs are filling up with fluid)
- LCt50: 3,200mg-min/m<sup>3</sup>  
3-24 hours to effect (during which lungs are filling with fluid)
- Detoxification Rate: Not detoxified, cumulative

# Diphosgene (DP)

---

## Chemical and Physical Properties

- Physical state: Colorless gas
- Odor: New-mown hay, grass, corn
- Boiling point: 127°C at 760 mm HG
- Freezing point: 57°
- Volatility: 12,000 mg/m<sup>3</sup> at 0°C, 45,000 mg/m<sup>3</sup> at 20°C, 270,000 mg/m<sup>3</sup> at 51.7 °C
- Decomposition temp: 300°C
- Stability in storage: Only stable in glass
- Molecular weight: 197.85

# Diphosgene (DP)

---

## Other Data

- Means of detection in the field:
  - M18A2, Odor
- Protection required:
  - Protective mask
- Decontamination:
  - Confined areas, aeration
  - Not required in the field
- Persistency
  - Short; vapor may persist for some time in low places under calm or light winds and stable atmospheric conditions ( approximately 30 minutes in summer; and 3 hours at -20 degrees

# Arsine (SA)

---

## Impact of SA

- Choking agent
- Primary usage: Delayed-action casualty agent
- Enters body primarily through respiratory tract
- Symptoms: Headache; uneasiness; chills; nausea; vomiting; damages blood, causing anemia
- SA is a carcinogen

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# Arsine (SA)

---

## Toxicity Data

- ICt50: 2,500 mg-min/m<sup>3</sup>  
Effects are delayed from 2 hours as to much as 11 days
- LCt50: 5,000 mg-min/m<sup>3</sup>  
Estimated that 2mg of SA per kilogram of body weight would be lethal to humans
- Detoxification Rate: Not rapid enough to be of importance



# Arsine (SA)

---

## Chemical and Physical Properties

- Physical state: Colorless gas
- Odor: Mild, garlic like
- Boiling point: -62.5°C at 760 mm HG
- Freezing point: -116°
- Volatility: 20,900,000mg/m<sup>3</sup> at 0°C, highest volatility found amongst compounds considered for tactical use as chemical agents
- Decomposition temp: 280°C
- Stability in storage: Unstable in uncoated metal containers
- Molecular weight: 77.93

# Arsine (SA)

---

## Other Data

- Means of detection in the field:
  - M18A2, Odor
- Protection required:
  - Protective mask
- Decontamination:
  - Not required
- Persistency
  - Extremely short

# BLOOD AGENTS

# AC (Hydrogen Cyanide)

---

## Impact of HC

- Primary usage: Quick action casualty agent suitable for surprise attack
- Enters body primarily through respiratory tract
- Symptoms: Flushed skin, weakness, headaches, nausea, confusion, dizziness, unconsciousness, convulsions, violent contraction of blood vessels, severe shock, end to breathing

# AC (Hydrogen Cyanide)

---

## Toxicity Data

- Vapor LCt50: 2,500 mg-min/m<sup>3</sup>
- Respiratory LCt50: 5,000 mg-min/m<sup>3</sup>  
30 seconds to 15 minutes till effect
- Detoxification Rate: Low essentially cumulative

# AC (Hydrogen Cyanide)

---

## Weapon Data

- (U) Agent is widely available; can be readily synthesized in large quantities and is commercially available (some states use AC for capital punishment)
- (U) Fixed munitions should not be stored for period of time since an explosive polymer may form within the canister

# AC (Hydrogen Cyanide)

## Chemical and Physical Properties

- Physical state: Colorless liquid; evaporates quickly
- Odor: Bitter almonds or peach kernels
- Boiling point: 25.7°C at 760 mm HG
- Freezing point: -13.3°
- Volatility: 1,080,000mg/m<sup>3</sup> at 25°C,  
441,000mg/m<sup>3</sup> at 0 °C, 37,500mg/m<sup>3</sup>  
at -40 °C
- Decomposition temp: Above 65.5°C
- Stability in storage: Unstable except when very pure,  
forms explosive polymer on long  
standing, will stabilize with addition of  
small amounts of phosphoric acid or  
sulfur dioxide
- Molecular weight: 27.03
- Heat of vaporization: 2332 cal/g

# AC (Hydrogen Cyanide)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256, M256A1, and M8 Alarms
- Protection required:
  - Protective mask. Liquid AC can penetrate the skin, but because liquid AC is not likely to be encountered in the field, protective clothing is required only in unusual situations
- Decontamination:
  - None required under field conditions
- Persistency
  - Short; the agent is highly volatile, and in the gaseous state it dissipates quickly in the air
- Antidotes/Treatments
  - Thiosulfate or other substances that react with the blood may be of some use, but only if administered very soon after exposure



# CK (Cyanogen Chloride)

---

## Impact of HC

- Primary usage: Quick action casualty agent used for degradation of canisters or filter elements in protective mask
- Enters body primarily through respiratory tract
- Symptoms: Eye and respiratory irritation, weakness, headache, disorientation, nausea, vomiting, pinkness of skin, loss of consciousness, coma, end of respiration, and death in 15 minutes

# CK (Cyanogen Chloride)

---

## Toxicity Data

- Median concentration detectable by tearing: 12 mg/m<sup>3</sup>
- Respiratory ICt50: 7,000 mg-min/m<sup>3</sup>  
30 minutes to 1 hour to effect
- Respiratory LCt50: 11,00 mg-min/m<sup>3</sup>  
1-15 minutes till effect
- Detoxification Rate: Rapid

# CK (Cyanogen Chloride)

---

## Chemical and Physical Properties

- Physical state: Colorless liquid; evaporates quickly
- Odor: None
- Boiling point: 25.7°C at 760 mm HG
- Freezing point: -13.3°C
- Volatility: 1,080,000mg/m<sup>3</sup> at 25°C,  
441,000mg/m<sup>3</sup> at 0 °C, 37,500mg/m<sup>3</sup>  
at -40 °C
- Flash point: 18 °C
- Decomposition temp: Above 65.5°C
- Stability in storage: Stable at 65 °C for 30 days. Stabilized material can be stored up to 65°C. Will polymerize to form the solid cyanuric chloride which is corrosive. Impurities promotes polymerization; may explode
- Molecular weight: 27.03
- Heat of vaporization: 2332 cal/g

# CK (Cyanogen Chloride)

---

## Other Data

- Means of detection in the field:
  - M18A2, M256, M256A1, and M8 Alarms
- Protection required:
  - Protective mask. CK will break or penetrate a protective mask canister or filter element more readily than most other agents.
- Decontamination:
  - None required under field conditions
- Persistency
  - Short; the agent is highly volatile, and in the gaseous state it dissipates quickly in the air
- Antidotes/Treatments
  - Thiosulfate or other substances that react with the blood may be of some use, but only if administered very soon after exposure

# INCAPACITATING AGENTS

# BZ

---

## Impact of BZ

- Incapacitating agent
- Primary usage: Delayed-action incapacitating agent
- Enters body primarily through respiratory tract or digestive tract
- Symptoms: Fast heartbeat, drk skin and lips, blurred near vision, flushed skin, urinary retention, constipation, sedation progression to stupor and interference with ordinary activity, extreme excitement, delusions, hallucinations, high doses completely destroy the ability to perform any military task, untreated casualty requires from three to four days to reach full recovery

# BZ

## Toxicity Data

- LCt50: High estimated to be 200,000mg-min/m<sup>3</sup>
- ICt50: 112mg-min/m<sup>3</sup>
- Inhalation threshold dose: 2mg-min/m<sup>3</sup> individual
- Rate of detoxification: 36-45 hours
- Time to effect: Delayed; usual onset of symptoms occur approximately two hours after aerosol exposure. Depending on inhaled or ingested dosage, symptoms, may appear at any time from 30 minutes to 20 hours after exposure, effects from skin contact may appear 36 hours later

# BZ

## Chemical and Physical Properties

- Physical state: White, crystalline solid 20 °C
- Odor: None
- Boiling point: 320°C at 760 mm HG
- Melting point: 164-167°C
- Volatility: 1,080,000mg/m<sup>3</sup> at 25°C,  
441,000mg/m<sup>3</sup> at 0 °C, 37,500mg/m<sup>3</sup>  
at -40 °C
- Flash point: 18 °C
- Decomposition temp: 170 ° C
- Stability in storage: Stable in most materials
- Molecular weight: 337.41
- Heat of vaporization: 62 cal/g



# BZ

---

## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - Complete cleansing of the skin with soap and water at earliest opportunity
  - If washing is not possible, use the M258A1, M258, or M291
  - Decontaminate bulk quantities of BZ with caustic alcohol solutions

# TEAR AGENTS

# Bromobenzylcyanide (CA)

## Impact of CA

- Tear agent
- Primary usage: obsolete
- Enters body primarily through respiratory tract
- Symptoms: Burning sensation of the mucous membranes and severe irritation and tearing of the eyes with acute pain in the forehead

# Bromobenzylcyanide (CA)

---

## Toxicity Data

- LCt50: Estimated 8,000 to 11, 2mg-min/m<sup>3</sup>
- ICt50: About 30mg-min/m<sup>3</sup>
- Minimum irritant concentration: 0.3mg-min/m<sup>3</sup>
- Rate of detoxification: Rapidly detoxifies at the low concentrations ordinarily encountered
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Instantaneous

# Bromobenzylcyanide (CA)

---

## Chemical and Physical Properties

- Physical state: Yellow solid or liquid
- Odor: Sour or rotting fruit
- Boiling point: 242°C at 760 mm HG
- Melting point: 25.2°C
- Volatility: 17mg/m<sup>3</sup> at 0°C,  
115mg/m<sup>3</sup> at 20°C  
271mg/m<sup>3</sup> at -40 °C
- Flash point: None
- Decomposition temp: 60 ° C
- Stability in storage: Stable in glass containers
- Molecular weight: 196.0
- Heat of vaporization: 79.5 cal/g

# Bromobenzylcyanide (CA)

---

## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - Decontaminate clothing with steam or by boiling
  - Twenty-percent alcoholic caustic soda is effective on material, but may damage it
  - Porous surfaces, such as earth, they are very difficult to decontaminate
- Persistency
  - Depends on munitions used
  - Heavily splashed liquid last one to two day under average conditions

# Chloroactophenone (CN)

---

## Impact of CN

- Tear agent
- Primary usage: Training and riot control
- Enters body primarily through respiratory tract
- Symptoms: Burning sensation of the eyes and upper respiratory passages, tearing, tingling sensation, irritation, burning, and pain of the nose and throat, burning on tender areas of skin especially areas wet by perspiration

# Chloroactophenone (CN)

---

## Toxicity Data

- LCt50: 7,000mg-min/m<sup>3</sup>
- ICt50: 80mg-min/m<sup>3</sup>
- Minimum irritant concentration: 0.3mg-min/m<sup>3</sup>
- Rate of detoxification: minutes  
Rapidly effects disappear in minutes
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Instantaneous



# Chloroactophenone (CN)

---

## Chemical and Physical Properties

• Physical state:	Solid powder
• Odor:	Fragrant similar to apples
• Boiling point:	248°C at 760 mm HG
• Melting point:	54°C
• Volatility:	17mg/m <sup>3</sup> at 0°C, 115mg/m <sup>3</sup> at 20°C
•	271mg/m <sup>3</sup> at -40 °C
• Flash point:	None
• Decomposition temp:	Stoable to boiling point
• Stability in storage:	Stable
• Molecular weight:	154.59
• Heat of vaporization	98 cal/g

# Chloroactophenone (CN)

---

## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - Aeration in field
  - Strong soda ash solution or alcoholic caustic soda in enclosed areas
  - Porous surfaces, such as earth, they are very difficult to decontaminate
- Persistency
  - Short, because the compound is disseminated as an aerosol

# O-Chlorobenzylidene Malononitrile (CS)

## Impact of CS

- Tear agent
- Primary usage: obsolete
- Enters body primarily through respiratory tract
- Symptoms: Extreme burning of the eyes accompanied by copious flow of tears, coughing, difficulty in breathing, tightness of the chest, involuntary closing of the eyes, stinging or burning on moist skin, heavy mucous formation in the nose with sinus and nasal drip, dizziness, nausea, vomiting, severe skin irritation and blistering

# O-Chlorobenzylidene Malononitrile (CS)

## Toxicity Data

- LCt50: 61,000 mg-min/m<sup>3</sup>
- ICt50: 10 to 20 mg-min/m<sup>3</sup>
- Eye Effects: 1 to 5 mg-min/m<sup>3</sup>
- Rate of detoxification: quite rapid; 5-10 minutes
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Very rapid (max effect in 20-60 seconds)

# O-Chlorobenzylidene Malononitrile (CS)

## Chemical and Physical Properties

• Physical state:	Solid, powder or liquid
• Odor:	Pungent, pepper like
• Boiling point:	315°C at 760 mm HG
• Melting point:	95°C
• Volatility:	0.71mg/m <sup>3</sup> at 0°C
• Flash point:	197° C
• Decomposition temp:	Unknown
• Stability in storage:	Stable
• Molecular weight:	188.50
• Heat of vaporization	53.6 cal/g

# O-Chlorobenzylidene Malononitrile (CS)

## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask. and field clothing secured at the neck, wrist and ankles
- Decontamination:
  - Affected personnel should move to an uncontaminated area and face the wind
  - Use soap and water on contaminated equipment
- Persistency
  - Varies depending upon amount of contamination and form of CS
  - Aerosol has little residual hazard

# Chloropictrín (PS)

---

## Impact of PS

- Tear agent
- Primary usage: Not authorized for military use
- Enters body primarily through respiratory tract
- Symptoms: Nose and throat irritation, coughing, vomiting; tearing; lung damage, severe skin burns, blisters lesions

# Chloropictrín (PS)

---

## Toxicity Data

- IC<sub>50</sub>: 2,000mg-min/m<sup>3</sup>
- Minimum irritant concentration: 9mg-min/m<sup>3</sup> for ten min.
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Very rapid



# Chloropictrin (PS)

---

## Chemical and Physical Properties

• Physical state:	Colorless, oily liquid
• Odor:	Stinging pungent odor
• Boiling point:	112°C at 760 mm HG
• Melting point:	25.2°C
• Volatility:	165,000mg/m <sup>3</sup>
• Flash point:	Not flammable
• Decomposition temp:	Above 400 ° C
• Stability in storage:	Unstable liquid
• Molecular weight:	196.0
• Heat of vaporization	79.5 cal/g

# Chloropictrin (PS)

---

## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - Neutral or slightly basic solutions with sulfides such as sodium sulfide
  - Do not use acidic solutions for decontamination; acids reduce PS or CX, a blister agent
- Persistency
  - Approximately 6 hours in vegetated fields

# Dibenz-(b,f)-1,4-oxazepine(CR)

---

## Impact of PR

- Tear agent
- Primary usage: Riot control agent dispersed as spray
- Enters body primarily through respiratory tract
- Symptoms: Immediate and severe stinging of the sin, eyes, nose, and throat, eye pain, discomfort, and excessive tearing, painful sensitivity, to strong light or temporary blindness, nasal irritation, coughing, sneezing, nasal drip, sting or burning sensation with increased irritation on moist skin, nausea and vomiting

# Dibenz-(b,f)-1,4-oxazepine(CR)

---

## Toxicity Data

- IC<sub>50</sub>: 0.5mg-min/m<sup>3</sup>
- Threshold effects: 0.002mg-min/m<sup>3</sup> (respiratory tract)  
0.004mg-min/m<sup>3</sup> (eyes)
- Rate of detoxification: 15 to 30 minutes after removal  
Eye effects up to 6 hours
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Very rapid

# Dibenz-(b,f)-1,4-oxazepine(CR)

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## Chemical and Physical Properties

- Physical state: Yellow powder in solution
- Odor: Burning sensation
- Boiling point: 335°C at 760 mm HG
- Freezing point: 72°C
- Volatility: 0.63mg/m<sup>3</sup> at 0°C,
- Flash point: 188° C
- Decomposition temp: 60 ° C
- Stability in storage: Stable in aqueous, heated acidid and strong alkali solutions
- Molecular weight: 192.25

# Dibenz-(b,f)-1,4-oxazepine(CR)

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## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask. and field clothing secured at wrist, neck, and ankles
- Decontamination:
  - Remove from equipment by wiping, shoveling, or sweeping
  - Do not use standard decontaminants that contain chlorine, CR may become more potent
  - Aeration is sufficient to decontaminate personnel, dissipation occurs in 5-10 minutes
- Persistency
  - Under suitable conditions, CR can persist on certain surfaces (especially porous material) for up to 60 days

# VOMITING AGENTS

# Diphenylchloroarsine (DA)

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## Impact of DA

- Vomiting agent
- Primary usage: Not authorized for military use
- Enters body primarily through respiratory tract
- Symptoms: Irritation of eyes and the mucous membranes; viscous discharge from the nose similar to that caused by a cold, sneezing and coughing; severe headache, acute pain and tightness in the chest; nausea and vomiting
- Effect last for 30 minutes after person leaves contaminated atmosphere
- At high concentrations effects may last up to several hours



# Diphenylchloroarsine (DA)

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## Toxicity Data

- LCt50: 15,000mg-min/m<sup>3</sup>
- ICt50: 12mg-min/m<sup>3</sup>
- Rate of detoxification: One to two hours
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Rapid, with one-three minutes

# Diphenylchloroarsine (DA)

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## Chemical and Physical Properties

- Physical state: Colorless crystals when pure
- Odor: No odor
- Boiling point: 333°C at 760 mm HG
- Melting point: 44.5°C
- Volatility: 45mg/m<sup>3</sup> at 45°C
- Flash point: 350°C
- Decomposition temp: 300° C
- Stability in storage: Stable when pure
- Molecular weight: 264.5
- Heat of vaporization: 56.6 cal/g

# Diphenylchloroarsine (DA)

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## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - None required in field
  - Caustic soda or chlorina used for gross contamination in enclosed spaces
- Persistency
  - Short, because compound is disseminated as an aerosol
  - Heavily splashed liquid last one to two day under average conditions

# Diphenylcyanoarsine (DC)

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## Impact of DC

- Vomiting agent
- Primary usage: Not authorized for military use
- Enters body primarily through respiratory tract
- Symptoms: Irritation of eyes and the mucous membranes; viscous discharge from the nose similar to that caused by a cold, sneezing and coughing; severe headache, acute pain and tightness in the chest; nausea and vomiting
- Effect last for 30 minutes after person leaves contaminated atmosphere
- At high concentrations effects may last up to several hours

# Diphenylcyanoarsine (DC)

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## Toxicity Data

- LCt50: 10,000mg-min/m<sup>3</sup>
- ICt50: 30mg-min/m<sup>3</sup>
- Rate of detoxification: One to two hours
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Rapid, intolerable at 30 secs.

# Diphenylcyanoarsine (DC)

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## Chemical and Physical Properties

- |                         |                                |
|-------------------------|--------------------------------|
| • Physical state:       | Solid                          |
| • Odor:                 | Garlic and bitter almond smell |
| • Boiling point:        | 350°C at 760 mm HG             |
| • Melting point:        | 35°C                           |
| • Volatility:           | 2.8mg/m <sup>3</sup> at 45°C   |
| • Flash point:          | Low                            |
| • Decomposition temp:   | 300° C                         |
| • Stability in storage: | Stable at all ordinary temp.   |
| • Molecular weight:     | 255.0                          |
| • Heat of vaporization  | 71.1 cal/g                     |

# Diphenylcyanoarsine (DC)

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## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - None required in field
  - Bleach or DS2 for gross contamination in enclosed spaces
- Persistency
  - Short, because compound is disseminated as an aerosol

# Adamsite (DM)

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## Impact of DM

- Vomiting agent
- Primary usage: Not authorized for military use
- Enters body primarily through respiratory tract
- Symptoms: Irritation of eyes and the mucous membranes; viscous discharge from the nose similar to that caused by a cold, sneezing and coughing; severe headache, acute pain and tightness in the chest; nausea and vomiting
- Effect last for 30 minutes after person leaves contaminated atmosphere
- At high concentrations effects may last up to several hours



# Adamsite (DM)

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## Toxicity Data

- LCt50: 11,000mg-min/m<sup>3</sup>
- ICt50: 22-150mg-min/m<sup>3</sup>
- Rate of detoxification: Rapid in small amounts
- Eye and skin toxicity: Irritating; not toxic
- Time to effect: Rapid, one minute to incapacitate

# Adamsite (DM)

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## Chemical and Physical Properties

• Physical state:	Light yellow to green crystal
• Odor:	No odor, but irritating
• Boiling point:	410°C at 760 mm HG
• Freezing point:	195°C
• Volatility:	Negligible
• Flash point:	None under usual conditions
• Decomposition temp:	300° C
• Stability in storage:	Stable when pure
• Molecular weight:	277.57
• Heat of vaporization	56.6 cal/g

# Adamsite (DM)

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## Other Data

- Means of detection in the field:
  - None.
- Protection required:
  - Protective mask.
- Decontamination:
  - None required in field
  - Bleaching powder or DS2 used for gross contamination in enclosed spaces
- Persistency
  - Short, because compound is disseminated as an aerosol