

(6) Nitrogen Mustards

HN1: Bis(2-chloroethyl)ethylamine	528-07-8
HN2: Bis(2-chloroethyl)methylamine	51-75-2
HN3: Tris(2-chloroethyl)amine	555-77-1

HN1, $C_6H_{13}Cl_2N$
CAS No. 528-07-8
HS No. 29.21.19
Merck 4644

Synonyms: Bis(2-chloroethyl)ethylamine; 2,2'-dichlorotriethylamine

Physical properties: MW: 170.08; mp: $-34^{\circ}C$; bp: $194^{\circ}C$ dec; d. 1.09; very slightly soluble in water; miscible with most organic solvents; slow decomposition through quarternary ammonium salts.

Synthesis: The reaction of ethyldiethanolamine with thionyl chloride.

Toxicity: Toxic to subcutaneous tissue with formation of rashes and blisters over a 12 hr period; immediate effects on the eyes; median lethal dosage is 1,500 mg-min/m³ (inhalation) and 20,000 mg-min/m³ (skin). Deadly vesicant.

Key precursors: ethyldiethanolamine (CAS No. 139-87-7).

HN2, $C_5H_{11}Cl_2N$
CAS No. 51-75-2
HS No. 29.21.19
Merck 5655

Synonyms: 2,2-dichloro-N-methylethylamine; 2-chloro-N-(2-chloroethyl)-N-methylethanamine; 2,2'-dichloro-N-methyldiethylamine; N-methyl-2,2'-dichlorodiethylamine; chlormethine; mustine; mechlorethamine.

Physical properties: MW: 156.07; mp: $-60^{\circ}C$; bp: 87° ; d. 1.15 dO(24)^s 1.118; mobile liquid with odour of herring; very slightly soluble in water; miscible with most organic solvents; decomposes on standing to form polymeric salts.

Synthesis: Prepared by the reaction of thionyl chloride and 2,2'-(methylimino)diethanol in trichloroethylene [Prelog and Stephan, Coll. Czech. Chem. Commun., 7, 93 (1935)].

Toxicity: Immediate effect on eyes with rashes, blisters and pulmonary effects appearing over 12 hours; median lethal dose is 3000 mg-min/m³ (inhalation). It is a cumulative poison; high enough concentrations can cause blindness; death occurs through asphyxiation or heart failure.