

NFPA 1991, 2005 Edition Chemical Permeation Boot Requirement
Chemical Permeation tests performed in accordance with ASTM F 739

Tingley HazProof® Boots	Normalized Breakthrough Time (min.)				Maximum Permeation Rate $\mu\text{g}/\text{cm}^2/\text{min}$				Minimum Detectable Rate for Test $\mu\text{g}/\text{cm}^2/\text{min}$
	Cell 1	Cell 2	Cell 3	Avg.	Cell 1	Cell 2	Cell 3	Avg.	
Chemical / Agent	Cell 1	Cell 2	Cell 3	Avg.	Cell 1	Cell 2	Cell 3	Avg.	
Acetone	134	154	114	134	7.70	0.27	14.46	7.48	0.01
Acetonitrile	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Ammonia	>180	>180	>180	>180	<0.05	<0.05	<0.05	<0.05	0.05
1,3, Butadiene	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Carbon Disulfide	109	105	119	111	1.99	1.52	1.01	1.51	0.01
Carbonyl Chloride (CG)	>60	>60	>60	>60	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chlorine	>180	>180	>180	>180	<0.03	<0.03	<0.03	<0.03	0.03
Cyanogen Chloride (CK)	>60	>60	>60	>60	<0.00025	0.0523	<0.00025	0.017	<0.00025
Dichloromethane	68	52	66	62	30.09	32.59	27.86	30.18	0.06
Diethylamine	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Dimethylformamide	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Dimethyl Sulfate (DMA)	>180	>180	>180	>180	<0.10	<0.10	<0.10	<0.10	0.10
Ethyl Acetate	>180	>180	>180	>180	<0.09	<0.09	<0.09	<0.09	0.09
Ethylene Oxide	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Hexane	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Hydrogen Chloride	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Hydrogen Cyanide (AC, HCN)	>60	>60	>60	>60	0.018	0.016	0.014	0.016	<0.0054
Methanol	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Methyl Chloride	>180	>180	>180	>180	<0.03	<0.03	<0.03	<0.03	0.03
Nitrobenzene	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Sodium Hydroxide (50%)	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Sulfuric Acid	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Tetrachloroethylene	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
Tetrahydrofuran	115	111	113	113	17.72	16.70	20.35	18.26	0.02
Toluene	>180	>180	>180	>180	<0.01	<0.01	<0.01	<0.01	0.01
	Normalized Breakthrough Time (min.)				Cumulative Permeation $\mu\text{g}/\text{cm}^2$				Minimum Detectable Rate for Test $\mu\text{g}/\text{cm}^2/\text{min}$
	Cell 1	Cell 2	Cell 3	Avg.	Cell 1	Cell 2	Cell 3	Avg.	
Chemical warfare agents	Cell 1	Cell 2	Cell 3	Avg.	Cell 1	Cell 2	Cell 3	Avg.	
Sarin (GB)	>60	>60	>60	>60	0.10062	0.09931	0.12408	0.10800	<0.000945
Sulfur Mustard, distilled (HD)	>60	>60	>60	>60	0.00844	0.007430	0.00851	0.00812	<0.0011

Additional Permeation Resistance Test, Boot Upper.

Testing with Chemical Agents under Military Standard 282 has demonstrated permeation resistance to standard static diffusion tests (duration: 24 hrs.) as follows:

Blister Agents: Breakthrough Time Hours:

Mustard: HD > 14 hours (Method 204.1.2; Static Diffusion method)

Nerve Agents:

Sarin: GB > 24 hours (Method 206.1.3; Static Diffusion method)

Nerve: VX > 24 hours (Method 204.1.2; " " " modified for use with VX)

Soman; GD > 24 hours (Method 206.1.3; " " " modified for use with GD)

Tabun: GA > 24 hours (Method 205,1,3; " " " modified for use with GA)