University of Colorado at Boulder
Department of Environmental Health and Safety

Glove Protection and Selection Guide

INTRODUCTION

Hand protection is very important when working with hazardous chemicals, radioactive materials, and bloodborne pathogens or other potentially infectious materials. Gloves provide a chemical resistant barrier between the worker's hands and the reagent, but some chemicals can breach the barrier provided by the glove material. Any protective glove should be selected according to the chemical being handled and the nature of the lab operations.

Gloves are disposed of when overtly contaminated or when the integrity of the glove is compromised, and removed when work is completed. Disposable gloves should never be washed, reused, or used for touching "clean" surfaces (keyboards, telephones, etc.), and they should not be worn outside the lab. Alternatives to powdered latex gloves should be available. Hands should always be washed following removal of gloves.

Proper disposal of gloves is important. Gloves must be segregated and disposed of based on the chemical or material being handled. For questions, please consult with your Environmental Health and Safety department.

HOW TO SELECT THE BEST GLOVE:

1. Evaluate the physical conditions you will subject the glove to and determine which types of resistance are more important: abrasion, cut, puncture, temperature, etc. Physical conditions can influence chemical resistance.

2. Consider features you need for your application: grip, length, dexterity, comfort, insulation, type of cuff, extent of coating. Glove manufacturers offer a variety of styles to best suit your application. There are also several different cuff designs to suit your application requirements. There are knit wrist cuffs, designed to keep the glove firmly in place. This prevents debris from entering the glove and enhances warmth.

3. Select the glove that offers you the optimum combination of features, benefits and resistance to both physical and chemical hazards.

4. For chemical-resistance needs, refer to the *Glove Chemical Resistant Guide* listed below and the additional references.

5. Select a thinner-gauge unsupported glove when you require extra dexterity and tactile sensitivity. Choose a heavier-gauge unsupported glove for greater protection and wear. Consider a flock lined, unsupported glove for extra comfort, insulation and wear. Choose a supported or cut-and sewn glove for added cut, snag, and puncture or abrasion resistance.

6. Choose the finish you need for the grip necessary for your application: rough, smooth, wrinkle, embossed bisque, etc. *Note:* Some gloves have no special grip finish, yet still provide good gripping power due to intrinsic properties of the particular glove polymer.

7. Select glove length by determining the depth to which your hand and arm will be immersed in a solution and the extent to which you need splash protection.

8. Select the size that gives you the right fit, dexterity and comfort. To determine your size, measure the circumference around the palm area. This is your glove size. For example, 7" is equal to a size 7 glove. (XS = 6-7, S = 7-8, M = 8-9, L = 9-10, XL = 10-11).

9. For product protection, consider the toughness, fit, thickness and degree of disposability required. Select the style that provides the most important of these features and benefits.

10. Always inspect your gloves before using them. Of principal concern are cuts, tears and punctures. Discoloration or stiffness may indicate non-uniformities in the rubber or plastic or chemical attack resulting from previous use.

11. Glove colors can often be used to help identify contamination or to designate critical work areas. Select the style most suited to your needs.

BLOODBORNE PATHOGENS AND OTHER POTENTIALLY INFECTIOUS AGENSTS

1. Gloves are worn when hands may contact bloodborne pathogens, other potentially infectious materials, contaminated surfaces or equipment.

2. Wearing two pairs of gloves may be appropriate.

3. Gloves are disposed of when overtly contaminated or when the integrity of the glove is compromised, and removed when work with infectious materials is completed.

4. Disposable gloves should never be washed, reused, or used for touching "clean" surfaces (keyboards, telephones, etc.), and they should not be worn outside the lab.

5. Alternatives to powdered latex gloves should be available.

6. Hands should always be washed following removal of gloves.

CHEMOTHERAPEUTIC AGENTS

One of the most frequently used treatments for cancer is chemotherapy. Unfortunately it is well known that chemotherapeutic (cytostatic) agents are potentially hazardous for the manipulator.

Chemotherapeutics are known to be:

- Carcinogenic
- Mutagenic
- Teratogenic

It is important to wear the appropriate personal protective equipment when working with chemotherapeutic agents and this includes selecting a disposable glove that will protect against the adverse affects of these chemicals.

Medical gloves with a chemotherapy claim should meet an appropriate FDA-recognized consensus standard for medical gloves or an equivalent test method. Physical features such as increased thickness and length make these gloves more suitable for the safe handling of chemotherapy agents (usually minimal thickness of 0.10 mm, minimal length of 270 mm). Gloves for use with chemotherapy agents should also undergo the standard biocompatibility testing for medical gloves.

Ansell Cytostatic Permeation Program
http://150.101.90.21/mam_asset/Cytostatics%20brochure%20EN.pdf?id=01ffa7c0646b3fb2000001041cc543c9&col=/client_db/ANSL&ext=jpg&type=pdf

NIOSH - Preventing Occupational Exposure to Antineoplastic and Other Hazardous Drugs in Health Care Settings, September 2004
http://www.cdc.gov/niosh/docs/2004-165/pdfs/2004-165.pdf

DEFINITIONS

Breakthrough Time - The time which elapses between initial contact of a chemical with the outside surface of a protective material and when the chemical can be detected at the surface of the material.

Degradation - A reduction in one of physical properties of a glove or protective clothing.

Permeation - Process by which a chemical can pass a protective film without going through pores, or other visible openings (e.g., what happens to air in an inflated balloon after several hours -- same principle).

GLOVE CHEMICAL RESISTANCE GUIDE [1]

	Silver Shield (2) (4 Mil)			Viton (2) (9 Mil)			Butyl (2) (17 Mil)			Nitrile (2) (11 Mil)			Neoprene (2) (22 Mil)			PVC (2) (20 MIL)		
CHEMICAL	**Degradation (D)**	**Breakthrough (BT)**	**Permeation Rate (PR)**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**
Acetaldehyde	E	>6h	ND	P	0m	281.9	E	9.6	0.07	F	4m	161	E	21m	18	ID	ID	
Acetone	E	>6h	ND	P	ID	ID	E	>17h	ND	P	ID	ID	E	12m	35	P	>1m	>>
Acetonitrile	E	>8h	ND	ID	ID	ID	E	>8h	ND	ID	ID	ID	E	40m	7	ID	ID	
Acrylic Acid	ID	ID	ID	G	5.9h	0.23	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	
Acrylonitrile	E	ID	ID	F	1m	176	G	3.1h	<0.01	P	3m	176	ID	ID	ID	ID	ID	
Aldehyde	E	>6h	ND	P	0m	281.9	E	9.5h	0.07	P	4	161	ID	ID	ID	ID	ID	
Aniline	E	>8h	ID	G	10m	18.7	F	>8h	ND	P	1.1h	45	E	>8h	ND	G	>8h	ND
Benzaldehyde	ID	ID	ID	F	9.9h	4	E	9h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Benzene	E	>8h	ND	G	6h	0.012	P	31m	32.3	P	ID	ID	ID	16m	133	ID	2m	250
Benzoyl Chloride	ID	ID	ID	E	>8h	ND	F	6.2h	16.6	P	ID	ID	ID	ID	ID	ID	ID	
Bromobenzene	E	ID	ID	E	8h	ND	P	32m	39.8	P	13m	9.1	ID	ID	ID	ID	ID	
Butyl Acetate	E	>6h	ND	P	ID	ID	G	1.9h	7.61	P	29m	54.4	ID	52m	53	ID	ID	
p-t Butyltoluene	E	>8h	ND	E	>8h	ND	G	1.7h	8	P	ID	ID	ID	ID	ID	ID	ID	
Butyraldehyde	E	ID	ID	P	54m	9	E	>15h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Carbon Disulfide	G	>8h	ND	E	>8h	ND	P	7m	98	P	1m	51	ID	ID	ID	ID	ID	

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Carbon Tetrachloride	E	>6h	ND	E	>13h	ND	P	ID	ID	G	3.4h	5	F	31m	252	ID	ID	
Cellosolve	G	>6h	ND	F	ID	ID	G	ID	ID	P	ID	ID	E	5.9h	3	ID	ID	
Chlorobenzene	E	ID	ID	E	>8h	ND	P	35m	308	P	ID	ID	ID	ID	ID	ID	ID	
Chloroform	P	10m	O.OO9	E	9.5h	0.46	P	ID	ID	P	4m	352	P	12m	220	ID	ID	
Chloronaphthalene	E	>8h	ND	E	>16h	ND	P	ID	ID	P	2.9h	>1.3	ID	ID	ID	ID	ID	
Chloroprene	ID	ID	ID	ID	>8h	ND	P	28m	18	ID	ID	ID	ID	ID	ID	ID	ID	
Cyclohexane	E	>6h	ND	E	>7h	ND	P	1.1h	20.3	P	ID	ID	E	2.7h	7	ID	16m	17
Cyclohexanol	E	>6h	ND	E	>8h	ND	E	>11h	ND	E	>16h	ND	ID	ID	ID	ID	ID	
Cyclohexanone	E	>6h	ND	P	29m	86.3	E	>16h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Dibutylphthalate	E	>6h	ND	E	>8h	ND	E	>16h	ND	E	>16h	ND	ID	ID	ID	ID	ID	
1,1,Dichloroethane	ID	2.4h	6	G	1.5h	31	ID	ID	ID	P	ID	ID	ID	ID	ID	ID	ID	
1,2,Dichlorothane	E	>6h	ND	E	6.9	0.81	P	2h	53	P	8m	311	P	33m	247	ID	ID	
Diethylamine	E	>8h	ND	P	35m	852	P	47m	46	F	ID	ID	ID	ID	ID	ID	ID	
Diethylaminoethanol	E	ID	ID	E	>8h	ND	E	>8h	ND	E	>8h	ND	ID	ID	ID	ID	ID	
1,4-Diethylene Dioxide	ID	>8h	ND	P	23m	26.8	E	>20h	ND	P	28m	77.1	ID	28m	62	ID	8m	250
Diethyleneltriamine	ID	ID	ID	E	>8h	ND	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Diisobutyl Ketone 80%	E	>6h	ND	F	1.2h	90.6	G	3.3h	41.2	F	3h	48.9	ID	ID	ID	ID	ID	
Dimethyl Acetamide	ID	1.5h	0.728	P	25m	3	ID	>8h	ND	ID	ID	ID	ID	ID	ID	ID	ID	
Dimethyl Formamide	E	>8h	ND	P	8m	6.5	E	>8h	ND	F	1m	>15	ID	ID	ID	ID	ID	
Dimethylsulfoxide	G	ID	ID	F	1.5h	5	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	

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Dioxane	E	>8h	ND	F	23m	26.8	E	>20h	ND	P	28m	77.1	ID	28m	62	ID	8m	250
Divinyl Benzene	E	>8h	ND	E	>17h	ND	F	2.2h	238	P	ID	ID	ID	ID	ID	ID	ID	
Divinyl Benzene	E	>8h	ND	E	>17h	ND	F	2.2h	238	P	ID	ID	ID	ID	ID	ID	ID	
Epichlorohydrin	ID	ID	ID	P	2h	4	G	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Ether	ID	>6h	ND	P	12m	21.5	P	8m	92.2	P	14m	21.8	ID	ID	ID	ID	ID	
Ethyl Acetate	E	>6h	ND	P	ID	ID	G	7.6h	3.4	P	8m	145	G	34m	178	ID	ID	
Ethyl Ether	ID	>6h	ND	P	12m	21.5	P	8m	92.2	P	14m	21.8	E	18m	51	ID	ID	
Ethylamine 70%	E	47m	7.64	P	ID	ID	E	>12h	ND	F	1.1h	30.1	ID	ID	ID	ID	ID	
Ethylene dibromide	E	ID	ID	E	>8h	ND	F	3.3h	6	P	ID	ID	ID	ID	ID	ID	ID	
Formaldehyde 37%	E	>6h	ND	E	>16h	ND	E	16h	ND	E	>21h	ND	E	>8h	ND	G	8h	ND
Furan	ID	ID	ID	P	20m	23	P	1.3h	10	P	ID	ID	ID	ID	ID	ID	ID	
Furfural	E	>8h	ND	F	3.6h	14.8	E	>16h	ND	P	28m	265	ID	ID	ID	ID	ID	
Glutaraldehyde	E	ID	ID	E	>8h	ND	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	
n-Hexane	E	>6h	ND	ID	>11h	ND	P	ID	ID	E	ID	ID	E	39m	5	ID	ID	
Hydrazine 70%	G	>6h	ND	P	ID	ID	E	>8h	ND	G	>8h	ND	E	>8h	ND	E	8h	ND
Hydrochloric Acid 37%	E	>6h	ND	E	ID	ID	E	ID	ID	P	ID	ID	E	>8h	ND	E	>8h	ND
Hydrofluoric Acid 50%	G	>6h	ND	G	ID	ID	F	ID	ID	P	ID	ID	E	>8h	ND	E	1.8h	0
Isobutyl Alcohol	E	ID	ID	E	>8h	ND	E	>8h	ND	G	>8h	ND	ID	ID	ID	ID	ID	
Isobutyraldehyde	E	ID	ID	P	4m	11.5	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	
Methacrylic Acid	ID	ID	ID	F	>8h	ND	G	>8h	ND	P	1.7h	23	ID	ID	ID	ID	ID	

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Methacrylonitrile	E	ID	ID	F	4m	462	G	6.8h	0.001	P	7m	560	ID	ID	ID	ID	ID	
Methyl Chloroform	ID	>6h	ND	E	>15h	ND	P	ID	ID	P	41m	76.4	P	27m	197	ID	ID	
Methyl Cyanide	ID	>8h	ND	ID	ID	ID	E	>8h	ND	ID	ID	ID	E	40m	7	ID	ID	
Methyl Ethyl Ketone	E	>24h	ND	P	ID	ID	E	>8h	ND	P	ID	ID	G	22m	155	ID	1m	>>
Methyl Isocyanate	ID	ID	ID	P	4m	121	P	1.1h	9	P	ID	ID	ID	ID	ID	ID	ID	
Methylamine 40%	F	1.9h	2	E	>16h	ND	E	>15h	ND	G	>8h	ND	ID	ID	ID	ID	ID	
Methylene Chloride	G	>8h	ND	F	1h	7.32	P	24m	133	P	4m	766	F	6m	239	ID	ID	
Methylene Dianiline	E	>24h	ND	E	>8h	ND	E	>24h	ND	F	ID	ID	ID	ID	ID	ID	ID	
Methylene Dichloride	ID	1.9h	0.002	G	1.9h	7.32	P	ID	ID	P	4m	766	ID	ID	ID	ID	ID	
Morpholine	E	>8h	ND	G	ID	97	E	>16h	ND	P	48m	206	ID	ID	ID	ID	ID	
Nitric Acid, 3 Molar	E	>6h	ND	G	>8h	ID	F	ID	ID	P	ID	ID	E	>8h	ND	E	1.9h	0
Nitrobenzene	E	>8h	ND	E	21m	ND	E	>23	ND	F	33m	1.7	G	1h	20	ID	ID	
Nitropropane	E	>8h	ND	P	>8h	26.1	E	>8h	ND	P	16m	29.5	ID	ID	ID	ID	ID	
Oxalic Acid	E	>8h	ND	E	>8h	ND	E	>8h	ND	G	ID	ID	ID	ID	ID	ID	ID	
PCB, Aroclor 1254 50%	E	>8h	ND	E	>13h	ND	P	ID	ID	F	ID	ID	ID	ID	ID	ID	ID	
Pentachlorophenol 1% **(3)**	E	>8h	ND	ID	>8h	ND	P	ID	ID	E	>13h	ND	ID	8h	ND	ID	ID	
n-Pentane	E	>6h	ND	E	>17h	ND	P	ID	ID	E	ID	ID	ID	38m	3	ID	9m	17
Perchlorethylene	E	>6h	ND	E	>15h	ND	P	ID	ID	F	>1.3h	5.5	ID	28m	75.5	ID	ID	
Phenol 85%, water sat	G	>6h	ND	E	ID	ND	E	>20h	ND	P	39m	>1500	E	>8h	ND	ID	32m	13
Propyl Acetate	E	>6h	ND	P	ID	ID	G	2.7h	2.86	P	17m	72.5	ID	ID	ID	ID	ID	

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CHEMICAL	**Degradation (D)**	**Breakthrough (BT)**	**Permeation Rate (PR)**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**	**D**	**BT**	**PR**
Propyelenediamine	ID	ID	ID	E	38m	ND	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	
Pyridine	ID	ID	ID	P	ID	74	G	>8h	ND	P	ID	ID	ID	28m	117	ID	1m	>>
Red Fuming Nitric Acid	P	35m	ID	P	ID	ID	P	ID	ID	P	ID	ID	ID	ID	ID	ID	ID	
Sodium Hydroxide 50%	E	>6h	ND	G	ID	ID	E	ID	ID	G	ID	ID	E	>6.7h	ND	E	8h	ND
Styrene	G	>4h	ND	G	ID	ID	P	ID	ID	P	ID	ID	ID	ID	40	ID	27m	40
Sulfuric Acid, 3 Molar	E	>6h	ND	E	ID	ID	G	ID	ID	P	ID	ID	E	>6.7h	ND	E	>8h	ND
Tetrachloroethylene	E	>6h	ND	E	>17h	ND	P	ID	ID	F	1.3h	5.5	ID	28m	75.5	ID	ID	
Tetraethylenepentamine	ID	ID	ND	E	>8h	ND	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Tetrafluoroethylene	E	ID	ID	E	>8h	ND	E	>8h	ND	ID	ID	ID	ID	ID	ID	ID	ID	ID
Tetrahydrofuran	E	>8h	ND	P	4m	327	F	31m	112	P	4m	167	P	11m	671	ID	1m	>>
Thiophene	ID	>6h	ND	E	>8h	ND	P	1.8h	17	P	ID	ID	ID	ID	ID	ID	ID	ID
Toluene	E	>6h	ND	E	>16h	ND	F	21m	22.1	P	11m	68.1	ID	14m	576	ID	3m	350
Toluene Diisocyanate	E	>8h	ND	E	>16h	ND	E	>8h	ND	G	3.7h	1.8	ID	ID	ID	G	>6.7	ND
Trichloroethane	E	>6h	ND	G	7.4h	0.24	P	18m	550	P	8m	283	ID	11m	881	ID	ID	ID
1,1,1 Trichloroethane	E	>6h	ND	E	>15h	ND	P	ID	ID	F	41m	76.4	P	27m	197	ID	ID	ID
1,1,2 Trichloroethane	ID	ID	ID	E	>8h	ND	P	5.7h	7	P	ID	ID	ID	ID	ID	ID	ID	ID
Triethylamine	ID	ID	ID	E	>8h	ND	P	ID	ID	E	>8h	ND	ID	ID	ID	ID	ID	ID
Vinyl Chloride	E	>8h	ND	G	4.4h	0.098	P	ID	ID	G	5.7h	0.14	ID	ID	ID	ID	ID	ID
Xylene	E	>24h	ND	E	>8h	ND	P	ID	ID	P	ID	ID	ID	23m	135	ID	4m	383

(1) Van Nostrand Reinhold publishing.

(2) The data for Silver ShieldTM, VitonTM, Butyl and Nitrile gloves were provided by Siebe North Inc, Charleston, SC; information on Neoprene and Polyvinyl Chloride (PVC) gloves were supplied by Pioneer Industrial Products, Williard, OH.
(3) In Kerosene

E = Excellent; **G** = Good; **F** = Fair; **P** = Poor; **ND** = None detected; **ID** = Insufficient Data; **D** = Degradation; **BT** = Breakthrough, amount of elapsed time after initial exposure before the chemical can be analytically detected on the inside surface of the glove; **PR** = Permeation Rate is expressed in mg/m2/sec. PR can be used for estimating glove thickness required; for a given material, thicker is more resistant.

Note: Silver Shield gloves may be worn as liners under other glove types to enhance protection.

Additional Glove Chemical Resistance Guides:

Ansell Healthcare – Chemical Resistance Guide, 8th edition
http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

BEST Glove Manufacturing http://www.bestglove.com/site/chemrest/

NIOSH: *Recommendations for Chemical Protective Clothing - A Companion to the NIOSH Pocket Guide to Chemical Hazards*
http://www.cdc.gov/niosh/ncpc/ncpc2.html