Gloves: choice and use

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Wearing gloves: why?

Gloves are worn for protection. However, gloves do not always protect, and can even be the cause of various problems :

1) Allergies, which can develop following frequent exposure to latex. Latex allergies are particularly dangerous since medical treatments, such as operations, become more risky and require specific precautions. The so-called rubber gloves are usually made out of latex, as are gloves used for dishwashing.

2) Increased toxicity problems, if a chemical passes through the glove and becomes concentrated at the skin surface, the glove preventing evaporation or thorough washing.

3) A false feeling of safety, as we can think we are better protected than we really are.

4) Contamination risks for others when someone is wearing gloves outside the lab and touches various objects, such as door handles.

Gloves must therefore be chosen with respect to the chemicals to be manipulated and type of exposure :

- **Short exposure, protection against splashes**: Disposable gloves, thinner and more comfortable.

- **Prolonged exposure, immersion in a solvent, extremely toxic or dangerous chemicals**: Reusable gloves, thicker and more importantly, existing in a wider variety of materials, adapted to many uses.

How should gloves be used ?

1) Choose gloves made out of a material appropriate for the intended use;

2) Inspect gloves before use to verify that they show no defects (holes, cracks, etc) (see following page);

3) Remove gloves when exiting the lab or once the breakthrough time of the glove is exceeded (see definition at end of document), taking care not to touch the external surface of the gloves with your hand;

4) Wash and air dry reusable gloves (if they have not been in contact with a toxic substance that could continue to migrate in the glove, and eventually contaminate the skin during a future use);

5) Throw out disposable gloves.

How to verify gloves before use :

Source : Canadian Center for Occupational Health and Safety
http://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html#_1_5

Figure 1

Hold cuff as illustrated, with thumbs inside, stretch cuff slightly.

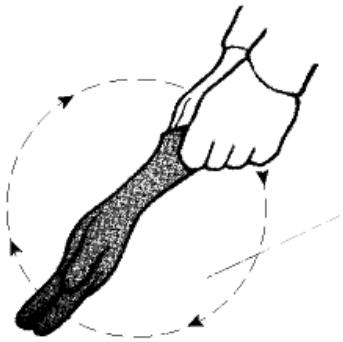

Figure 2

Swing glove outward and over towards the face, two or three times, trapping air inside.

Figure 3

Squeeze inflated portion of glove with left hand, causing rubber to expand and magnify any defect.

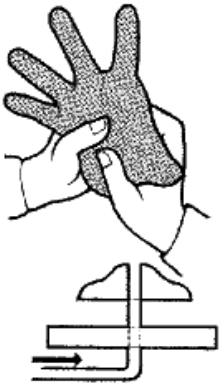

Figure 4

If large numbers need testing use a compressed air jig.

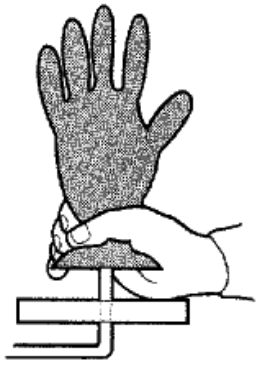

Figure 5

Double roll cuff over and grip with right hand.

How to choose gloves of appropriate composition?

1) If you are working with a particularly dangerous chemical, consult the Materials safety data sheet (MSDS) of the chemical or the data bank of one of the following manufacturers :

   Best Gloves : http://www.chemrest.com/French/French%20CHEMREST%20Title.htm

   North Company (software available on the Web) :
   http://www.northsafety.com/feature_ezguide.htm

   Mapa Company :
   http://www.mapaglove.com/ce/ChemicalSearch.asp

2) For protection against splashes or short contacts with chemicals in general: make a list of the main chemicals or chemical classes and choose according to a general table (see annex).

You must also choose the thickness and decide if you want powdered or non powdered gloves. The latter are easier to slip on, but can also be a cause of allergy and decreases the lifetime of the gloves.

The following tables indicate the main types of disposable and reusable gloves on the market, and their availability in the chemistry stores of Vachon Pavillon :

Disposable gloves :

Material	Availability at the chemistry store	Approx. cost	Recommended for	Not recommended for (non-exhaustive list)	Comments
Latex	President's choice (powdered)	8 $ / 100	Diluted acids and bases	Organics	Can cause allergies
Nitrile	Sensicare, Maxxim (non-powdered)	14 $ / 100	Organics	Organochlorinated	
Polyethylene	---	10 $ / 100			Not comfortable
Vinyle (PVC)	Sensicare, Maxxim (powdered)	8 $ / 100	Acids, bases, amines, peroxides	Organics	
Vinyle (PVC)	Fisherbrand (non-powdered)	13 $ / 100	Acids, bases, amines, peroxides	Organics	

Reusable gloves :

Material	Availability at the chemistry store	Approx. cost	Recommended for	Not recommended for (non-exhaustive list)	Comments
Rubber gloves (dishwashing gloves)	Best Value Master VML-09	1 $	Diluted acids and bases, alcohols	Organics	Can cause allergies (latex)
Neoprene	---	13 $	Acids, bases, peroxides, hydrocarbons, alcohols	Halogenated and aromatics	
Viton	---	100 $	Aromatics and chlorinated solvents		
Silvershield	---	7 $	Most chemicals		Not comfortable: not adjusted
Butyl rubber	---	80 $	Ketones, esters	Aliphatics, aromatics, halogenated chemicals, acids	

Note : Approximate prices in Canadian dollars at the chemistry stores or in the 2003-2004 Aldrich catalogue. Price varies with thickness, sterility and manufacturer.

Evaluation Parameters

- **Degradation** : Changes in physical characteristics following contact with a chemical (gloves becomes softer, easily tearable or brittle).
- **Permeation** : Speed at which a chemical penetrates the glove.
- **Breakthrough time (BT)** : Time required for a chemical to pass through the glove. This is the useful lifetime limit for a glove, and should be the main choice criteria.

For further information, see:

http://www.labsafety.com/refinfo/ezfacts/ezf191.htm
http://www.irsst.qc.ca/htmfr/pdf_txt/R-104.pdf
http://membership.acs.org/c/chas/Magazine/hotarticles/97/novdec/latex.html
http://www.cdc.gov/niosh/latexalt.html
http://www.cdc.gov/niosh/latexpg.html

CHEMICAL RESISTANCE CHART

ASTM Breakthrough Times in Minutes and ISEA/CE Ratings for Best Gloves

Explanation of Ratings

BTT or Breakthrough times are given in minutes and represent the Normalized breakthrough times required by ASTM F 739-96 Method for Permeation. The ratings are a part of the ANSI/ISEA 105-2000 American National Standard for Hand Protection Selection Criteria. The ratings range from 0 to 6 with 6 being the best choice.

Chemical Resistance Ratings

0 < 10 minute breakthrough time
1 ≥ 10 minute breakthrough time
2 ≥ 30 minute breakthrough time
3 ≥ 60 minute breakthrough time
4 ≥ 120 minute breakthrough time
5 ≥ 240 minute breakthrough time
6 ≥ 480 minute breakthrough time

Chemical by Class	Neoprene		Nitrile		Rubber		PVC		Butyl		Viton	
Aliphatic Solvents	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating
1. Cyclohexane	228	4	>480	6	NR	0	88	3	44	2	>480	6
2. Gasoline (unleaded)	46	2	>480	6	NR	0	22	1	NR	0	>480	6
3. Heptane	>480	6	>480	6	24	1	39	2	23	1	>480	6
4. Hexane	173	4	>480	6	21	1	29	1	13	1	>480	6
5. Isooctane	>480	6	>480	6	57	2	114	3	56	2	>480	6
6. Kerosene	>480	6	>480	6	NR	0	>480	6	94	3	>480	6
7. Petroleum Ether	99	3	>480	6	5	0	19	1	15	1	>480	6
Acids, Organic												
8. Acetic Acid 84%	>480	6	240	5	>480	6	300	5	>480	6	>480	6
9. Formic Acid 90%	>480	6	75	3	>480	6	>480	6	>480	6	>480	6
Acids, Mineral												
10. Battery 47%	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
11. Hydrochloric 37%	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
12. Hydrofluoric 48%	>480	6	60	3	45	2	110	3	>480	6	>480	6
13. Muriatic 10%	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
14. Nitric 70%	>480	6	NR	0	>480	6	240	5	>480	6	>480	6
15. Sulfuric 97%	>480	6	180	4	>480	6	>480	6	>480	6	>480	6
Alcohols												
16. Amyl	>480	6	>480	6	>480	6	116	3	>480	6	>480	6
17. Butyl	>480	6	>480	6	>480	6	155	4	>480	6	>480	6
18. Cresols	>480	6	NR	0	371	5	>480	6	>480	6	>480	6
19. Ethyl	>480	6	225	5	>480	6	66	3	>480	6	>480	6
20. Methyl	64	3	28	1	82	3	39	3	>480	6	>480	6
21. Isobutyl	>480	6	>480	6	>480	6	138	4	>480	6	>480	6
Aldehydes												
22. Acetaldehyde	1	0	NR	0	55	2	13	1	>480	6	NR	0
23. Benzaldehyde	93	3	NR	0	81	3	NR	0	>480	6	>480	6
24. Formaldehyde	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
25. Furfural	116	3	NR	0	>480	6	85	3	>480	6	298	5
Alkalies												
26. Ammonium Hydroxide	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
27. Potassium Hydroxide	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6
28. Sodium Hydroxide	>480	6	>480	6	>480	6	>480	6	>480	6	>480	6

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ASTM Breakthrough Times in Minutes and ISEA/CE Ratings

Chemical by Class	Neoprene		Nitrile		Rubber		PVC		Butyl		Viton	
Amides	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating	BTT	Rating
29. Dimethylacetamide	84	3	NR	0	29	1	51	2	>480	6	NR	0
30. Dimethylformamide	100	3	NR	0	>480	6	NR	0	>480	6	NR	0
31. N-Methyl Pyrrolidone	140	4	34	2	>480	6	140	4	>480	6	NR	0
Amines												
32. Aniline	32	2	NR	0	1	0	71	3	>480	6	>480	6
33. Butylamine	NR	0	NR	0	45	2	15	1	45	2	NR	0
34. Diethylamine	13	1	60	3	60	3	107	3	30	2	9	0
Aromatic Solvents												
35. Benzene	15	1	16	1	NR	0	13	1	34	2	>480	6
36. Toluene	25	1	26	1	NR	0	19	1	7	0	>480	6
37. Xylene	37	2	41	2	NR	0	23	1	NR	0	>480	6
Chlorinated Solv.												
38. Carbon Tetrachloride	73	3	>480	6	NR	0	46	2	53	2	>480	6
39. Chloroform	23	1	6	0	NR	0	10	1	21	1	>480	6
40. Methylene Chloride	4	0	4	0	NR	0	NR	0	20	1	113	3
41. Perchloroethylene	40	2	>480	6	NR	0	NR	0	28	1	>480	6
42. Trichloroethylene	12	1	NR	0	NR	0	NR	0	13	1	>480	6
43. 1,1,1-Trichloroethane	51	2	49	2	NR	0	52	2	72	3	>480	6
Esters												
44. Amyl Acetate	110	3	77	3	NR	0	NR	0	158	4	NR	0
45. Ethyl Acetate	24	1	30	2	72	3	5	0	212	4	NR	0
46. Methyl Methacrylate	27	1	NR	0	77	3	NR	0	63	3	NR	0
Ethers												
47. Cellosolve Acetate	228	4	47	2	107	3	64	3	>480	6	>480	6
48. Ethyl Ether	12	1	33	2	11	1	14	1	19	1	29	1
49. Tetrahydrofuran	13	1	5	0	NR	0	NR	0	24	1	NR	0
Gases												
50. Ammonia, anhydrous	29	1	336	5	1	0	60	3	>480	6	>480	6
51. 1,3-Butadiene	33	2	>480	6	25	1	24	1	473	5	>480	6
52. Chlorine	>480	6	>480	6	>480	6	360	5	>480	6	>480	6
53. Ethylene Oxide	21	1	17	1	1	0	360	5	189	4	48	2
54. Hydrogen Fluoride	210	4	1	0	142	4	1	0	>480	6	>480	6
55. Methyl Chloride	84	3	>480	6	52	2	>480	6	>480	6	>480	6
56. Vinyl Chloride	7	0	>480	6	2	0	19	1	268	5	>480	6
Ketones												
57. Acetone	35	2	3	0	9	0	7	0	>480	6	NR	0
58. Methyl Ethyl Ketone	30	2	NR	0	12	1	NR	0	202	4	NR	0
59. MIBK	41	2	NR	0	38	2	NR	0	292	5	NR	0
Nitriles												
60. Acetonitrile	65	3	6	0	16	1	24	1	>480	6	NR	0
61. Acrylonitrile	27	1	NR	0	48	2	14	1	>480	6	55	2

This information has been provided by Best Manufacturing Company and is applicable to Best gloves only. For additional Data and glove specifications, please visit www.chemrest.com