

Permeation can occur with no visible effects. Chemical molecules can enter the glove and leave on the other side.

UNDERSTANDING THE EFFECTS HAZARDOUS CHEMICALS CAN HAVE ON PROTECTIVE GLOVES

Hazardous chemicals can degradate and/or permeate glove materials. Here's the difference...

■ **Degradation** occurs when one or more physical properties of a glove is reduced due to its contact with a chemical. The glove could get harder, stiffer, brittle or softer and weaker. It might also swell to several times its original size.

■ **Permeation** can occur with no visible effect on a glove product. Molecules of the chemical can enter the glove, pass between the film molecules, and leave on the other side.

■ In considering gloves for a specific application involving chemicals, both permeation and degradation testing should be conducted. Remember, a glove may have acceptable degradation resistance to a chemical, yet may not be suitable for the application because of poor permeability. This means workers can be exposed to a chemical, even though the glove may show no visible effects.

TESTS CONDUCTED IN A CONTROLLED LABORATORY MAY CARRY FROM ACTUAL WORKPLACE CONDITIONS. YOU MUST CONDUCT YOUR OWN EVALUATIONS TO DETERMINE HOW YOUR PARTICULAR APPLICATIONS AND CONDITIONS MAY EFFECT A GLOVE'S DEGRADATION AND PERMEATION RESISTANCE.

CHEMICAL GLOVES PERMEATION GUIDE

- For each product, there is a corresponding chemical with data that covers; (1) its overall rating for degradation resistance; (2) the time of permeation breakthrough; (3) the rate or permeation, and (4) its performance index number.
- When testing for breakthrough time, the shortest times observed, from the start of the test to the first detection of the chemical on the other side of the sample, were recorded. This data provides a basis for determining how long a glove can

be expected to provide the most effective resistance against a hazardous solvent.

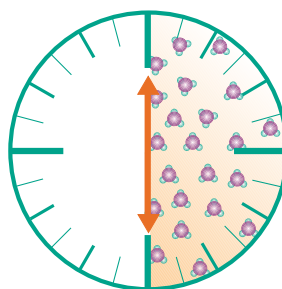
- Permeation rates were determined by recording the highest flow rates, during a six-hour test period, for the permeating chemicals through the protective glove films. The ratings are qualitative and reflect the comparisons of permeation rates to each other.

KEY TO DEGRADATION RATINGS

- E Excellent; fluid has very little degrading effect.
- G Good; fluid has minor degrading effect.
- F Fluid has moderate degrading effect.
- P Poor; fluid has pronounced degrading effect.
- NR Fluid is not recommended with this material.

KEY TO PERMEATION BREAKTHROUGHS

- > Greater Than (time)
- < Less than (time)
- ND – None detected; no breakthrough in 6 hour test.



Note: Any test samples rate P (Poor) or NR (Not Recommended) in degradation testing were not tested for permeation resistance. A dash (-) appears in those cases.

KEY TO PERMEATION RATE

- ND None detected during a 6-hour test
- MIN Minimal; permeation rate of less than 1.0 µg/cm²/min.
- VLow Very Low; permeation rate of 1.0 µg/cm²/min. to less than 10 µg/cm²/min.
- Low Low; permeation rate of 10 µg/cm²/min. to less than 100 µg/cm²/min.
- Mod Moderate; permeation rate of 100 µg/cm²/min. to less than 1,000 µg/cm²/min.
- High High; permeation rate of 1,000 µg/cm²/min. to less than 10,000 µg/cm²/min.
- VHigh Very High; permeation rate of 10,000 µg/cm²/min. and greater

KEY TO PERFORMANCE INDEX NUMBERS

- 0 The glove material is the most resistant for this specific chemical.
- 1 The glove material offers high resistance to this specific chemical.
- 2 The glove material is recommended for intermittent contact with this specific chemical.
- 3 The glove material is recommended for splash protection with careful control of its use with this specific chemical
- 4 The glove material is recommended for low-level exposure. Change gloves with each new exposure.
- 5 Not recommended.

Note: The performance index numbers allow assessment of the relative performance of gloves against specific chemicals. The index used is based on that of Forsberg & Keith, and takes into consideration both breakthrough time and permeation rate.*

**Chemical Protective Clothing Performance Book, Forsberg & Keith, John Wiley and Sons, Inc.*

| | NITROSOL | | | | NEOSOL | | | | NATRASOL | | | | CHEMESOL | | | |
|------------------------------|--------------------|-------------------------|-----------------|---------------------|----------------------|-------------------------|-----------------|---------------------|--------------------|-------------------------|-----------------|---------------------|--------------------------|-------------------------|-----------------|---------------------|
| | NITRILE NBR | | | | NEOPRENE UNSUPPORTED | | | | NATURAL RUBBER | | | | NEOPRENE/ NATURAL RUBBER | | | |
| | Degradation Rating | Permeation Breakthrough | Permeation Rate | Performance Index # | Degradation Rating | Permeation Breakthrough | Permeation Rate | Performance Index # | Degradation Rating | Permeation Breakthrough | Permeation Rate | Performance Index # | Degradation Rating | Permeation Breakthrough | Permeation Rate | Performance Index # |
| 1. Acetaldehyde | P | - | - | 5 | E | 10 min. | High | 5 | E | 7 min. | Mod | 4 | E | 7 min. | Med | 4 |
| 2. Acetic Acid, Glacial | G | 4 ½ hr. | NA | NA | E | 7 hr. | NA | NA | E | 2 ¼ hr. | NA | NA | E | 2 ¼ hr. | NA | NA |
| 3. Acetone | NR | - | - | 5 | G | 5 min. | Mod | 4 | E | 10 min. | Mod | 4 | E | 10 min. | Med | 4 |
| 4. Acetonitrile | F | 30 min. | Mod | 3 | E | 30 min. | VLow | 2 | E | 4 min. | VLow | 3 | E | 5 min. | VLow | 3 |
| 5. Ammonium Fluoride, 40% | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 6. Ammonium Hydroxide, Conc. | E | ND | ND | 0 | E | >6 hr. | ND | 0 | E | 1 ¾ hr. | NA | NA | E | 1 ¾ hr. | NA | NA |
| 7. Aniline | NR | - | - | 5 | G | 35 min. | VLow | 2 | G | 30 min. | VLow | 2 | G | 30 min. | VLow | 2 |
| 8. Aqua Regia | F | ND | ND | 0 | G | 45 min. | NA | NA | G | ND | ND | 0 | G | ND | ND | 0 |
| 9. Benzaldehyde | NR | - | - | 5 | NR | - | - | 5 | F | 14 min. | Low | 4 | F | 14 min. | Low | 4 |
| 10. Benzene | P | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 11. Butyl Acetate | F | 1 ¼ hr. | Mod | 3 | NR | - | - | 5 | P | - | - | 5 | P | - | - | 5 |
| 12. Butyl Alcohol | E | ND | ND | 0 | E | 4 hr. | VLow | 1 | E | 15 min. | Low | 3 | E | 15 min. | Low | 3 |
| 13. Butyl Cellosolve® | E | 1 ½ hr. | VLow | 1 | E | 1 ½ hr. | VLow | 1 | E | 45 min. | Low | 3 | E | 50 min. | Low | 3 |
| 14. Carbon Disulfide | G | 30 min. | Mod | 3 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 15. Carbon Tetrachloride | G | 2 ½ hr. | Low | 2 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 16. Cellosolve® Acetate | F | 1 ½ hr. | Low | 2 | F | 25 min. | Low | 3 | G | 11 min. | Low | 4 | E | 15 min. | Low | 4 |
| 17. Cellosolve® Solvent | G | 3 ½ hr. | Low | 2 | E | 45 min. | Min | 1 | E | 45 min. | Low | 3 | E | 45 min. | Low | 3 |
| 18. Chlorobenzene | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 19. Chloroform | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 20. Chloronaphthalene | P | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 21. Chromic Acid, 50% | F | 4 hr. | NA | NA | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 22. Citric Acid, 10% | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 23. Cyclohexanol | E | ND | ND | 0 | E | 2 ½ hr. | VLow | 1 | E | 15 min. | Low | 3 | E | 15 min. | Low | 3 |
| 24. Diacetone Alcohol | G | 4 hr. | VLow | 1 | E | 5 hr. | Min | 0 | E | 20 min. | VLow | 2 | E | 20 min. | Low | 2 |
| 25. Dibutyl Phthalate | G | ND | ND | 0 | F | 2 hr. | Min | 1 | G | 17 min. | NA | NA | G | 15 min. | NA | NA |
| 26. Diethylamine | F | 45 min. | Mod | 3 | P | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 27. Di-Isobutyl Ketone, DIBK | E | 2 hr. | Mod | 3 | P | - | - | 5 | P | - | - | 5 | NR | - | - | 5 |
| 28. Dimethyl Formamide, DMF | NR | - | - | 5 | G | 10 min. | Low | 4 | E | 30 min. | Mod | 3 | E | 30 min. | Med | 3 |
| 29. Dimethyl Sulfoxide, DMSO | E | >4 hr. | VLow | 1 | E | ND | ND | 0 | E | 60 min. | VLow | 1 | E | 60 min. | VLow | 1 |
| 30. Dioctyl Phthalate, DOP | G | >6 hr. | ND | 0 | G | >6 hr. | Min | 0 | F | >6 hr. | Min | 0 | F | ND | Min | 0 |
| 31. Dioxane | NR | - | - | 5 | NR | - | - | 5 | F | 5 min. | Mod | 4 | F | 5 min. | Mod | 4 |
| 32. Ethyl Acetate | NR | - | - | 5 | F | 15 min. | Low | 3 | G | 5 min. | Low | 4 | G | 5 min. | Low | 4 |
| 33. Ethyl Alcohol | E | 4 hr. | VLow | 1 | E | 1 ½ hr. | VLow | 1 | E | 30 min. | VLow | 2 | E | 30 min. | VLow | 2 |
| 34. Ethylene Dichloride | NR | - | - | 5 | NR | - | - | 5 | P | - | - | 5 | P | - | - | 5 |
| 35. Ethylene Glycol | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 36. Ethyl Ether | E | 2 hr. | Low | 2 | E | 10 min. | Low | 4 | NR | - | - | 5 | NR | - | - | 5 |
| 37. Formaldehyde | E | ND | ND | 0 | E | 2hr. | Min | 1 | E | 1 hr. | VLow | 1 | E | 1 hr. | VLow | 1 |
| 38. Formic Acid 90% | F | 4 hr. | NA | NA | E | ND | ND | 0 | E | 2 hr. | NA | NA | E | 2 hr. | NA | NA |
| 39. Freon® TMC | NA | 10 min. | High | 5 | NA | 3 min. | High | 5 | NA | 3 min. | High | 5 | NA | - | - | - |
| 40. Freon® TF | E | ND | ND | 0 | E | 4 hr. | Min | 0 | NR | - | - | 5 | NA | - | - | - |
| 41. Furfural | NR | - | - | 5 | G | 20 min. | Low | 3 | E | 15 min. | Low | 3 | E | 15 min. | Low | 3 |
| 42. Gasoline (White) | E | ND | ND | 0 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 43. Hexane | E | ND | ND | 0 | E | 45 min. | Mod | 3 | NR | - | - | 5 | NR | - | - | 5 |
| 44. Hydrazine 65% | E | ND | ND | 0 | E | ND | ND | 0 | G | ND | ND | 0 | G | ND | ND | 0 |
| 45. Hydrochloric Acid, Conc. | E | ND | ND | 0 | E | ND | ND | 0 | G | >5 hr. | NA | NA | G | 5 hr. | NA | NA |
| 46. Hydrochloric Acid, 10% | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | F | ND | ND | 0 |
| 47. Hydrofluoric Acid, 48% | E | 2 hr. | NA | NA | E | 1 hr. | NA | NA | G | 3 ½ hr. | NA | NA | G | 3.5 hr | NA | NA |
| 48. Hydrogen Peroxide, 30% | E | ND | ND | 0 | E | 5 min. | NA | NA | E | ND | ND | 0 | E | ND | ND | 0 |
| 49. Hydroquinone, Saturated | E | ND | ND | 0 | E | ND | ND | 0 | G | ND | ND | 0 | G | ND | ND | 0 |
| 50. Isobutyl Alcohol | E | ND | ND | 0 | E | 10 min. | Min | 3 | E | 25 min. | Low | 3 | E | 25 min. | Low | 3 |
| 51. Iso-Octane | E | 6 hr. | VLow | 0 | E | 1 hr. | Low | 2 | NR | - | - | 5 | NR | - | - | 5 |
| 52. Isopropyl Alcohol | E | ND | ND | 0 | E | ND | ND | 0 | E | 7 min. | Min | 3 | E | 7 min. | Min | 3 |

THIS DATA APPLIES ONLY TO GLOVES MANUFACTURED BY LAKELAND INDUSTRIES, INC.

Cellosolve® is a registered trademark of Union Carbide Corp., Freon® is a registered trademark of E. I. DuPont

Lakeland Industries, Inc. makes no guarantee of results and assumes no obligation or liability in regards to this information. Test data contained in this guide reflects laboratory performance and may not replicate conditions of end use. Anyone intending to use suggestions contained in this guide should first verify that the glove selected is suitable for the intended use and meets all appropriate health standards. Lakeland is glad to assist you in selecting the appropriate glove for your needs. Please call customer service at 1-800-645-9291. Note: NA = Data not available

| | NITROSOL | | | | NEOSOL | | | | NATRASOL | | | | CHEMESOL | | | |
|----------------------------------|--------------------|-------------------------|-----------------|---------------------|----------------------|-------------------------|-----------------|---------------------|--------------------|-------------------------|-----------------|---------------------|-------------------------|-------------------------|-----------------|---------------------|
| | NITRILE NBR | | | | NEOPRENE UNSUPPORTED | | | | NATURAL RUBBER | | | | NEOPRENE/NATURAL RUBBER | | | |
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| 53. Kerosene | E | ND | ND | 0 | E | >6 hr. | MIn | 0 | F | 30 min. | VLow | 2 | F | 30 min. | VLow | 2 |
| 54. Maleic Acid, Saturated | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 55. Methyl Alcohol | E | 11 min. | Mod | 4 | E | 1 hr. | Min | 1 | E | 13 min | Min | 3 | E | 15 min. | Min | 3 |
| 56. Methylamine | E | ND | ND | 0 | G | 4 1/2 hr. | Low | 2 | E | 25 min. | Low | 3 | E | 30 min. | Low | 3 |
| 57. Methyl Cellusolve® | F | 11 min. | Low | 4 | E | 25 min. | Low | 3 | E | 4 min | VLow | 3 | E | 5 min. | VLow | 3 |
| 58. Methylene Bromide | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 59. Methylene Chloride | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 60. Methyl Ethyl Ketone, MEK | NR | - | - | 5 | P | - | - | 5 | G | 10 min. | High | 5 | G | 10 min. | High | 5 |
| 61. Methyl Isobutyl Ketone, MIBK | P | - | - | 5 | NR | - | - | 5 | F | 6 min. | Mod | 4 | F | 6 min. | Mod | 4 |
| 62. Methyl Methacrylate | P | - | - | 5 | NR | - | - | 5 | P | - | - | 5 | P | - | - | 5 |
| 63. Mineral Spirits, Rule 66 | E | ND | ND | 0 | G | 1 1/2 hr. | VLow | 1 | NR | - | - | 5 | NR | - | - | 5 |
| 64. Monoethanolamine | E | ND | ND | 0 | E | ND | ND | 0 | E | 3 1/2 hr. | VLow | 1 | E | 3.5 hr. | VLow | 1 |
| 65. Morpholine | NR | - | - | 5 | P | - | - | 5 | E | 30 min. | VLow | 2 | E | 30 min. | VLow | 2 |
| 66. Naphtha VM & P | E | ND | ND | 0 | G | 15 min | Mod | 3 | NR | - | - | 5 | NR | - | - | 5 |
| 67. Nitric Acid, 10% | E | ND | ND | 0 | E | ND | ND | 0 | G | ND | ND | 0 | G | ND | ND | 0 |
| 68. Nitric Acid, 70% | NR | - | - | 5 | G | 2 1/3 hr. | NA | NA | NR | - | - | 5 | NR | - | - | 5 |
| 69. Nitric Acid Red Fuming | NR | - | - | 5 | NR | - | - | 5 | P | - | - | 5 | NR | - | - | 5 |
| 70. Nitrobenzene | NR | - | - | 5 | NR | - | - | 5 | F | 5 min. | Low | 4 | F | 5 min. | Low | 4 |
| 71. Nitromethane 95.5% | F | 30 min. | Mod | 3 | E | 1 hr. | VLow | 1 | E | 4 min. | Min | 3 | E | 5 min. | Low | 3 |
| 72. Nitropropane 95.5% | NR | - | - | 5 | G | 5 min. | Mod | 4 | E | 5 min. | Low | 4 | E | 5 min. | Low | 4 |
| 73. Octyl Alcohol | E | ND | ND | 0 | E | 7 hr. | Min | 0 | E | 1 hr. | Min | 1 | E | 1 hr. | Low | 1 |
| 74. Oleic Acid | E | ND | ND | 0 | E | 1 hr | VLow | 1 | F | 30 min. | VLow | 2 | F | 30 min. | VLow | 2 |
| 75. Oxalic Acid, Saturated | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 76. Pentachlorophenol | E | ND | ND | 0 | E | 6 min | Min | 3 | NR | - | - | 5 | NR | - | - | 5 |
| 77. Pentane | E | ND | ND | 0 | E | 30 min. | Mod | 3 | P | - | - | 5 | P | - | - | 5 |
| 78. Perchloric Acid, 60% | E | ND | ND | 0 | E | ND | ND | 0 | F | ND | ND | 0 | F | ND | ND | 0 |
| 79. Perchloroethylene | G | 5 hr. | VLow | 1 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 80. Phenol | NR | - | - | 5 | E | 3 hr | Low | 2 | E | 1 hr. | Low | 2 | E | 1 hr. | Low | 2 |
| 81. Phosphoric Acid, Conc. | E | ND | ND | 0 | E | ND | ND | 0 | G | ND | ND | 0 | G | ND | ND | 0 |
| 82. Picric Acid, Sat/ETOH | E | 2 2/3 hr. | VLow | 1 | E | 2 1/2 hr. | VLow | 1 | G | 3 min. | VLow | 3 | G | 3 min. | VLow | 3 |
| 83. Potassium Hydroxide KOH 50% | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 84. Propyl Acetate | F | 20 min. | LOW | 3 | P | - | - | 5 | F | 5 min. | Mod | 4 | P | - | - | 5 |
| 85. Propyl Alcohol | E | ND | ND | 0 | E | 2 1/2 hr. | Min | 1 | E | 20 min. | VLow | 2 | E | 20 min. | VLow | 2 |
| 86. Propylene Oxide | NR | - | - | 5 | NR | - | - | 5 | P | - | - | 5 | P | - | - | 5 |
| 87. Pyridine | NR | - | - | 5 | NR | - | - | 5 | F | 5 min. | Mod | 4 | P | - | - | 5 |
| 88. Rubber Solvent | E | ND | ND | 0 | G | 30 min. | Low | 3 | NR | - | - | 5 | NR | - | - | 5 |
| 89. Silicon Etch | NR | - | - | 5 | G | ND | ND | 0 | NR | - | - | 5 | P | - | - | 5 |
| 90. Sodium Hydroxide NaOH 50% | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 | E | ND | ND | 0 |
| 91. Stoddard Solvent | E | ND | ND | 0 | E | 3 hr. | VLow | 1 | NR | - | - | 5 | NR | - | - | 5 |
| 92. Styrene | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 93. Sulfuric Acid, 95% | NR | - | - | 5 | F | 3 hr. | NA | NA | NR | - | - | 5 | NR | - | - | 5 |
| 94. Tetrahydrofuran, THF | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 95. Toluene | F | 10 min. | Mod | 4 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 96. Toluene Di-Isocyanate, TDI | NR | - | - | 5 | NR | - | - | 5 | F | 7 min. | Low | 4 | F | 7 min. | Low | 4 |
| 97. 1,1,1, - Trichloroethane | F | 1 1/2 hr. | High | 4 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 98. Trichloroethylene, TCE | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 | NE | - | - | 5 |
| 99. Tricresyl Phosphate, TCP | E | ND | ND | 0 | F | ND | ND | 0 | E | 45 min. | Min | 2 | E | 45 min. | Low | 2 |
| 100. Triethanolamine 85%, TEA | E | ND | ND | 0 | E | ND | ND | 0 | G | 1 hr. | Min | 1 | G | 1 hr. | Low | 1 |
| 101. Turpentine | E | 30 min. | Min | 2 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |
| 102. Xylene | G | 1 1/4 hr. | Mod | 3 | NR | - | - | 5 | NR | - | - | 5 | NR | - | - | 5 |

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IMPORTANT NOTE: Chemicals highlighted in yellow are experimental or suspected carcinogens according to the seventh addition of: Dangerous Properties of Industrial Materials, Sax and Lewis.

Note: NA = Data not available