

About the Laboratory

The Respirex Testing Laboratory is an independent test facility accredited by the United Kingdom Accreditation Service (UKAS) and has provided the majority of the results for this permeation guide. It offers a range of chemical permeation and physical testing services to European, International and American standards:

- BS EN 374-3:2003
- BS EN 14325:2004
- BS EN ISO 6529:2001
- ASTM F739-07

Accredited testing is carried out at 23°C plus or minus 1°C, depending on the standard chosen.

The laboratory can provide technical advice on the permeation performance of Respirex products, and which fabrics may be most suitable for different applications. Further testing against chemicals or fabric combinations not listed in this guide can be also commissioned. The laboratory offers:

- Confidentiality
- Independent Service
- Fast Turnaround

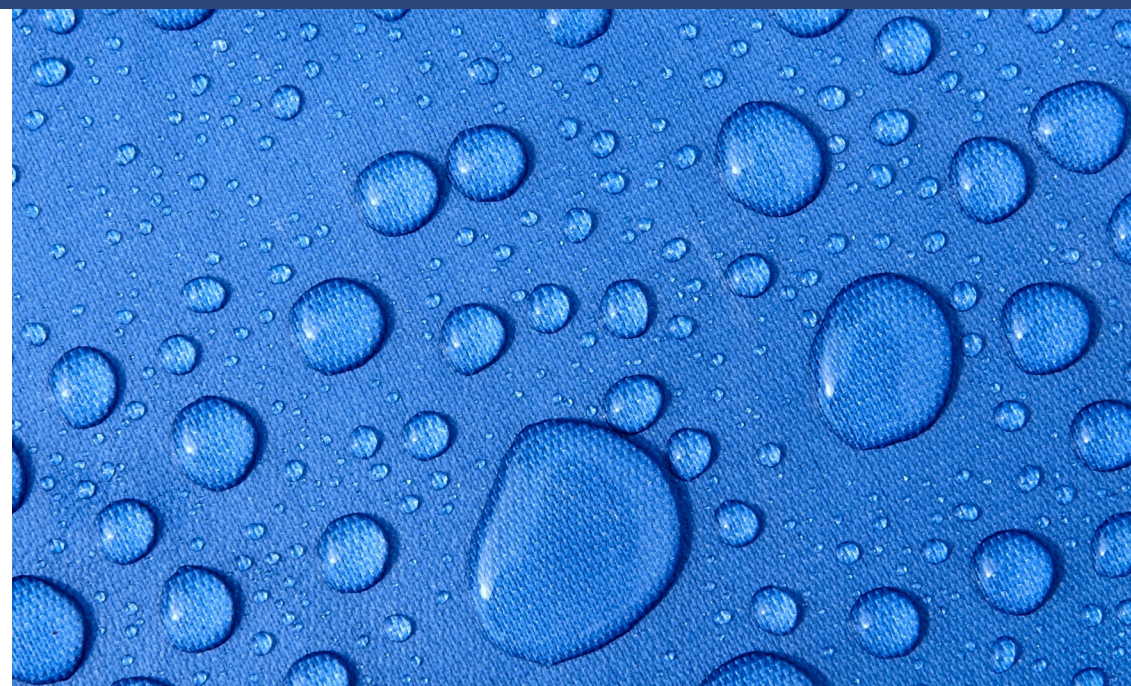
The laboratory can be contacted on by telephone on +44 (0)1737 857931 or by e-mail at laboratory@respirex.co.uk.

Disclaimer:

Every effort is taken to ensure the information in the Material Permeation Guide is up-to-date, but materials manufacturers are constantly refining production techniques and material specifications, which may effect test results. The Permeation Guide is intended for materials selection guidance only, if you are unsure about a materials suitability for your particular application, please contact Respirex.

www.respirexinternational.com

Respirex International Limited
Unit F, Kingsfield Business Centre, Philanthropic Road,
Redhill, Surrey, RH1 4DP United Kingdom
Tel: +44 (0)1737 778600
Fax: +44 (0)1737 779441
E-mail: info@respirex.co.uk



Material Permeation Guide

| Chemical | CAS Number | Viton Laminate | VBV | VBP | Yellow Laminate* | Blue Laminate | Butyl | Neoprene | PVC C2 | Heavy duty grey PVC | Hazmax™ Boot |
|--------------------------|------------|-------------------|------|------|---------------------|------------------|-------|----------|--------|------------------------|-----------------|
| acetaldehyde | 75-07-0 | | >480 | >480 | >480 | >480 | | | | | |
| acetic acid, 10% | 64-19-7 | | | | | | >480 | >480 | | | |
| acetic acid,glacial | 64-19-7 | | >480 | >480 | >480 | >480 | | | | | >480 |
| acetic anhydride | 108-24-7 | | >480 | >480 | >480 | >480 | | | | | |
| acetone | 67-64-1 | >480 | >480 | | >480 | >480 | | | | | |
| acetonitrile | 75-05-8 | >480 | >480 | >480 | >480 | >480 | | | | | |
| acetophenone | 98-86-2 | | >480 | >480 | >480 | >480 | | | | | |
| acrylic acid | 79-10-7 | | >480 | >480 | >480 | >480 | | | | | >480 |
| acrylonitrile | 107-13-1 | | | >480 | >480 | >480 | | | | | |
| allyl chloride | 107-05-01 | | | | | | | | | | |
| ammonia gas | 7664-41-7 | >480 | >480 | >480 | >480 | >480 | >480 | >480 | | | >480 |
| ammonia solution,35% | 1336-21-6 | | | | >480 | >480 | >480 | >480 | | | |
| ammonium nitrate sat. | 6884-52-2 | | | | | | >480 | | | | |
| amyl acetate | 628-63-7 | | | | >480 | >480 | | | | | |
| aniline | 62-53-3 | | >480 | >480 | >480 | >480 | | | | | >480 |
| aviation fuel | n/a | | >480 | >480 | >480 | >480 | | | | | |
| benzene | 71-43-2 | | | | | | | | | | |
| benzoyl chloride | 98-88-4 | | >480 | >480 | >480 | >480 | | | | | |
| benzyl alcohol | 100-51-6 | | >480 | >480 | >480 | >480 | >480 | | | | |
| brake fluid Mobil DTE 25 | n/a | | | >480 | | | | | | | |
| bromine liquid | 7726-95-6 | | >480 | | | | | | | | |
| butadiene, 1,3- | 106-99-0 | | >480 | | >480 | >480 | | | | | |
| butanone (MEK) | 78-93-3 | | | | >480 | >480 | | | | | |
| carbon disulphide | 75-15-0 | >480 | >480 | >480 | >480 | >480 | | | | | |
| chlorine gas | 7782-50-5 | >480 | >480 | | >480 | >480 | >480 | | | | |
| chlorobenzene | 108-90-7 | | >480 | | | | | | | | |
| chloroform | 67-66-3 | | | | | | | | | | |
| chloromethane gas | 74-87-3 | | >480 | | >480 | >480 | >480 | | | | |
| chlorosulphonic acid | 7790-94-5 | | | >480 | | | | | | | |
| cyclohexanone | 108-94-1 | | >480 | >480 | >480 | >480 | | | | | |
| dibromomethane | 74-95-3 | | >480 | | >480 | >480 | | | | | |
| dichloromethane | 75-09-2 | | | | >480 | >480 | | | | | |
| diethylamine | 109-89-7 | >480 | | | >480 | | | | | | |
| diethylsulphate | 64-67-5 | | | >480 | | | | | | | |
| dimethylacetamide, N,N- | 127-19-5 | | >480 | >480 | >480 | >480 | >480 | | | | >480 |
| dimethylformamide | 68-12-2 | | >480 | >480 | >480 | >480 | | | | | >480 |

| Chemical | CAS Number | Viton Laminate | VBV | VBP | Yellow Laminate* | Blue Laminate | Butyl | Neoprene | PVC C2 | Heavy duty grey PVC | Hazmax™ Boot |
|------------------------------|------------|-------------------|------|------|---------------------|------------------|-------|----------|--------|------------------------|-----------------|
| dimethyl sulphate | 77-78-1 | | >480 | | >480 | >480 | >480 | >480 | | | |
| epichlorohydrin | 106-89-8 | | >480 | | >480 | >480 | >480 | | | | |
| ethanol | 64-17-5 | | >480 | | >480 | >480 | >480 | | | | >480 |
| ethyl acetate | 141-78-6 | >480 | | | >480 | >480 | | | | | |
| ethyl benzene | 100-41-4 | | >480 | >480 | | | | | | | |
| ethylene oxide | 75-21-8 | | >480 | | >480 | >480 | | | | | |
| formaldehyde,37% sol | 50-00-0 | | >480 | | >480 | >480 | | >480 | >480 | | >480 |
| formic acid, 30% - 90% | 64-18-6 | | | | >480 | >480 | | >480 | >480 | | >480 |
| furfural | 98-01-1 | | >480 | >480 | >480 | >480 | >480 | | | | >480 |
| heptane | 142-82-5 | >480 | >480 | >480 | >480 | >480 | | | | | >480 |
| hexamethylene diisocyanate | 822-06-0 | | | >480 | | | >480 | | >480 | | |
| hexane | 110-54-3 | | >480 | >480 | >480 | >480 | | | | | |
| hydrazine hydrate | 7803-57-8 | | | >480 | >480 | >480 | | >480 | | | >480 |
| hydrochloric acid, 36% | 7647-01-0 | | >480 | >480 | >480 | >480 | | >480 | >480 | | >480 |
| hydrofluoric acid 48% | 7664-39-3 | | >480 | >480 | >480 | >480 | >480 | >480 | >480 | | >480 |
| hydrofluoric acid 73% | 7664-39-3 | | >480 | | >480 | >480 | | | | | >480 |
| hydrogen chloride gas | 7647-01-0 | >480 | >480 | | >480 | >480 | | | | | >480 |
| hydrogen fluoride gas | 7664-39-3 | | | | | | | | | | |
| hydrogen fluoride liquid | 7664-39-3 | | >480 | | | | | | | | |
| hydrogen peroxide, 27.5% | 7722-84-1 | | | | >480 | >480 | >480 | >480 | | | >480 |
| lactic acid, 40% | 50-21-5 | | | | >480 | >480 | | >480 | >480 | | >480 |
| methacrylic acid | 79-41-4 | | >480 | >480 | >480 | >480 | | | | | |
| methane sulphonyl chloride | 124-63-0 | | | | | | | | | | |
| methanol | 67-56-1 | >480 | >480 | >480 | >480 | >480 | >480 | | | | >480 |
| methyl acrylate | 96-33-3 | | | | >480 | >480 | | | | | |
| methyl methacrylate | 80-62-6 | | | | >480 | >480 | | | | | |
| methyl vinyl ketone | 78-94-4 | | >480 | | >480 | >480 | | | | | |
| nitric acid, 10% | 7697-37-2 | | | | >480 | >480 | | >480 | >480 | | >480 |
| nitric acid, 60% - 70% | 7697-37-2 | | >480 | >480 | >480 | >480 | >480 | >480 | | | >480 |
| nitric acid,fuming | 7697-37-2 | | | | >480 | >480 | | | | >480 | |
| nitrobenzene | 98-95-3 | | >480 | | >480 | >480 | >480 | | | | |
| oleum, 30% | 8014-95-7 | | >480 | >480 | | | | | | | >480 |
| oxalic acid, saturated | 144-62-7 | | | | >480 | >480 | | >480 | >480 | | >480 |
| petrol - unleaded | 8006-61-9 | | >480 | >480 | >480 | >480 | | | | | |
| phenol, solid | 108-95-2 | | | | | | | >480 | | | |
| phenol,85% | 108-95-2 | | | >480 | >480 | >480 | | | >480 | | >480 |

| Chemical | CAS Number | Viton Laminate | VBV | VBP | Yellow Laminate* | Blue Laminate | Butyl | Neoprene | PVC C2 | Heavy duty grey PVC | Hazmax™ Boot |
|------------------------------|------------|----------------|------|------|------------------|---------------|-------|----------|--------|---------------------|--------------|
| phenol, liquid -41 degC | 108-95-2 | | >480 | >480 | | | | | | | |
| phosgene | 75-44-5 | | >480 | | | | | | | | |
| phosphoric acid, 20% | 7664-38-2 | | | | | | | >480 | >480 | | >480 |
| phosphoric acid, 85% | 7664-38-2 | | | >480 | >480 | >480 | >480 | >480 | >480 | | >480 |
| phosphorus trichloride | 7719-12-2 | | | | | | | | | | |
| potassium hydroxide, 40% | 1310-58-3 | | | | | | | >480 | >480 | | |
| propan-2-ol | 67-63-0 | | >480 | >480 | >480 | >480 | >480 | >480 | | | |
| propylene oxide | 75-56-9 | | | | >480 | >480 | | | | | |
| pyridine | 110-86-1 | | | | >480 | >480 | | | | | |
| sodium hydroxide, 40% | 1310-73-2 | >480 | >480 | | >480 | >480 | >480 | >480 | >480 | | >480 |
| sodium hypochlorite, 13% | 7681-52-9 | | | | >480 | >480 | | >480 | >480 | | >480 |
| styrene | 100-42-5 | | >480 | | >480 | >480 | | | | | >480 |
| sulphur dioxide | 7446-09-5 | | | >480 | >480 | >480 | >480 | >480 | | | |
| sulphuric acid 10% - 50% | 7664-93-9 | | | >480 | >480 | >480 | >480 | >480 | >480 | | |
| sulphuric acid 96% | 7664-93-9 | >480 | >480 | >480 | >480 | >480 | | | | | >480 |
| tetrachloroethylene | 127-18-4 | | >480 | >480 | >480 | >480 | | | | | >480 |
| tetrahydrofuran | 109-99-9 | >480 | | | >480 | | | | | | |
| thionyl chloride | 7719-09-7 | | | | | | | | | | |
| toluene | 108-88-3 | >480 | >480 | >480 | >480 | | | | | | |
| toluene-2,4-diisocyanate | 584-84-9 | | >480 | >480 | >480 | >480 | >480 | | | | >480 |
| toluidine, o- | 95-53-4 | | | >480 | >480 | >480 | >480 | | | | |
| trichlorobenzene, 1,2,4- | 120-82-1 | | >480 | >480 | >480 | >480 | | | | | |
| trichloroethylene | 79-01-06 | | >480 | | | | | | | | |
| triethylamine | 121-44-8 | | >480 | >480 | | | | | | | |
| trifluoroacetic acid | 76-05-1 | | | | >480 | >480 | | >480 | | | |
| vinyl acetate | 108-05-4 | | | | >480 | >480 | | | | | |
| xylene | 1330-20-7 | | >480 | >480 | >480 | >480 | | | | | |

Key to Permeation Tables

Breakthrough Times:

| | |
|------|--|
| >480 | Recommended; breakthrough times over 480 minutes |
| | Recommended; breakthrough times 241 to 480 minutes |
| | Use only with caution; breakthrough times 61 to 240 minutes |
| | Very light splash protection only; breakthrough times 31 to 60 minutes |
| | Not recommended; breakthrough times less than 30 minutes |

Material Abbreviations:

| |
|-----------------------|
| VBV |
| Viton/Butyl/Viton |
| VBP |
| Viton/Butyl/Polyester |
| Butyl |
| Bromobutyl Rubber |

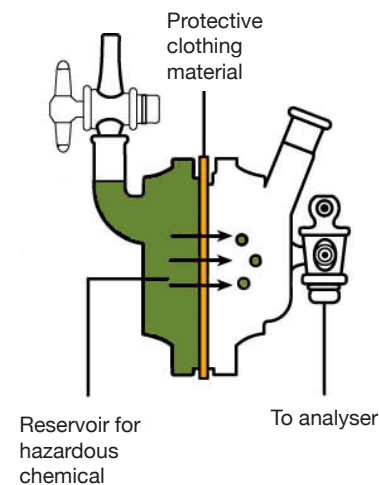
Chemicals in bold text are the 15 standard test chemicals defined in EN943-2:2002



Permeation is a process by which a chemical passes through a polymer by means of molecular diffusion. This occurs without there being any physical holes in the fabric.

How is permeation measured?

Permeation is measured by exposing the outer surface of a sample of fabric to the chemical against which it is being tested. The exposure is total and constant, and emulates total immersion conditions. The inner surface of the fabric is monitored analytically to determine the amount of chemical (if any) passing through the fabric.



What is the “breakthrough time”

The breakthrough time is the elapsed time between first exposure of the fabric to chemical and the rate of permeation reaching a target value. The target permeation rate for tests carried out according to BS EN ISO 6529 or BS EN 374-3 is one microgram of chemical passing through each square centimetre of fabric every minute. When measured according to a standard method, the breakthrough time is a value by which the performance of different fabrics can be compared.