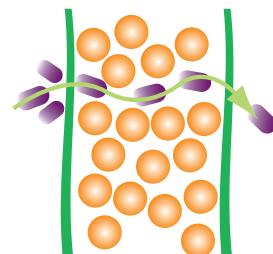


# Guidance on Chemical Permeation and Penetration

## What is permeation?

**Permeation is the process by which a hazardous chemical moves through a material on a molecular level. Molecules of chemical absorb into the outer surface of the material. They then diffuse across the material and are released or desorbed from the inner surface.**



### Measuring permeation

The resistance of a protective clothing fabric to permeation by a potentially hazardous chemical is determined by measuring the breakthrough time and the permeation rate of the chemical through the fabric.

### Permeation Test Methods

There are various permeation test methods in use today. Which one to use depends on a number of factors including the country of use for the protective clothing, and the type of chemical (i.e. gas or liquid).

### Permeation rate (PR)

This is the rate at which the hazardous chemical permeates through the test fabric and is expressed as a mass of hazardous chemical flowing through a fabric area per unit of time i.e.  $1.0\mu\text{g}/\text{cm}^2/\text{min}$  or 1.0 millionth of a gram per square centimetre per minute.

### Breakthrough Detection time (BDT)

The average time elapsed between initial contact of the chemical with the outside surface of the fabric and the detection of the chemical at the inside surface by the analytical device.

A breakthrough detection time of  $>480$  mins and a permeation rate of "nd" (not detected) does not mean breakthrough has not occurred. It means that permeation was not detected after an observation time of eight hours. Permeation may have occurred, but at a rate less than the minimum detectable permeation rate or MDPR. MDPR can vary depending on the chemical or the analytical device/test method.

### Breakthrough time (BT)

This is the average time between initial contact of the chemical with the outside surface of the fabric and the time at which the chemical is detected at the inside surface of the fabric at the permeation rate specified by the appropriate standard.

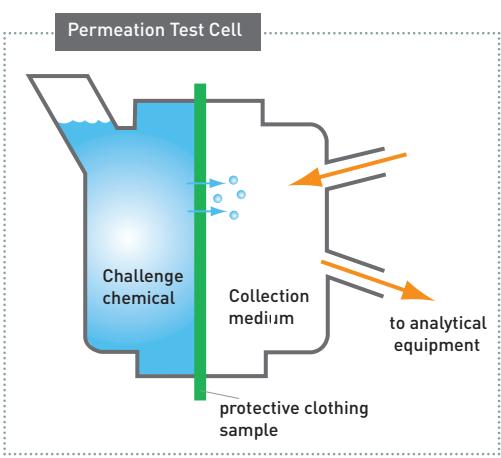
#### The key test methods and the normalised permeation rates required are listed below:

- 1) EN374-3 specifies a normalised permeation rate of  $1.0\mu\text{g}/\text{cm}^2/\text{min}$ , with the lowest BT to be recorded.
- 2) ISO 6529: 2001 specifies BT to be reported at the normalised permeation rate of  $1.0\mu\text{g}/\text{cm}^2/\text{min}$  or  $0.1\mu\text{g}/\text{cm}^2/\text{min}$ , with the mean BT to be recorded.
- 3) ASTM F739 specifies results to be recorded as breakthrough time (BT) at  $0.1\mu\text{g}/\text{cm}^2/\text{min}$ .

In Europe (as specified in EN 14325:2004) either EN374-3 or EN ISO 6529: 2001 can be used for permeation testing, and the normalised breakthrough time is recorded at the permeation rate of  $1.0\mu\text{g}/\text{cm}^2/\text{min}$ .

The resistance of MICROCHEM® to permeation by a hazardous chemical is determined by measuring the breakthrough time and permeation rate of the chemical through the fabric. Permeation tests are performed by independent, accredited laboratories in accordance with EN ISO 6529, EN374-3 or ASTM F739.

For further information on MICROCHEM® resistance to permeation see pages 57-62 or visit [www.microgard.com](http://www.microgard.com)



## What is penetration?

**Penetration is a process by which a chemical flows through holes (i.e. pores) or essential openings in a material on a non-molecular level.**



### Penetration Test Methods

There are various penetration test methods in use today. Which one to use depends on a number of factors, including the country of use for the protective clothing and the task for which the chemical protective clothing will be used. Recognised penetration test methods include:

#### EN ISO 6530 "Gutter Test"

Test method for the measurement of indices of penetration, absorption and repellence for protective clothing materials against liquid chemicals, mainly chemicals of low volatility. Specified in EN 13034 for "Type 6" chemical protective clothing, this test involves 10ml of liquid chemical being applied in 10s (+/-1s) onto the surface of a protective clothing material, which is laid in an inclined gutter at an angle of 45°. Results are taken 1 minute after initial exposure, simulating a light splash of liquid chemicals, and expressed in percentages (%)

Example of MICROGARD® Fabrics Resistance to Penetration in accordance with EN ISO 6530			
Chemical	CAS Number	MICROGARD® 1500 PLUS	
		Repellence [%]	Penetration [%]
Sulphuric Acid (30wt%)	7664-93-9	97.1	0.1
Sodium Hydroxide (10wt%)	1310-72-2	95.2	0

\*Test results for white fabric only. For test results on other colours and chemicals tested visit [www.microgard.com](http://www.microgard.com) or contact the MICROGARD Technical Team, e-mail [technical@microgard.com](mailto:technical@microgard.com)

#### ISO 13994 "Penetration under Pressure Test"

ISO 13994 describes a series of test methods that enable the determination of the resistance of materials used in protective clothing to visible penetration under the conditions of continuous liquid contact and pressure. Protective clothing "pass/fail" determinations are based on visual detection of liquid penetration. As specified in ISO 16602 for "Type 4" spray tight chemical protective clothing, ISO 13994 test procedure D involves the continuous exposure of a material to a liquid chemical with pressure maintained at 0kPa for 5 minutes. This is followed by increasing the pressure in increments of 3.5kPa every 15s until failure is observed or a maximum of 35kPa is reached.

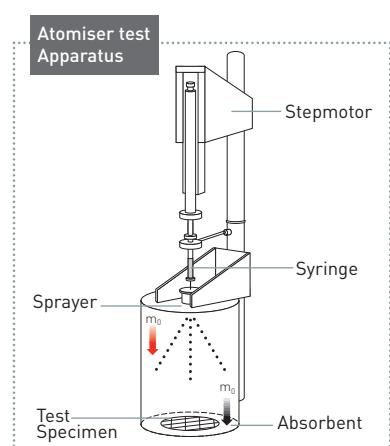
Example of MICROGARD® 2000 Resistance to Penetration Under Pressure ISO 13994, Procedure D		
Chemical	CAS Number	Result (kPa)
Sulphuric Acid (96wt%)	7664-93-9	>14
Sodium Hydroxide (30wt%)	1310-72-2	>14
Methanol	67-56-1	10.5
Toluene	108-88-3	7

ASTM F903 is the US equivalent of ISO 13994 procedure C1. Specified in NFPA 1992 (Liquid tight protective clothing for emergency responders), this involves the continuous exposure of a material to a liquid chemical with pressure maintained at 0 psi for 5 min followed by 2 psi [13.8 kPa] for 1 min followed by 0 psi for 54 min. For details of MICROGARD® performance in accordance with this method please contact the Microgard Technical Team, e-mail [technical@microgard.com](mailto:technical@microgard.com)

#### EN 14786 "Atomiser Test"

Test method to determine the resistance of protective clothing materials against penetration by atomised liquid chemicals, emulsions and dispersions. Specified in DIN 32781 and ISO/FDIS 27065 for protective clothing worn by operators applying liquid pesticides, this test involves a specimen being contaminated by a small quantity of liquid chemical, emulsion or dispersion. After 30 minute exposure the specimen is analysed using a suitable technique (e.g. high pressure liquid chromatography (HPLC)) to measure the quantity of liquid which penetrated. The penetration of a protective clothing material is defined as the ratio of the mass of chemical penetrated to the mass of chemical applied.

MICROGARD® 2000 performance when tested according to EN 14786 is available on page 23 and online at [www.microgard.com](http://www.microgard.com)



# MICROGARD® and MICROCHEM® Chemical Permeation Data

## Versatile chemical protection starts with MICROCHEM®

Working with chemicals, you and your colleagues face hazards every day. Everything from an accidental spill or splash exposure to industrial chemicals, warfare agents and radioactive processes.

The resistance of MICROCHEM® to permeation by a hazardous chemical is determined by measuring the breakthrough time and permeation rate of the chemical through the fabric. Permeation tests are carried out by independent, accredited laboratories in accordance with EN ISO 6529, EN369, EN374-3 and ASTM F739.

For more information on test methods or to discuss permeation testing of your specific chemical, or chemical mixture, please visit [www.microgard.com](http://www.microgard.com), contact the technical team on +44 (0) 1482 625444 or email [technical@microgard.com](mailto:technical@microgard.com)

EN Class/ CP Class	Normalised breakthrough times	Time to cumulative permeation of 150µg/cm <sup>2</sup>
0	Immediate (no class)	Immediate (no class)
1	>10	≥10
2	>30	≥30
3	>60	≥60
4	>120	≥120
5	>240	≥240
6	>480	≥480

NOW AVAILABLE

CHEMICAL PERMEATION DATA

SEARCH BY...  
**>Chemical Name >CAS No.**

The Microgard chemical database is now available online and features permeation resistance for a wide range of chemicals, including the ASTM F1001 and EN ISO 6529 recommended list of challenge chemicals. All testing is performed by independent, accredited testing laboratories.

Key features of the chemical database include

- Instant access to over 200 chemicals with permeation data for MICROCHEM® 3000, 4000 & 5000.
- Easy to use navigation
- Allows you to compare MICROCHEM® fabric performance

For up to the minute chemical permeation data visit:  
[www.microgard.com](http://www.microgard.com)

## ACRONYMS KEY

—	Not Reported
<b>MDPR</b>	Minimum detectable permeation rate
<b>BDT</b>	Breakthrough detection time (first appearance after the MDPR)
<b>BT 0.1</b>	Normalised breakthrough detection time at 0.1µg/cm <sup>2</sup> /min
<b>BT 1.0</b>	Normalised breakthrough detection time at 1.0µg/cm <sup>2</sup> /min
<b>EN Class</b>	Based on the mean BT (or lowest if the mean is not available) at 1.0µg/cm <sup>2</sup> /min according to ISO 6529
<b>CP</b>	Cumulative Permeation for the test duration. If no permeation detected, then often reported as <(MDPR x 480)
<b>CPT</b>	Time to cumulative permeation of 150µg/cm <sup>2</sup>
<b>CP Class</b>	Based on the time to cumulative permeation of 150µg/cm <sup>2</sup> , in accordance with ISO 16602
<b>PR</b>	Steady state permeation rate. If not reached then maximum permeation rate for the duration of the test is reported. If no permeation is detected then reported as <MDPR

**Safety Note:** All chemical tests and breakthrough times given relate to laboratory tests on fabrics only. Seams and closures may have lower breakthrough times, particularly when worn or damaged. It is the user's responsibility to select an appropriate garment, gloves, boots and other equipment for the particular use. The user shall be responsible for determining how long the garment can be worn for the particular use and whether it can be suitably cleaned for re-use. Microgard Limited does not give any warranties or make any representations about its garments other than those contained in the official literature supplied by Microgard Limited with each garment.



## MICROGARD® 2500 Permeation Data

Chemical Name	CAS Number	MDPR µg/cm²/min	BDT	BT 0.1 µg/cm²/min	BT 1.0 µg/cm²/min	EN Class EN 14325	CP µg/cm²	CPT µg/cm²/min	CP Class	PR µg/cm²/min
Acetone	67-64-1	-	Imm	Imm	Imm	0	-	-	-	High
Acetonitrile	75-05-8	-	Imm	Imm	Imm	0	-	-	-	High
Carbon Disulphide	75-15-0	-	-	5	45	2	181.4	>360	5	-
Dichloromethane (99.99 wt%)	75-09-2	-	Imm	Imm	Imm	0	-	-	-	High
Diethylamine (99.9 wt%)	109-89-7	-	Imm	Imm	Imm	0	-	-	-	High
Dimethylformamide-N,N (99.95 wt%)	68-12-2	-	Imm	Imm	Imm	0	-	-	-	High
Ethyl Acetate (99.98 wt%)	141-78-6	-	Imm	Imm	Imm	0	-	-	-	High
Hexane, n-	110-54-3	-	Imm	Imm	Imm	0	-	-	-	High
Hydrochloric Acid (36-37 wt%)	7647-01-0	≤0.05	Imm	Imm	Imm	0	-	-	-	-
Methanol (> 99.5 wt%)	67-56-1	-	Imm	Imm	Imm	0	-	-	-	High
Nitrobenzene (99.99 wt%)	98-95-3	-	Imm	Imm	Imm	0	5639	<30	1	-
Sodium Hydroxide (aq., 50wt%)	1310-73-2	-	>480	>480	>480	6	-	-	-	<0.1
Sodium Hypochlorite Solution (aq., 5 wt% available chlorine)	7681-52-9	0.041	>480	>480	>480	6	<19.7	>480	6	<0.041
Sulphuric Acid (95-96 wt%)	7664-93-9	-	>480	>480	>480	6	6.1	>480	6	-
Tetrachloroethylene (99.9 wt%)	127-18-4	-	Imm	Imm	Imm	0	-	-	-	High
Tetrahydrofuran	109-99-9	-	Imm	Imm	Imm	0	-	-	-	High
Toluene (99.99 wt%)	108-88-3	-	Imm	Imm	Imm	0	-	-	-	High

## MICROCHEM® 3000 Permeation Data

Chemical Name	CAS Number	MDPR µg/cm²/min	BDT	BT 0.1 µg/cm²/min	BT 1.0 µg/cm²/min	EN Class EN 14325	CP µg/cm²	CPT µg/cm²/min	CP Class	PR µg/cm²/min
Acetic Acid, Glacial (99.88wt%)	64-19-7	≤0.05	-	-	>540	6	-	-	-	<1.0
Acetic Anhydride	108-24-7	≤0.05	-	-	>540	6	-	-	-	<1.0
Acetone	67-64-1	≤0.08	4	4	30	1	-	-	-	-
Acetonitrile	75-05-8	≤0.08	Imm	Imm	7	0	-	-	-	-
Acrylamide	79-06-1	-	-	-	>480	6	-	-	-	<1.0
Acrylic Acid	79-10-7	-	-	-	>480	6	-	-	-	<1.0
Ammonia Gas (>99.98 wt%) 1 atmos.	7664-41-7	≤0.05	Imm	1	3	0	-	-	-	-
Ammonium Hydrogen Fluoride	1341-49-7	-	-	-	>480	6	-	-	-	<1.0
Aniline	62-53-3	-	-	-	>480	6	-	-	-	<1.0
Benlate®	17804-35-2	-	-	-	>480	6	-	-	-	<1.0
Benzene	71-43-2	-	-	-	2	0	-	-	-	-
Benzene Sulphonyl Chloride (99%)	98-09-9	-	-	-	>480	6	-	-	-	<1.0
Benzyl Chloride (99wt%)	100-44-7	-	-	-	16	1	-	-	-	-
Bromine	7726-95-6	-	-	-	2	0	-	-	-	-
Butanol N-	71-36-3	-	-	-	>480	6	-	-	-	<1.0
Butyl Acrylate N-	141-32-2	-	-	-	16	1	-	-	-	-
Butyl methyl ether T-	1634-04-4	<0.1	-	-	1	0	-	-	-	-
Carbon Disulphide	75-15-0	-	-	Imm	Imm	0	-	-	-	-
Chlorine (>99.8wt%) Gas, 1 atmos.	7782-50-5	≤0.05	9	9	10	1	-	-	-	-
Chlorine, liquid (saturated 99.9+ %)	7782-50-5	-	-	-	2	0	-	-	-	-
Chloroacetic Acid (79wt%)	79-11-8	0.076	>480	>480	>480	6	<37	>480	6	<0.076
Chloroacetyl Chloride	79-04-9	-	-	-	36	2	-	-	-	-
Chloroethanol 2- (99%)	107-07-3	-	-	-	>480	6	-	-	-	<1.0
Chloroform	67-66-3	-	-	-	Imm	0	-	-	-	-
Chromium trioxide (50 wt%)	1333-82-0	0.09	>480	>480	>480	6	<43.2	>480	6	<0.09
Cresols, mixed	1319-77-3	<1.0	-	-	>480	6	-	-	-	<1.0
Dichloroethane 1,2	107-06-2	-	-	-	4	0	-	-	-	-
Dichlorethylene trans 1,2	156-60-5	-	-	-	2	0	-	-	-	-
Dichlormethane (99.99 wt%)	75-09-2	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Diesel	68334-30-5	-	-	-	15	1	-	-	-	-
Diethyl Ether	60-29-7	-	-	-	Imm	0	-	-	-	-
Diethylamine (99.9 wt%)	109-89-7	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Difluoroaniline 2,4	367-25-9	-	-	-	>480	6	-	-	-	<1.0
(Dimethyl Amino) Pyridine 2- (99+ %)	5683-33-0	-	-	-	57	2	-	-	-	-
Dimethyl Sulphate	77-78-1	-	-	-	>480	6	-	-	-	<1.0
Dimethylamine (40 wt%)	124-40-3	-	-	-	>480	6	-	-	-	<1.0
Dimethylformamide N, N (>99.8 wt%)	68-12-2	-	-	-	>480	6	-	-	-	<1.0
Epichlorohydrin (99%)	106-89-8	-	-	-	>480	6	-	-	-	<1.0
Ethanolamine (99.8 wt%)	141-43-5	0.07	>480	>480	>480	6	<33.6	>480	6	<0.07
Ethyl Acetate (99.98 wt%)	141-78-6	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Ethylene Glycol	107-21-1	-	-	-	>480	6	-	-	-	<1.0
Ethylhexanoic Acid 2,	149-57-5	-	-	-	>480	6	-	-	-	<1.0

**Important:** Breakthrough time alone is not sufficient to determine how long a garment may be worn once the garment has been contaminated. Safe wear time may be longer or shorter depending on numerous other factors, including the toxicity, exposure conditions and permeation behaviour of the substance.

# MICROCHEM® Chemical Permeation Data

## MICROCHEM® 3000 Permeation Data

Chemical Name	CAS Number	MDPR µg/cm <sup>2</sup> /min	BDT	BT 0.1 µg/cm <sup>2</sup> /min	BT 1.0 µg/cm <sup>2</sup> /min	EN Class EN 14325	CP µg/cm <sup>2</sup>	CPT µg/cm <sup>2</sup> /min	CP Class	PR µg/cm <sup>2</sup> /min
Farm Fluid S	N/A	<1.0	-	-	>360	5	-	-	-	<1.0
Formaldehyde 37%	50-00-0	-	-	-	>480	6	-	-	-	<1.0
Formic Acid 90%	64-18-6	-	-	-	>480	6	-	-	-	<1.0
Furfural	98-01-1	-	-	-	>540	6	-	-	-	<1.0
Heptane, n- (99.8 wt%)	142-82-5	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Hexamethylene Diamine 1,6-	124-09-4	-			>480	6				<1.0
Hexane, n-	110-54-3	0.09	Imm	Imm	Imm	0	-	-	-	-
Hydrazine monohydrate 98% (containing Hydrazine, 64-65 wt%)	7803-57-8	<1.0	>540	-	>540	6	-	-	-	<1.0
Hydrobromic Acid	10035-10-6	-	-	-	>480	6	-	-	-	<1.0
Hydrochloric Acid (36-37 wt%)	7647-01-0	0.05	14	193	>540	6	-	>540	6	<1.0
Hydrofluoric Acid (62-64% in urea)	7664-39-3	-	-	-	41	2	-	-	-	-
Hydrogen Chloride (> 99.0 wt%) Gas, 1 atmos	7647-01-0	≤0.05	Imm	Imm	8	0	-	-	-	-
Hydrogen Peroxide 35%	7722-84-1	-	-	-	>480	6	-	-	-	<1.0
Iodine	7553-56-2	-	-	-	>540	6	-	-	-	<1.0
Isopropyl Alcohol	67-63-0	-	-	-	>480	6	-	-	-	<1.0
Mercury	7439-97-6	0.05	>480	>480	>480	6	<24.0	>480	6	<0.05
Methanol (> 99.5 wt%)	67-56-1	0.05	imm	<1	>480	6	-	364	5	0.59
Methoxyacetic Acid 2-	625-45-6	-	-	-	>540	6	-	-	-	<1.0
Methyl Iodide	74-88-4	-	-	-	>480	6	-	-	-	<1.0
Methyl-2-Pyrrolidone,N-	872-50-4	-	-	-	>480	6	-	-	-	<1.0
Nitric Acid Conc (70%)	7697-37-2	-	-	-	>480	6	-	-	-	<1.0
Nitrobenzene (99.99 wt%)	98-95-3	-	-	-	>480	6	-	-	-	<1.0
Octave	75747-77-2	-	-	-	>480	6	-	-	-	<1.0
Paraffin	92062-35-6	-	-	-	25	1	-	-	-	-
Perchloric Acid (30 wt%)	7601-90-3	≤0.05	>540	>540	>540	6	-	-	-	≤0.05
Petrol (unleaded)	8006-61-9	-	-	-	2	0	-	-	-	-
Phenol ("liquified" approx. 90wt% with water)	108-95-2	0.021	>480	>480	>480	6	<10.0	>480	6	<0.021
Phenol Liquid at 45°C	108-95-2	-	-	-	>480	6	-	-	-	<1.0
Phenol/Benzyl Alcohol 25/5	108-95-2 (in 100-51-6)	-	-	-	>480	6	-	-	-	<1.0
Phosphoric Acid 85 + %	7664-38-2	-	-	-	>480	6	-	-	-	<1.0
Phosphoric Pentachloride	10026-13-8	-	-	-	>480	6	-	-	-	<1.0
Phosphorus Oxychloride	10025-87-3	-	-	-	9	0	-	-	-	-
Phthalic Anhydride (135°C)	85-44-9	-	-	-	>480	6	-	-	-	<1.0
Pivalic Acid	75-98-9	-	-	-	>480	6	-	-	-	<1.0
Polyethylene Glycol 200	25322-68-3	-	-	-	>480	6	-	-	-	<1.0
Propionaldehyde	123-38-6	-	-	-	70	3	-	-	-	-
Reglone	85-00-7	-	-	-	>480	6	-	-	-	<1.0
Ripcord	52315-07-8	-	-	-	>480	6	-	-	-	<1.0
Round-up	38641-94-0	-	-	-	>480	6	-	-	-	<1.0
Sodium Bisulphite (40%)	7681-38-1	-	-	-	>480	6	-	-	-	<1.0
Sodium Chloride	7647-14-5	-	-	-	>480	6	-	-	-	<1.0
Sodium Cyanide (sat'd soln)	143-33-9	-	-	-	>480	6	-	-	-	<1.0
Sodium Fluoride (sat'd)	7681-49-4	-	-	-	>480	6	-	-	-	<1.0
Sodium Hydroxide (aq., 40 wt%)	1310-73-2	0.068	>540	>540	>540	6	<32.6	>540	6	<0.068
Sodium Hydroxide (aq., 50wt%)	1310-73-2	0.068	>540	>540	>540	6	<33	>540	6	<0.068
Sodium Hydroxide (aq., 50wt%) at 80°C	1310-73-2	0.031	>480	>480	>480	6	<26.0	>480	6	<0.031
Sodium Hypochlorite Solution (aq., 14.5 wt% available chlorine)	7681-52-9	0.041	>480	>480	>480	6	<19.7	>480	6	<0.041
Sodium Hypochlorite Solution (aq., 5 wt% available chlorine)	7681-52-9	0.041	>480	>480	>480	6	<19.7	>480	6	<0.041
Sodium Methylate 30%	124-41-4	-	-	-	>480	6	-	-	-	<1.0
Sodium Silicofluoride (sat'd)	16893-85-9	-	-	-	>480	6	-	-	-	<1.0
Styrene	100-42-5	-	-	-	2	0	-	-	-	-
Sulphuric Acid (95-96 wt%)	7664-93-9	0.051	>540	>540	>540	6	<24.5	>540	6	<0.051
Sulphuric Acid (aq., 50wt%) at 80°C	7664-93-9	0.021	>480	>480	>480	6	<10.0	>480	6	<0.021
Sulphuric Acid 98 + %	7664-93-9	<0.1	-	-	>480	6	-	-	-	<1.0
SUVA HCFC-123 (1,1 Dichloro-2,2,2 Trifluoroethane)	306-83-2	-	-	-	251	5	-	-	-	-
Tetrahydrofuran	109-99-9	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Thionyl Chloride	7719-09-07	-	-	-	Imm	0	-	-	-	-
Thiourea Dioxide (sat'd)	1758-73-2	-	-	-	>480	6	-	-	-	<1.0
Toluene (99.99 wt%)	108-88-3	≤0.08	Imm	Imm	Imm	0	-	-	-	-
Toluene 2,4 Diisocyanate	584-84-9	-	-	-	>480	6	-	-	-	<1.0
Tolidine o	95-53-4	-	-	-	>480	6	-	-	-	<1.0
Trichloroacetic Acid 98%	76-03-9	-	-	-	>480	6	-	-	-	<1.0
Trichlorethylene	79-01-6	-	-	-	2	0	-	-	-	-
Triethylamine	121-44-8	-	-	-	Imm	0	-	-	-	-
Trifluoroacetic Acid (99.0wt%)	76-05-1	-	-	-	>540	6	-	-	-	<1.0
Vinyl Acrylate	2177-18-6	-	-	-	3	0	-	-	-	-
Xylene m	1330-20-7	-	-	-	2	0	-	-	-	-
Zinc Bromide (sat'd soln)	7699-45-8	-	-	-	>480	6	-	-	-	<1.0



## MICROCHEM® 4000 Permeation Data

Chemical Name	CAS Number	MDPR µg/cm²/min	BDT	BT 0.1 µg/cm²/min	BT 1.0 µg/cm²/min	EN Class EN 14325	CP µg/cm²	CPT µg/cm²/min	CP Class	PR µg/cm²/min
Acetic Acid, Glacial (99.88wt%)	64-19-7	≤0.05	-	-	>540	6	-	-	-	<1.0
Acetic Anhydride	108-24-7	≤0.05	-	-	>540	6	-	-	-	<1.0
Acetone	67-64-1	≤0.08	43	127	>540	6	-	-	-	<1.0
Acetonitrile	75-05-8	≤0.08	>540	>540	>540	6	-	-	-	<0.08
Acrylamide	79-06-1	-	-	-	>480	6	-	-	-	<1.0
Acrylic Acid	79-10-7	-	-	-	>480	6	-	-	-	<1.0
Acrylonitrile	107-13-1	-	-	-	>480	6	-	-	-	<1.0
Ammonia Gas (>99.98 wt%) 1 atmos.	7664-41-7	≤0.05	5	18	60	2	-	-	-	-
Ammonia Liquid (99%), Liquified at -34°C	7664-41-7	0.01	Imm	>480	>480	6	-	>480	6	0.02
Ammonium Hydrogen Fluoride	1341-49-7	-	-	-	>480	6	-	-	-	<1.0
Ammonium Hydroxide (28%)	1336-21-6	-	-	-	>480	6	-	-	-	<1.0
Amyl acetate	628-63-7	-	-	-	>480	6	-	-	-	<1.0
Aniline	62-53-3	-	-	-	>480	6	-	-	-	<1.0
Benlate®	17804-35-2	-	-	-	>480	6	-	-	-	<1.0
Benzene	71-43-2	<0.05	21	157	>540	6	-	-	-	<0.25
Benzyl Chloride (99wt%)	100-44-7	-	-	-	>480	6	-	-	-	<1.0
Bis(3-aminopropyl)amine	56-18-8	<1.0	-	-	>480	6	-	-	-	<1.0
Bromine	7726-95-6	-	-	-	10	0	-	-	-	-
Butadiene 1,3- (>99.0 wt%)	106-99-0	0.011	>540	>540	>540	6	<5.4	>540	6	<0.011
Butanol N-	71-36-3	-	-	-	>480	6	-	-	-	<1.0
Butyl Acrylate N-	141-32-2	-	-	-	>480	6	-	-	-	<1.0
Butyl methyl ether T-	1634-04-4	<0.1	-	-	>480	6	-	-	-	<1.0
Carbon Disulphide	75-15-0	-	Imm	Imm	2	0	-	-	-	-
Chlorine (>99.8wt%) Gas, 1 atmos.	7782-50-5	0.020	196	402	>540	6	24	>540	6	0.11
Chlorine, liquid (saturated 99.9 + %)	7782-50-5	-	-	-	>480	6	-	-	-	<1.0
Chloro-5-(chloromethyl)pyridine 2-	70258-18-3	0.5	-	-	>540	6	-	-	-	<1.0
Chloroacetic Acid (79wt%)	79-11-8	-	-	-	>480	6	-	-	-	<1.0
Chloroacetic Acid Ethyl Ester (99wt%)	105-39-5	-	-	-	>480	6	-	-	-	<1.0
Chloroacetyl Chloride	79-04-9	-	-	-	>480	6	-	-	-	<1.0
Chloroacrylonitrile 2-	920-37-6	<0.1	-	-	>480	6	-	-	-	<1.0
Chloroaniline 4- (75°C)	106-47-8	-	-	-	>480	6	-	-	-	<1.0
Chlorobenzene	108-90-7	-	-	-	>480	6	-	-	-	<1.0
Chloroform	67-66-3	-	-	-	11	1	-	-	-	-
Chloromethane (99.9 wt%)	74-87-3	0.023	>540	>540	>540	6	<11	>540	6	<0.023
Chlorosulphonic Acid	7790-94-5	-	-	-	69	3	-	-	-	-
Chlorotoluene o	95-49-8	-	-	-	>480	6	-	-	-	<1.0
Chlorotoluene p	106-43-4	-	-	-	>480	6	-	-	-	<1.0
Chromium trioxide (50 wt%)	1333-82-0	0.09	>480	>480	>480	6	<43.2	>480	6	<0.09
Cresol-m in Water Solution (20g/l)	108-39-4	<0.1	-	-	>480	6	-	-	-	<1.0
Cresol-o in Water Solution (20g/l)	95-48-7	<0.1	-	-	>480	6	-	-	-	<1.0
Cresol-p in Water Solution (20g/l)	106-44-5	<0.1	-	-	>480	6	-	-	-	<1.0
Cumene (99.9wt%)	98-82-8	0.016	>540	>540	>540	6	<7.7	>540	6	<0.016
Cyclohexylamine (>99.5% wt%)	108-91-8	0.05	49	55	82	3	-	-	-	-
Di (aminopropyl) Amino (Diamine)	56-18-8	<1.0	-	-	>480	6	-	-	-	<1.0
Di-tert-butyl peroxide (98 wt%)	110-05-4	<0.05	>540	>540	>540	6	-	-	-	<0.05
Dichloro-4-(trifluoromethyl)benzene 1,2	328-84-7	-	-	-	>480	6	-	-	-	<1.0
Dichloroacetone 1,1	513-88-2	-	-	-	>480	6	-	-	-	<1.0
Dichloroacetone 1,3	534-07-6	-	-	-	>480	6	-	-	-	<1.0
Dichlorodiethylether 2,2-	111-44-4	-	-	-	>540	6	-	-	-	<1.0
Dichloroethane 1,2	107-06-2	-	-	-	>480	6	-	-	-	<1.0
Dichlormethane (99.99 wt%)	75-09-2	-	-	-	9	0	-	93	3	2.94
Dichromethysilane (>99 wt%)	75-54-7	-	-	-	20	1	-	-	-	-
Diesel	68334-30-5	-	-	-	>480	6	-	-	-	<1.0
Diethanolamine (99wt%)	111-42-2	-	-	-	>480	6	-	-	-	<1.0
Diethyl Ether	60-29-7	-	-	-	2	0	-	-	-	-
Diethylamine (99.9 wt%)	109-89-7	0.019	Imm	Imm	Imm	0	-	8	0	90.1
Diethylenetriamine	111-40-0	-	-	-	>480	6	-	-	-	<1.0
Difluoroaniline 2,4	367-25-9	-	-	-	>480	6	-	-	-	<1.0
Dimethyl Dicarbonate	4525-33-1	<1.0	-	-	>540	6	-	-	-	<1.0
Dimethyl Sulphate	77-78-1	-	-	-	>480	6	-	-	-	<1.0
Dimethyl Sulphoxide (99 + %)	67-68-5	-	-	-	>480	6	-	-	-	<1.0
Dimethylacetamide-N,N (liquid)	127-19-5	-	-	-	>480	6	-	-	-	<1.0
Dimethylamine (40 wt%)	124-40-3	-	-	-	>480	6	-	-	-	<1.0
Dimethylformamide N, N (>99.8 wt%)	68-12-2	<0.05	>540	>540	>540	6	-	-	-	<0.05
Dimethylformamide-N,N (99.95 wt%)	68-12-2	0.0094	>540	>540	>540	6	<4.5	>540	6	<0.0094
Dipropylene Glycol Methyl Ether	34590-94-8	-	-	-	>480	6	-	-	-	<1.0
Epichlorohydrin (99%)	106-89-8	-	-	-	>480	6	-	-	-	<1.0
Ethanol	64-17-5	<0.1	>540	>540	>540	6	-	-	-	<0.1

**Important:** Breakthrough time alone is not sufficient to determine how long a garment may be worn once the garment has been contaminated. Safe wear time may be longer or shorter depending on numerous other factors, including the toxicity, exposure conditions and permeation behaviour of the substance.

# MICROCHEM® Chemical Permeation Data

## MICROCHEM® 4000 Permeation Data

Chemical Name	CAS Number	MDPR µg/cm <sup>2</sup> /min	BDT	BT 0.1 µg/cm <sup>2</sup> /min	BT 1.0 µg/cm <sup>2</sup> /min	EN Class EN 14325	CP µg/cm <sup>2</sup>	CPT µg/cm <sup>2</sup> /min	CP Class	PR µg/cm <sup>2</sup> /min
Ethanolamine (98wt%)	141-43-5	-	-	-	>480	6	-	-	-	<1.0
Ethion	563-12-2	<1.0	-	-	>540	6	-	-	-	<1.0
Ethyl Acetate (99.98 wt%)	141-78-6	≤0.08	28	40	>540	6	-	-	-	<1.0
Ethyl Benzene	100-41-4	-	-	-	>480	6	-	-	-	<1.0
Ethyl Parathion	56-38-2	<1.0	-	-	>480	6	-	-	-	<1.0
Ethylene Diamine	107-15-3	-	-	-	>480	6	-	-	-	<1.0
Ethylene Dibromide	106-93-4	-	-	-	>480	6	-	-	-	<1.0
Ethylene Glycol	107-21-1	-	-	-	>480	6	-	-	-	<1.0
Ethylene Oxide (gas at ca. 1 Atmos)	75-21-8	<0.1	>540	>540	>540	6	-	-	-	<0.1
Ethylhexanoic Acid 2,	149-57-5	-	-	-	>480	6	-	-	-	<1.0
Fluorobenzene	462-06-6	-	-	-	105	3	-	-	-	-
Formaldehyde 37%	50-00-0	-	-	-	>480	6	-	-	-	<1.0
Formic Acid 90%	64-18-6	-	-	-	>480	6	-	-	-	<1.0
Furfural	98-01-1	-	-	-	>480	6	-	-	-	<1.0
Fyfanon	121-75-5	<1.0	-	-	>480	6	-	-	-	<1.0
Gas Oil (SHELL "Heizoel HVS 300 CST")	68476-33-5	-	-	-	>540	6	-	-	-	<1.0
Heptane, n- (99.8 wt%)	142-82-5	≤0.08	49	73	>540	6	-	-	-	0.12
Hexachloro-1, 3-butadiene	87-68-3	0.09	>540	>540	>540	6	-	-	-	<0.09
Hexamethyl Disilazane	999-97-3	-	-	-	>480	6	-	-	-	<1.0
Hexane, n-	110-54-3	0.09	>540	>540	>540	6	-	-	-	<0.09
Hydrazine monohydrate 98% (containing Hydrazine, 64-65 wt%)	7803-57-8	<1.0	>540	-	>540	6	-	-	-	<1.0
Hydrobromic Acid	10035-10-6	<0.1	>540	>540	>540	6	-	-	-	<0.1
Hydrochloric Acid (36-37 wt%)	7647-01-0	0.01	-	-	>480	6	-	-	-	<1.0
Hydrofluoric Acid (71-75 wt%)	7664-39-3	<0.05	8	175	>540	6	-	-	-	0.89
Hydrofluoric Acid 37%	7664-39-3	<0.1	-	-	>480	6	-	-	-	<1.0
Hydrofluorosilicic acid	16961-83-4	0.04	>480	>480	>480	6	<19.2	>480	6	<0.04
Hydrogen Chloride (> 99.0 wt%) Gas, 1 atmos	7647-01-0	≤0.05	8	125	>540	6	-	-	-	<1.0
Hydrogen Fluoride (99%), Liquified at 17°C	7664-39-3	0.01	90	110	120	4	-	375	5	1.82
Hydrogen Fluoride (anhydrous) Gas	7664-39-3	0.001	-	-	42	2	-	-	-	-
Hydrogen Peroxide 35%	7722-84-1	-	-	-	>480	6	-	-	-	<1.0
Hydrogen Sulphide (>99wt%)	7783-06-4	0.04	>540	>540	>540	6	-	-	-	<0.04
Isopropyl Alcohol	67-63-0	-	-	-	>480	6	-	-	-	<1.0
Maleic Anhydride	108-31-6	-	-	-	>480	6	-	-	-	<1.0
Mercury	7439-97-6	0.05	>480	>480	>480	6	<24.0	>480	6	<0.05
Methanesulphonyl Chloride (99.8 wt%)	124-63-0	0.04	>480	>480	>480	6	<19.2	>480	6	<0.04
Methanol (> 99.5 wt%)	67-56-1	≤0.08	21	>540	>540	6	-	-	-	<0.1
Methyl Chloride	74-87-3	-	-	-	>480	6	-	-	-	<1.0
Methyl Chloroformate	79-22-1	<0.5	-	-	>540	6	-	-	-	<1.0
Methyl Ethyl Ketone	78-93-3	<0.1	9	53	>540	6	-	-	-	<1.0
Methyl methacrylate (>99.0 wt%)	80-62-6	<0.05	>540	>540	>540	6	-	-	-	<0.05
Methyl Parathion	298-00-0	<1.0	-	-	>480	6	-	-	-	<1.0
Methyl-2- Pyrrolidone,N-	872-50-4	0.05	-	-	>480	6	-	-	-	<1.0
Nicotine (> 99.0 wt%)	54-11-5	0.6	>480	-	>480	6	<288	>250	5	<0.6
Nitric Acid (≥ 99.5 %)	7697-37-2	<0.06	>540	>540	>540	6	-	-	-	<0.06
Nitric Acid Conc (70%)	7697-37-2	<0.05	>540	>540	>540	6	-	-	-	<0.05
Nitrobenzene (99.99 wt%)	98-95-3	0.024	>540	>540	>540	6	<11	>540	6	<0.024
Nitrochlorobenzene-P 88°C	100-00-5	<0.5	-	-	<480	6	-	-	-	<1.0
Paraffin	92062-35-6	-	-	-	>480	6	-	-	-	-
Perchloroethylene	127-18-4	-	-	-	>480	6	-	-	-	<1.0
Petrol (unleaded)	8006-61-9	-	-	-	>480	6	-	-	-	<1.0
Phenol ("liquified" approx. 90wt% with water)	108-95-2	<0.1	>540	>540	>540	6	-	-	-	<0.1
Phenol Liquid at 45°C	108-95-2	-	-	-	>480	6	-	-	-	-
Phenol/Benzyl Alcohol 25/5	108-95-2 (in 100-51-6)	-	-	-	>480	6	-	-	-	<1.0
Phosgene Gas	75-44-5	0.05	-	-	387	5	-	-	-	-
Phosphoric Acid 85 + %	7664-38-2	-	-	-	>480	6	-	-	-	<1.0
Phosphoric Pentachloride	10026-13-8	-	-	-	>480	6	-	-	-	<1.0
Phosphorus Trichloride (99wt%)	7719-12-2	-	-	-	>540	6	-	-	-	<1.0
Pivalic Acid	75-98-9	-	-	-	>480	6	-	-	-	<1.0
Polyethylene Glycol 200	25322-68-3	-	-	-	>480	6	-	-	-	<1.0
Propionaldehyde	123-38-6	-	-	-	>480	6	-	-	-	<1.0
Propionic Acid	79-09-4	-	-	-	>480	6	-	-	-	<1.0
Propionitrile	107-12-0	-	-	-	>480	6	-	-	-	<1.0
Propylene Oxide 99%	75-56-9	<0.05	3	3	17	1	-	-	-	-
Quinoline (98 wt%)	91-22-5	0.08	>480	>480	>480	6	<38.4	>480	6	<0.08
Reglone	85-00-7	-	-	-	>480	6	-	-	-	<1.0
Ripcord	52315-07-8	-	-	-	>480	6	-	-	-	<1.0
Round-up	38641-94-0	-	-	-	>480	6	-	-	-	<1.0
Sodium Chloride	7647-14-5	-	-	-	>480	6	-	-	-	<1.0
Sodium Cyanide (satd soln)	143-33-9	-	-	-	>480	6	-	-	-	<1.0
Sodium Fluoride (satd)	7681-49-4	-	-	-	>480	6	-	-	-	<1.0
Sodium Hydroxide (aq., 40 wt%)	1310-73-2	≤0.05	>540	>540	>540	6	-	-	-	<0.05
Sodium Hydroxide (aq., 50wt%)	1310-73-2	0.068	>540	>540	>540	6	<33	>540	6	<0.068
Sodium Hydroxide (aq., 50wt%) at 80°C	1310-73-2	0.031	>480	>480	>480	6	<26.0	>480	6	<0.031

MICROCHEM®  
4000MICROCHEM®  
5000**MICROCHEM® 4000 Permeation Data**

Chemical Name	CAS Number	MDPR µg/cm²/min	BDT	BT 0.1 µg/cm²/min	BT 1.0 µg/cm²/min	EN Class EN 14325	CP µg/cm²	CPT µg/cm²/min	CP Class	PR µg/cm²/min
Sodium Hypochlorite Solution (aq., 14.5 wt% available chlorine)	7681-52-9	0.041	>480	>480	>480	6	<19.7	>480	6	<0.041
Sodium Hypochlorite Solution (aq., 5 wt% available chlorine)	7681-52-9	0.041	>480	>480	>480	6	<19.7	>480	6	<0.041
Sodium Silicofluoride (sat'd)	16893-85-9	-	-	-	>480	6	-	-	-	<1.0
Styrene	100-42-5	-	-	-	>480	6	-	-	-	<1.0
Sulphur Dioxide Gas	7446-09-5	0.001	-	-	>480	6	-	-	-	<1.0
Sulphuric Acid (50 wt%)	7664-93-9	<0.05	>540	>540	>540	6	-	-	-	<0.05
Sulphuric Acid (95-96 wt%)	7664-93-9	≤0.05	>540	>540	>540	6	-	-	-	<0.05
Sulphuric Acid (aq., 50wt%) at 80°C	7664-93-9	0.021	>480	>480	>480	6	<10.0	>480	6	<0.021
Sulphuric Acid 98 +%	7664-93-9	<0.1	-	-	>480	6	-	-	-	<0.1
SUVA HCFC-123 (1,1 Dichloro-2,2,2 Trifluoroethane)	306-83-2	-	-	-	380	5	-	-	-	-
Tetrachloroethylene (99.9 wt%)	127-18-4	0.030	30	218	>540	6	42	>540	6	0.17
Tetrahydrofuran	109-99-9	≤0.08	Imm	Imm	5	0	-	-	-	-
Tetramethyl Ammonium Hydroxide (Sat'd)	75-59-2	-	-	-	>480	6	-	-	-	<1.0
Thionyl Chloride	7719-09-07	-	-	-	2	0	-	-	-	-
Thiourea Dioxide (sat'd)	1758-73-2	-	-	-	>480	6	-	-	-	<1.0
Toluene (99.97wt%)	108-88-3	0.042	3	69	>540	6	65	>540	6	0.17
Toluene (99.99 wt%)	108-88-3	≤0.08	<6	<6	>540	6	-	-	-	0.67
Toluene 2,4 Diisocyanate	584-84-9	-	-	-	>480	6	-	-	-	<1.0
Toluidine o	95-53-4	-	-	-	>480	6	-	-	-	<1.0
Triacetonediamine	36768-62-4	-	-	-	>540	6	-	-	-	<1.0
Trichloroacetic Acid 98%	76-03-9	<1.0	-	-	>480	6	-	-	-	<1.0
Trichloroethylene	79-01-6	-	-	-	7	0	-	-	-	-
Triethylamine	121-44-8	-	-	-	5	0	-	-	-	-
Vinyl Acetate (99.97wt%)	108-05-4	0.022	>540	>540	>540	6	<11	>540	6	<0.022
Vinyl Acrylate	2177-18-6	-	-	-	>480	6	-	-	-	<1.0
Vinyl Benzyl Chloride	57458-41-0	-	-	-	>480	6	-	-	-	<1.0
Xylene m	1330-20-7	-	-	-	>480	6	-	-	-	<1.0
Xylenediamine-m	1477-55-0	-	-	-	>540	6	-	-	-	<1.0

**MICROCHEM® 5000 Permeation Data**

Chemical Name	CAS Number	MDPR µg/cm²/min	BDT	BT 0.1 µg/cm²/min	BT 1.0 µg/cm²/min	EN Class EN 14325	CP µg/cm²	CPT µg/cm²/min	CP Class	PR µg/cm²/min
Acetone	67-64-1	0.02	>480	>480	>480	6	-	>480	6	<0.02
Acetonitrile	75-05-8	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Ammonia Gas (>99.98 wt%) 1 atmos.	7664-41-7	0.03	38	41	>480	6	62.7	>480	6	0.03
Ammonia Liquid (99%), Liquified at -34°C	7664-41-7	0.01	>480	>480	>480	6	-	>480	6	<0.01
Bromine	7726-95-6	0.05	10	11	12	1	-	-	-	High
Butadiene 1,3- (>99.0 wt%)	106-99-0	0.02	>480	>480	>480	6	<9.6	>480	6	<0.02
Carbon Disulphide	75-15-0	0.1	-	277	>480	6	15	>480	6	0.1
Chlorine (>99.8wt%) Gas, 1 atmos.	7782-50-5	0.001	>480	>480	>480	6	<0.48	>480	6	<0.001
Chloroform	67-66-3	0.07	45	53	101	3	-	184	4	2.26
Chloromethane (99.9 wt%)	74-87-3	0.05	>480	>480	>480	6	<24	>480	6	<0.05
Cyclohexylamine (>99.5% wt%)	108-91-8	0.099	>480	>480	>480	6	<47.5	>480	6	<0.099
Dichlormethane (99.9 wt%)	75-09-2	0.04	19	23	59	2	-	114	3	6.99
Diethyl Ether	60-29-7	0.1	>480	>480	>480	6	<4.8	>480	6	<0.1
Diethylamine (99.9 wt%)	109-89-7	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Dimethylformamide N, N (>99.8 wt%)	68-12-2	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Ethyl Acetate (99.98 wt%)	141-78-6	0.1	-	>480	>480	6	<2.5	>480	6	<0.1
Ethylene Oxide (gas at ca. 1 Atmos)	75-21-8	0.04	41	55	195	4	-	273	5	1.04
Heptane, n- (99.8 wt%)	142-82-5	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Hexane, n-	110-54-3	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Hydrofluoric Acid (71-75 wt%)	7664-39-3	0.03	>480	>480	>480	6	<14.4	>480	6	<0.03
Hydrogen Chloride (> 99.0 wt%) Gas, 1 atmos	7647-01-0	0.03	-	>480	>480	6	<3.5	>480	6	<0.03
Hydrogen Fluoride (99%), Liquified at 17°C	7664-39-3	0.01	>480	>480	>480	6	-	>480	6	0.05
Hydrogen Sulphide (> 99 wt%)	7783-06-4	0.05	>480	>480	>480	6	ND *	>480	6	<0.05
Methanol (> 99.5 wt%)	67-56-1	0.03	>480	>480	>480	6	<14.4	>480	6	<0.03
Nitrobenzene (99.99 wt%)	98-95-3	0.1	-	>480	>480	6	<2.5	>480	6	<0.1
Propylamine, n-	107-10-8	0.02	145	163	>480	6	114	390	5	0.86
Propylene Oxide 99%	75-56-9	0.08	90	90	114	3	-	171	4	4.38
Sodium Hydroxide (aq., 50wt%)	1310-73-2	0.05	-	>480	>480	6	<6	>480	6	<0.05
Sodium Hydroxide 30%	1310-73-2	0.05	-	>480	>480	6	<6	>480	6	<0.05
Sulphuric Acid (95-96 wt%)	7664-93-9	0.02	>480	>480	>480	6	<9.6	>480	6	<0.02
Tetrachloroethylene (99.9 wt%)	127-18-4	0.05	>480	>480	>480	6	<24	>480	6	<0.05
Tetrahydrofuran	109-99-9	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01
Thionyl Chloride	7719-09-07	0.02	15	15	17	1	-	27	1	High
Toluene (99.99 wt%)	108-88-3	0.01	>480	>480	>480	6	<4.8	>480	6	<0.01

**Important:** Breakthrough time alone is not sufficient to determine how long a garment may be worn once the garment has been contaminated. Safe wear time may be longer or shorter depending on numerous other factors, including the toxicity, exposure conditions and permeation behaviour of the substance.