

# S-Series Hoods & Headcovers: Liquid Permeation

## Purpose

The 3M™ S-Series hoods and headcovers are designed to be used with certain 3M breathing tubes and Powered Air- Purifying (PAPRs) or Supplied Air (SA) units to form a respirator system. In addition to their use as respiratory protection, these products may be used as a physical barrier to help prevent liquid-skin contact in certain work environments. The purpose of this technical data bulletin is to provide information on respiratory protection systems that include the S-Series hoods and headcovers in order to assist industrial hygienists, safety engineers, and other qualified professionals in determining suitability for specific operations. All information listed is accurate as of the date of publishing.

## Background

The US Occupational Safety and Health Administration (OSHA) Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to conduct a worksite assessment to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). When conducting an assessment to determine whether PPE is needed to help prevent skin contact from liquids, there are many factors to consider. Workers handling, dispensing, using, and transporting liquid materials may need skin coverage. The worksite assessment should evaluate each task taking into account such things as whether skin contact may occur, whether it is continuous or intermittent, the nature of the contact (i.e. immersion, pressurized or non-pressurized spray, splash, surface contact, etc), accidental or anticipated contact, duration of the exposure, and whether the contaminant can be absorbed through the skin. There are many resources available to assist employers in conducting worksite assessments, including the OSHA PPE standard compliance guideline (29 CFR 1910 subpart I Appendix B) available at [www.osha.gov](http://www.osha.gov).

Once a worksite assessment has been completed appropriate controls can be selected. Consideration should be given to eliminating the hazard by substituting materials for less hazardous alternatives, making job or process changes, or by implementing other types of engineering or administrative controls. If PPE must be used, there are many guides and resources to assist with selection. Sources of information include publications such as the *Quick Selection Guide to Chemical Protective Clothing*<sup>1</sup>, on-line databases such as the *Recommendations for Chemical Protective Clothing* available on the NIOSH (National Institute for Occupational Safety & Health) website at [www.cdc.gov/niosh/ncpc/ncpc2.html](http://www.cdc.gov/niosh/ncpc/ncpc2.html), as well as information and data from the specific PPE manufacturer.

## S-Series Range: Styles and Materials of Construction

The S-series product range includes both hoods and loose fitting facepieces (i.e. headcovers). They are designed to be used in similar applications as the H-Series products including spray painting, pharmaceutical manufacturing, wood working, health care, coating operations, food and beverage production, and general maintenance. The S- Series product family provides a variety of offerings to cover the head; or head, neck, and shoulders; and, with specific models, parts of the torso. Tables 1a and 1b summarize the various headgear styles and fabric types used within the S- Series product line.

### Table 1a. S-Series Hoods and Headcovers with Integrated Head Suspension\*

					
<b>S-series</b>	<b>S-533S S-533L</b>	<b>S-133S S-133L</b>	<b>S-103S S-103L</b>	<b>S-403S S-403L</b>	<b>S-433S S-433L</b>
<b>Style</b>	Hood	Headcover	Headcover	Hood	Hood
<b>Fabric Type</b>	Polyurethane coated knitted polyamide	Polypropylene coated nonwoven polypropylene			
<b>Sealed Seams</b>	No	No	No	No	No
<b>Coverage Area</b>	Head, neck, shoulders; single outershroud	Head	Head	Head neck, shoulders; inner and outershroud	Head neck, shoulders; single outershroud

\* For environments that require a hood that offers hard hat protection, 3M offers the H-412 Hood Assembly made from a polypropylene coated non-woven polypropylene material and the H-612 Sealed Seam Hood Assembly made from Tychem® SL Chemical Barrier Fabric.

**Table 1b. S-Series Hoods with Premium Head Suspension\*\***

			
<b>S-series</b>	S-605/S-607 (S-655/S-657 Kit)	S-707 (S-757 Kit)	S-805/S-807 (S-855/S-857 kit)
<b>Style</b>	Hood	Hood	Hood
<b>Fabric Type</b>	Polypropylene coated nonwoven polypropylene		Zytron® 200
<b>Sealed Seams</b>	No	No	Yes
<b>Coverage Area</b>	Head, neck, shoulders; outer shroud plus inner neck collar (S-605) or inner shroud (S-607)	Head, neck, shoulders; inner and outer shroud	Head, neck, shoulders, and part of torso; outer shroud plus inner neck collar (S-805) or inner shroud (S-807)

\*\* For environments that require a hood that offers hard hat protection, 3M offers the H-412 Hood Assembly made from a polypropylene coated non-woven polypropylene material and the H-612 Sealed Seam Hood Assembly made from Tychem® SL Chemical Barrier Fabric. The H-600 series hoods are made from Tychem® SL fabric and have sealed seams to help prevent permeation through thread holes.

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The S-Series product range offers customers more choices in materials. The S-133, S-433, S-605, and S-607 products are constructed of a general purpose polypropylene coated non-woven polypropylene material. The S-707 hood is also made from polypropylene coated non-woven polypropylene, but is specifically constructed for liquid paint spray applications to capture overspray. While any of the products could be used in paint spray applications, the S-707 is specifically designed to help absorb paint overspray so the paint is less likely to drip or flake off into the painter's work. An integral barrier film helps prevent paint contact with skin or clothes. The S-533 is made from a polyurethane coated, knitted polyamide. The fabric is soft to the touch and offers good drape, high durability, and low fabric noise. Finally, the S-800 series is made from Zytron® 200 and has sealed seams.

Zytron® 200 is spun bond polypropylene with a multilayer barrier film.

## Permeation Testing

Permeation breakthrough time and rate are the more common factors used in assessing barrier materials to help prevent skin contact. Permeation is the process by which a chemical moves through a material on a molecular level. The test method commonly used in the protective clothing industry to evaluate permeation through barrier fabrics is ASTM F 739 *Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids and Gases under Conditions of Continuous Contact*. This is a laboratory permeation test whereby a swatch of fabric is placed in a test cell. One side of the fabric is exposed to a challenge chemical (liquid phase) and the other side faces a sampling chamber. If the detection equipment measures the challenge chemical on the sampling side of the fabric, the chemical has permeated the fabric. Permeation information is available from Kappler for the S-800 series material. For all other S-Series materials, permeation testing was performed by independent laboratories in accordance with the ASTM F739 test method. The chemicals used for testing were primarily the liquids suggested in ASTM F 1001 - 99a *Standard Guide for Selection of Chemicals to Evaluate Protective Clothing Materials*. ASTM F1001 establishes a standardized list of chemicals representing a broad range of chemical classes and properties, to use in evaluating protective apparel in testing programs. Testing was conducted under laboratory conditions at room temperature. The numbers reported in this technical data bulletin are averages. Results of permeation tests can be variable. Breakthrough times and permeation rates are estimates and are not exact.

This variability should be taken into account when selecting product for specific use environments. **Breakthrough times through seams and closures may be lower (and permeation rates may be higher) than through the fabric.** Tables 2 & 3 summarize the results of the permeation testing. Final determination as to the suitability of these products for a particular situation is the employer's responsibility. This information is subject to revision at any time. Always read and follow all *User Instructions* supplied with your 3M™ S-Series hood or headcover in order to ensure correct system operation. If you have questions contact 3M Technical Service.

**Table 2. Summary of ASTM F739 Test Data: S-100, 400, 500, 600, 700 Series**

<b>S-Series</b>	S-533 Series	S-103, S-133, S-403, S-433, S-600, S-700 Series
<b>Fabric Type</b>	Polyurethane Coated Knitted Polyamide	Polypropylene Coated Nonwoven Polypropylene
<b>Other 3M hoods/headcovers made from fabric type</b>	None	H-400 Series*

Chemical	CAS	Breakthrough time <sup>A</sup> (min)	PermeationRate (ug/cm <sup>2</sup> /min)	Breakthrough time <sup>A</sup> (min)	PermeationRate (ug/cm <sup>2</sup> /min)
Acetic Acid	64-19-7	-	-	>480	Not detected
Acetone	67-64-1	immediate	15	immediate	11
Acetonitrile	75-05-8	immediate	528	immediate	16
Black Liquor	308074-23-9	-	-	>480	Not detected
Carbon Disulfide	75-15-0	immediate	42	immediate	27
Chloroacetic acid	79-11-8	-	-	>480	Not detected
Cresol	95-48-7	-	-	>480	Not detected
Dichloro-methane	75-09-2	immediate	7	immediate	0.4
Diethylamine	109-89-7	immediate	66	immediate	12
Dimethyl-formamide	68-12-2	129	11	>480	Not detected
Ethyl Acetate	141-78-6	immediate	64	immediate	15
Ethylenedia mine	107-15-3	-	-	>480	Not detected
Ethylene Glycol	107-21-1	-	-	>480	Not detected
Formalin	50-00-0	-	-	>480	Not detected
Glutaraldehy de	111-30-8	-	-	>480	Not detected
n-Hexane	110-54-3	>480	<0.03	immediate	5
Hexa-methylene diisocyanate (HDI)	822-06-0	immediate	6.4	>480	Not detected

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Hydrofluoric Acid	7664-39-3	-	-	44	50.1
Hydrogen Peroxide	7722-84-1	-	-	>480	Not detected
Lithium Chloride	7447-41-8	-	-	>480	Not detected
Lithium Hydroxide	1310-65-2	-	-	>480	Not detected
Methanol	67-56-1	immediate	68	immediate	.69
4,4'-diphenylmethane diisocyanate (MDI)	101-68-8	>480	ND	>480	Not detected
Muriatic Acid	7647-01-0	-	-	236	1.35
Nitric Acid	7697-37-2	-	-	>480	Not detected
Nitrobenzene	98-95-3	immediate	>2	immediate	1
Oleum (20% Free SO <sub>3</sub> )	8014-95-7	-	-	24	High
1,5 Pentanediol	111-29-5	-	-	>480	Not detected
2-Propanol	67-63-0	-	-	>480	Not detected
PMDI	9016-87-9	-	-	>480	Not detected

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<b>Potassium Hydroxide</b>	<b>1310-58-3</b>	-	-	>480	Not detected
<b>Potassium Permanganate</b>	<b>7722-64-7</b>	-	-	>480	Not detected
<b>Sodium hydroxide, 50%</b>	<b>1310-73-2</b>	>480	<0.01	>480	Not detected
<b>Sodium Hypochlorite</b>	<b>7681-52-9</b>	-	-	>480	Not detected
<b>Sulfamic Acid</b>	<b>5329-14-6</b>	-	-	>480	Not detected
<b>Sulphuric Acid, 93-98%</b>	<b>7664-93-9</b>	immediate	>3000	>480	Not detected
<b>Tetrachloro-ethylene</b>	<b>127-18-4</b>	immediate	7	immediate	High
<b>Tetrahydrofuran</b>	<b>109-99-9</b>	immediate	19	immediate	67
<b>Toluene2-4 diisocyanate (TDI)</b>	<b>584-84-9</b>	172	2.4	>480	Not Detected
<b>Toluene</b>	<b>108-88-3</b>	immediate	41	immediate	56
<b>White Liquor</b>	<b>68131-33-9</b>	-	-	>480	Not detected

<sup>A</sup>Normalized breakthrough time. Defined by ASTM F739 as the time (in minutes) when the permeation rate reaches 0.1 ug/cm<sup>2</sup>/min. Breakthrough times of less than 10 minutes are listed as immediate.

\*H-400 made of white polypropylene coated non-woven polypropylene material after May 2021.

**Table 3. Summary of ASTM F739 Test Data: S-800 Series**

S-Series		S-800 Series		None	
Fabric Type		Zytron® 200 <sup>B</sup>		Tychem® SL <sup>C</sup>	
Other 3M hoods/headcovers made from fabric type		None		H-600 Series	
Chemical	CAS	Breakthrough time <sup>D</sup> (min)	Permeation Rate (ug/cm <sup>2</sup> /min)	Breakthrough time <sup>D</sup> (min)	Permeation Rate (ug/cm <sup>2</sup> /min)
Acetone	67-64-1	17	2.2	12	1.6
Acetonitrile	75-05-8	52	0.76	12	2.8
Ammonium Hydroxide, 28%	1336-21-6	>480	0.018	>480	<0.1
Carbon Disulfide	75-15-0	immediate	4.4	immediate	>50
Dichloromethane	75-09-2	immediate	85	immediate	>50
Diethylamine	109-89-7	21	235	12	>50
Dimethyl-formamide	68-12-2	77	1.8	78	0.85
Dimethyl sulfate	77-78-1	>480	Not detected	>480	<0.1
Ethyl Acetate	141-78-6	14	6.1	14	0.54
n-Hexane	110-54-3	immediate	0.35	10	0.48
Methanol	67-56-1	>480	Not detected	>480	<0.001
Nitrobenzene	98-95-3	97	19.8	102	2.3
Potassium Hydroxide, 45%	1310-58-3	>480	Not detected	Not tested	Not tested
Sodium hydroxide, 50%	1310-73-2	>480	Not detected	>480	<0.1
Sulphuric Acid, 93-98%	7664-93-9	>480	Not detected	>480	<0.1
Tetrachloro-ethylene	127-18-4	21	8.4	immediate	5.7
Tetrahydrofuran	109-99-9	immediate	463	immediate	>50
Toluene	108-88-3	immediate	355	immediate	25

<sup>B</sup>Data supplied by Kappler USA. For the most current permeation information on this material contact Kappler at [www.kappler.com](http://www.kappler.com) or 1-800-600-4019.

<sup>C</sup>From the “Permeation Guide for Dupont™ Tychem® Protective Fabrics”, effective June 2004. For the most current permeation information on this material contact Dupont at [http://www2.dupont.com/Personal\\_Protection/en\\_US/tech\\_info/literature\\_tychem.html](http://www2.dupont.com/Personal_Protection/en_US/tech_info/literature_tychem.html)

<sup>D</sup>Normalized breakthrough time. Defined by ASTM F739 as the time (in minutes) when the permeation rate reaches 0.1 ug/cm<sup>2</sup>/min. Breakthrough times of less than 10 minutes are listed as immediate.

## References

- 1) **Forsberg, K, Mansdorf, S.Z:** *Quick Selection Guide to Chemical Protective Clothing*, 4<sup>th</sup>ed. Hoboken, New Jersey: John Wiley & Sons, 2002.
- 2) **Dupont:** *Dupont™ Tychem QC® Chemical Protective Clothing*; K-17394 (09/07). Dupont Personal Protection: Richmond, VA: 2007.

**Personal Safety Division**  
3M Center, Building 235-2W-70

St. Paul, MN 55144-1000

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**In United States of America**  
Technical Service: 1-800-243-4630

Customer Service: 1-800-328-1667  
[3M.com/workersafety](http://3M.com/workersafety)

**In Canada**  
Technical Service: 1-800-267-4414  
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