



Chemical Splash

FABRIC

Technical Data and
Application Guide

Selecting Chemical-Protective Clothing

Choosing the right chemical-protective clothing can be difficult due to a lack of standards and insufficient data. It has been common to choose chemical-protective clothing based on the A, B, and C levels defined by the EPA. While these definitions provide guidelines and a framework for discussing PPE, the descriptive narrative in these levels does not identify the minimum performance criteria required to assure that the wearer is adequately protected from any specific hazards.

The NFPA Approach

Choosing the correct protective clothing requires a clear understanding of what the garment is expected to do and why it is being worn. This practical and simple approach was used by the National Fire Protection Association (NFPA) to establish performance-oriented protective clothing standards as follows:

NFPA 1991 Vapor-Protective Ensembles for Hazardous Materials Emergencies

NFPA 1992 Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies

These standards address full ensemble performance. Each standard sets minimum levels of performance for protection provided by the overall ensemble, garment material, seams, closures, and other components. These criteria have been written with the hazardous chemical emergency response team in mind, but they can apply to a number of other protective clothing applications as well.

Because the NFPA Standards define performance levels instead of design levels, they are more appropriate for selecting types of protective ensembles and clothing than the A, B, C, or D levels from EPA. The terminology from these standards can be related, as the comparison in the following table shows:

Performance Required	NFPA Performance Standard	EPA Design Level
Vapor Protection	NFPA 1991	Level A (gas tight)
Liquid Splash Protection	NFPA 1992	Levels B and C

When Vapor Protection Is Needed

When you need vapor protection, it is appropriate to choose a certified vapor-protective ensemble when the capability to protect against a specific chemical is based on *permeation data* (ASTM F739). **Permeation** is the process by which a chemical moves through material on a molecular level. NFPA 1991 associates vapor-tight integrity and permeation data (ASTM F739) with vapor protection. Therefore, vapor-protective ensembles compliant with NFPA 1991 are suitable for this purpose.

Protection Plus Comfort

GORE® Chemical Splash Fabric provides liquid splash protection while maintaining comfort. Clothing made from this fabric allows your body to “breathe”, so your sweat can evaporate through the GORE® membrane, providing you with some heat stress relief. Because it is light and comfortable, it generally can be worn for a full shift without excessive overheating. Protective garments made from this unique fabric give you the time necessary to exit the area and get to an emergency shower in case of an accidental splash with a dangerous chemical. The accompanying information will help you in deciding whether clothing made from GORE® Chemical Splash Fabric is right for your chemical application.

When Liquid Splash Protection Is Needed

When you need liquid splash protection, but *do not need vapor protection*, it is appropriate to choose a certified liquid splash protective ensemble which meets NFPA 1992. These protective ensembles are selected for their capability to protect against a specific chemical based on *penetration data* (ASTM F903). **Penetration** is the bulk flow of a liquid chemical through the material, seams, or suit closures. NFPA 1992 associates liquid-tight integrity and penetration data (ASTM F903) with liquid splash protection. Since clothing of this type is designed to protect the wearer from liquid contact, but allows exposure to vapors, *permeation data is inappropriate for judging material performance for this level of protection*.

In addition, the overall ensemble must also demonstrate liquid-tight integrity. NFPA 1992 provides test methods and criteria for making this assessment. Organizations such as the Safety Equipment Institute (SEI) and Underwriters Laboratories (UL) will certify complete protective clothing ensembles that meet the NFPA standards.

Other test methods are often used to describe the liquid resistance of materials. However, the choice of liquid splash-protective clothing should be based on the results of penetration testing that has been performed in accordance with the procedures in ASTM F903, Procedure C. These criteria provide a truer evaluation of liquid barrier performance.

When Both Vapor and Liquid Splash Protection Are Needed

When you need *both* vapor and liquid splash protection, it is appropriate to choose a certified vapor-protective ensemble compliant with NFPA 1991 since, by definition, vapor-protective ensembles also provide liquid splash protection. *Never use liquid splash-protective clothing in vapor exposure situations, even if the material offers acceptable resistance to chemical permeation, because these suits lack overall vapor-tight integrity. Penetration data is inappropriate for judging material performance for this level of protection.*

Continued on back page



Chemical Splash

FABRIC

How To Use This Chemical Penetration Application Guide

This guide shows penetration testing results for GORE® Chemical Splash Fabric. It can be used to determine applications for clothing made from GORE® Chemical Splash Fabric.

This clothing should be used only for those situations where you do not need vapor protection or where vapor exposure is determined to be acceptable by an industrial safety or health professional. Because GORE® Chemical Splash Fabric is vapor-permeable, it should not be used for protection against any hazardous vapor exposures, or for exposures to carcinogens or other health-threatening materials.

Penetration Resistance

Penetration is the bulk flow of a liquid through porous materials, seams, closures, and pinholes or other imperfections in a protective clothing ensemble. Penetration may occur from chemical deterioration of the materials, which leads to a liquid passing through the material.

Measurement of Penetration Resistance

The penetration test¹ measures the resistance of protective clothing materials to penetration by liquids using a one-hour, one-sided liquid exposure to the normal outside material surface. The test is conducted at atmospheric pressure and room temperature. During the sixth minute, the test is conducted at 2 psig to simulate the pressure from a burst pipe. Liquid penetration is detected visually at the end of the test. Penetration results are recorded as either “PASS” or “FAIL”.

Color Coding

The chemical penetration data is color coded, as described below, to assist in determining the proper application for protective clothing made from GORE® Chemical Splash Fabric.

■ **GREEN** These chemicals represent liquid splash hazards as defined by NFPA 1992 Standards². GORE® Chemical Splash Fabric passes the penetration test for chemicals printed in green.

■ **YELLOW** These chemicals represent both potential vapor and liquid splash hazards³. GORE® Chemical Splash Fabric passes the penetration test for chemicals printed in yellow. Significant amounts of chemical vapor permeate this material.

Use GORE® Chemical Splash Fabric for these chemicals only in controlled situations if vapor exposure is acceptable. Consult a trained professional in industrial safety or hygiene when making this determination. Failure to comply with this warning may result in serious injury or death.

■ **RED – Do Not Use** – GORE® Chemical Splash Fabric fails the penetration test for chemicals printed in red.

NOTE: GORE® Chemical Splash Fabric is readily permeable by most chemical challenges when tested for permeation resistance in accordance with ASTM F739. Contact Gore for additional information on its other products that can pass ASTM F739 for some chemicals and circumstances.

Chemical Penetration Data

Chemical ⁴	Synonym	Penetration Test Result ⁵
Acetic Acid, Glacial	Ethanoic Acid	PASS
Acetone*+	2-Propanone	PASS
Acetonitrile*	Methyl Cyanide	PASS
Acrylic Acid (99%)	2-Propenoic Acid	PASS
Acrylonitrile	2-Propenenitrile	PASS
Aluminum Ammonium Sulfate (12.2%)	Alum	PASS
Ammonium Hydroxide (30%)	Aqua Ammonia	PASS
Ammonium Phosphate (Monobasic, Satd. Soln.)	Ammonium Acid Phosphate	PASS
Calcium Hydroxide (Satd. Soln.)	Caustic Lime	PASS
Calcium Hypochlorite (Satd. Soln.)	Calcium Oxychloride	PASS
Chloroacetic Acid (Satd. Soln.)	Monochloroacetic Acid, MCA	PASS
Chlorosulfonic Acid	Sulfuric Chlorohydrin	PASS
Chromic Acid (100%)	Chromium Trioxide	PASS
Citric Acid (50%)	B-Hydroxytricarballic Acid	PASS
Cyclohexanol	2-Ethylhexyl Alcohol	PASS
Cyclohexylamine	Hexahydroaniline	PASS
Dichloromethane*	Methane Dichloride	PASS
Diesel Fuel		PASS
Diethylamine*		PASS
Dimethylacetamide		PASS
Dimethylformamide*+		PASS
Ethyl Acetate*+	Acetic Ether	PASS
Ethylene Glycol	Ethylene Alcohol	PASS

Application Guide

Chemical ⁴	Synonym	Penetration Test Result ⁵
Fire-Resistant Hydraulic Fluid		PASS
Formaldehyde (37%)	Oxymethylene	PASS
Formic Acid (100%)	Methanoic Acid	PASS
Gasoline		PASS
Heptanoic Acid (99%)		PASS
Hexane*		PASS
Hydrochloric Acid (37%)	Muriatic Acid	PASS
Hydriodic Acid (47%)		PASS
Hydrofluoric Acid (10%)	Hydrogen Fluoride (HF)	PASS
Hydrofluoric Acid (49%)	Hydrogen Fluoride (HF)	FAIL
Hydrogen Peroxide (30%)	Hydrogen Dioxide	PASS
Hydrofluosilicic Acid (25%)	Hexafluoro Silicate (2-) Dihydrogen	PASS
Isooctane	2,2,4- Trimethylpentane	PASS
Isopar	Petroleum Distillates	PASS
Isopropanol	Isopropyl Alcohol	PASS
JP4 Jet Fuel		PASS
Mercuric Sulfide	Vermillion	PASS
Mercury	Quicksilver	PASS
Mercury (II) Sulfide	Mercuric Sulfide	PASS
Methanol*	Methyl Alcohol	PASS
Methylamine	Monomethylamine	FAIL
Methyl Ethyl Ketone	2-Butanone, MEK	PASS
Methyl Formate		PASS
Methyl Hydrazine	Monomethylhydrazine	FAIL
Methyl Isoamyl Ketone (98%)	5-Methyl-2-Hexanone	PASS
Methyl Methacrylate	Methyl-Alpha-Methacrylate	FAIL
Methyl Propyl Ketone (90%)	2-Pentanone	PASS
Motor Oil, SAE 30 wt.		PASS
N-Butylamine		FAIL
Nitric Acid (35%)	Aquafortis	PASS
Nitric Acid (50%)	Aquafortis	FAIL
Nitric Acid (70%)	Aquafortis	FAIL
Nitrobenzene*+		PASS
Oleum (18-24% SO ₂)	Fuming Sulfuric Acid	FAIL
1% PCB/99% Mineral Oil		PASS
4% PCB/6% Trichlorobenzene/90% Mineral Oil		PASS
50% PCB/50% Mineral Oil		PASS
Phenol (90%)	Carbolic Acid	PASS
Phosphoric Acid (80%)	Orthophosphoric Acid	PASS
Picric Acid	Trinitrophenol	PASS
Potassium Fluoride (40%)		PASS
Potassium Hydroxide (53%)	Caustic Potash	PASS
Silicon (IV) Chloride	Silicon Tetrachloride	PASS
Sodium Aluminate (30%)	Aluminum Sodium Oxide	PASS
Sodium Chlorate (Satd. Soln.)	Chlorate of Soda	PASS
Sodium Chlorite (Satd. Soln.)		PASS
Sodium Hydroxide (50%)*+	Caustic Soda	PASS
Sodium Hypochlorite (5.5%)	Chlorine Bleach	PASS
Sodium Methylate	Sodium Methoxide	PASS
Sodium Silicate (50%)	Sodium Metasilicate	PASS
Sulfuric Acid (10%)		PASS
Sulfuric Acid (93%)*+	Hydrogen Sulfate	PASS
Sulfuric Acid (96%)	Hydrogen Sulfate	PASS
Sulfuric Acid (98%)	Hydrogen Sulfate	PASS
Sulfur Chloride	Sulfur Monochloride	FAIL
Tetrachloroethylene*	Perchloroethylene	PASS
Tetrahydrofuran*+	THF	PASS
Toluene*	Methylbenzene	PASS
Trichloroethylene	TCE	PASS
Urea (54%)	Carbamide	PASS
Xylene, Mixed Isomers	Dimethylbenzene	PASS

Heat Stress Is a Serious Hazard

Heat stress is a serious hazard to wearers of chemical protective clothing. In some cases, heat stress may be even more dangerous than the chemical hazard itself. To release heat, your body sweats, and when the sweat evaporates, your body is cooled.

Chemical-protective clothing limits sweat evaporation. Liquid splash garments based on continuous film materials, such as vinyl or rubber, have one function for the wearer — protection against accidental contact with liquid chemicals. Vapor-protective ensembles prevent sweat evaporation altogether. None of these types of chemical-protective clothing provide relief from heat stress.

Gore Offers a Solution to Heat Stress

GORE® Chemical Splash Fabric is the only product that offers chemical splash protection per NFPA 1992 while allowing sweat vapor to escape.

You may use GORE® Chemical Splash Fabric when you need protection against chemicals that are listed in the NFPA 1992 Standard, as well as other chemicals meeting the NFPA 1992 guidelines — the chemicals that pose no threat in a vapor state or chemicals that have vapor pressures low enough (< 5mm Hg at 25°C) not to pose a vapor threat. (These chemicals are color-coded Green in the *Chemical Penetration Data Table*.)

It is also appropriate to use GORE® Chemical Splash Fabric when you need protection against chemicals that are outside NFPA 1992 guidelines, and it has been determined that a certain level of vapor exposure is acceptable. NFPA Standards were developed for emergency situations, but not all exposures to hazardous chemicals are emergencies. Under certain controlled circumstances, it may be acceptable to use a garment made from GORE® Chemical Splash Fabric for challenges outside those guidelines where it has passed the penetration test. (These chemicals are color-coded Yellow in the *Chemical Penetration Data Table*.)

Each end-use situation must be evaluated for its particular risks. A chemical-by-chemical determination alone is not always sufficient to capture the various situations where chemical-protective clothing is used. Additional circumstances such as quantity and temperature, at least, need to be considered. *Always consult a trained professional in safety or industrial hygiene when making this determination.*

Footnotes

1. Penetration test procedures as specified in National Fire Protection Association (NFPA) 1992 — *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies*. These procedures are identical to those in ASTM F903, Procedure C.

2. NFPA 1992 — *Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies* — only permits certification for chemicals, or specific chemical mixtures, which do not have known or suspected carcinogenicity in specified references, or “skin” toxicity notations in the “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices” unless the chemical’s vapor pressure is less than 5mm Hg at 25°C.

3. Certification for these chemicals is permitted by NFPA 1991 — *Standard on Vapor Protective Ensembles for Hazardous Materials Emergencies*. It is the user’s responsibility to determine the level of toxicity and the proper personal protective equipment needed. If you need to protect skin from exposure to a safety or health threat based on permeation of vapors, or vapors produced by liquids, *do not use* GORE® Chemical Splash Fabric.

Safety Considerations

Before determining fitness for use in any chemical application, consult a trained professional in safety or industrial hygiene. Chemical-protective clothing made from GORE® Chemical Splash Fabric does not provide protection from all chemicals or in all conditions. The technical information set forth in this *Technical Data and Application Guide* documents laboratory performance under laboratory conditions. Testing and other results presented herein are for fabric only. Performance of any particular garment will depend on a number of factors including, but not limited to, design, seams, closures, accessories, duration of use, maintenance of garment, and proper handling.

WARNING: Do Not Use GORE® Fabric for Chemical Splash Protection for conditions of deluge or continuous chemical exposure.

GORE® Chemical Splash Fabric is a barrier to many inorganic and organic liquid challenges. It is not a barrier against all liquid chemicals. It has been tested for the chemicals documented in the *Chemical Penetration Data Table*. If your only safety requirement is to keep one or more of these liquids off your skin, chemical-protective clothing made from GORE® Chemical Splash Fabric, in conjunction with good safety training and safety practices, may be used. Test results on other liquid chemical challenges can be provided on request.

WARNING: Do Not Use GORE® Chemical Splash Fabric for any untested, unknown, or “FAILED” liquid chemical challenges.

GORE® Chemical Splash Fabric is only designed for liquid splash protection. If a vapor, or a vapor coming from a liquid, represents a safety or health hazard, *do not use* garments made from GORE® Chemical Splash Fabric. Consult a trained professional in safety or industrial hygiene when making this determination.

WARNING: Do Not Use GORE® Chemical Splash Fabric for vapor protection.

Flammable Challenges

If the chemical challenge also represents a flammable hazard, clothing ensembles made with an aramid substrate should be used instead of the polyester substrate. (See *Protection You Can Wear* brochure.)

4. *Do not use* GORE® Chemical Splash Fabric for protection against chemicals or chemical mixtures not listed. *Do not use* GORE® Chemical Splash Fabric without penetration test data directly supplied by W. L. Gore & Associates, Inc. For chemicals not included in the *Chemical Penetration Data Table*, contact W. L. Gore & Associates, Inc. Failure to comply with this warning may result in serious injury or death.

5. This data was produced independently by TRI/Environmental, Inc. in accordance with NFPA 1992. Data reports are available upon request. All tests were performed under laboratory conditions and not under conditions of actual usage. TRI/Environmental, Inc. makes no warranties or other guarantees concerning protection by this material and assumes no liability for use of this material with the chemicals tested. The user should determine the applicability of test conditions when assessing the suitability of the material for actual anticipated exposure.

Warning: No products, including garments, hoods, footwear, or gloves, can offer absolute protection, even when new, and their protective performance will decline with wear, tear, abrasion and other damage associated with use.

W. L. GORE & ASSOCIATES, INC.

Fabrics Division

105 Vieve’s Way, Elkton, MD 21922

Phone: 410.392-3600 or 800.431.GORE (4673) • Fax: 410.392.4452