

Disposable and Chemical Protective Clothing Performance and Selection Guide



Tailoring your Solution is More Cost-Effective

You wouldn't enter a NASCAR® or Formula One® race in the family minivan. But neither would you use a race car for commuting or taking the kids to practice. Choices depend on the situation; optimal performance is the result of tailoring to the task at hand.

The same principal applies to protective clothing—selections should depend on the hazards and requirements encountered in your unique work environment.

If all you have is a hammer, everything looks like a nail.

When you try to do everything with the same tool, you do nothing very well: work environments are simply too variable for a “one size fits all” approach to safety. In the real world, under-protecting is negligent, while over-protection adds cost and may compromise comfort.

At Lakeland, we believe in offering multiple fabric solutions, each with its own barrier, comfort, durability and cost levels, so that you can select the single best product for your situation. Less compromise means you're more likely to have safe and happy workers.

A solution optimized for a specific application is not only superior in performance, but is also more cost-effective because you're only paying for what you need.

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How do you determine the best fabric choice for a given work environment?

The only reliable way is performance data using the same test methods for all fabrics.

On the following page is a chart compiled from lab testing of Tyvek® and two more targeted and less expensive Lakeland disposable fabrics, all in accordance with ISO 16602, the international standard advocated by DuPont, using data published in both companies' user instructions.

The ISO 16602 standard is based upon a system of “Types” according to the type and degree of the hazard (as shown below), and Performance Classes (higher number better).

ISO 16602

TYPE 6	TYPE 5	TYPE 4	TYPE 3	TYPE 2	TYPE 1
Non-gas tight limited protection against liquid aerosol	Non-gas tight protection against airborne dry particulate chemicals	Non-gas tight protection against liquid chemical splash	Non-gas tight protection against high pressure liquid exposure or splash	Non gas-tight positive pressure suits	Gas-tight protection against chemicals, vapors and toxic particles



Disposable Fabrics Performance Data

Type 6 Liquid Aerosol and Type 5 Dry Particulate ISO 16602 Classification

Physical Property	Test Method	DuPont Tyvek ^{®**}	Lakeland SafeGard [®] SMS	Lakeland MicroMax [®] NS
Strength / Durability Test		Performance Class Range 1-6, 6 being the highest performing		
Abrasion Resistance	EN 530 (method 2)	2	2	1
Puncture Resistance	EN 863	2	1	1
Flex Cracking	ISO 7854/B	6	6	4
Trapezoidal Tear MD	ISO 9073-4	1	2	3
Trapezoidal Tear XD	ISO 9073-4	1	2	2
Tensile Strength (max. MD/XD)	ISO 13934-1	1	3	2
Burst Strength	ISO 2960	Not Disclosed	2	1
Antistat	EN 1149-5	Pass	Pass	Pass
Seam Strength	EN/ISO 13935-2	3	3	3
		> 75 N	80.5 N	88.8 N
Resistance to Liquid Penetration		Performance Class Range 1-3		
Sulfuric Acid (30%) Penetration Repellancy	EN/ISO 6530	3	3	3
		3	3	3
Sodium Hydroxide (10%) Penetration Repellancy	EN/ISO 6530	3	3	3
		3	3	3
O-xylene Penetration Repellancy	EN/ISO 6530	1	< 1	3
		1	< 1	2
Butanol-1 Penetration Repellancy	EN/ISO 6530	2	< 1	3
		1	< 1	2
Whole Garment Tests				
Type 5 Particle Aerosol Inward Leakage Test	EN/ISO 13982-2	Pass	Pass	Pass
Type 6 Low Level Spray	EN 13034	Pass	Pass	Pass
Protection Factor (whole suit)	EN 1073-2	1	1	1

* Data taken from *DuPont User Instructions for CHF5*, document L-2984, October 2010/21.

EN14126 – Protection Against Infectious Agents

Physical Property	Test Method	DuPont Tyvek ^{®***}	Lakeland SafeGard [®] SMS	Lakeland MicroMax [®] NS
		Performance Class Range 1-3 or 1-6		
Protection against Blood and Body Fluids	ISO 16604:2004	< 1	Not Recommended	6
Protection against Biologically Contaminated Aerosols	ISO 22611:2003	1	Not Recommended	3 (3 is maximum)
Protection against Dry Microbial Penetration	ISO 22612:2005	1	Not Recommended	3 (3 is maximum)
Protection against Mechanical Contact with Substances Containing Contaminated Liquids	EN 14126:2003 Annex A	1	Not Recommended	6

** Data taken from *DuPont User Instructions for CAH5*, document L-2984, January 2009/15.

Analysis

Strength Tests: Of the ten tests in this category, the two Lakeland fabrics shown meet or exceed the performance of Tyvek® in more cases than Tyvek® exceeds them. In only one test- puncture resistance- does Tyvek® exceed both Lakeland solutions. And after a puncture occurs what matters most is resistance against tearing- where the Lakeland fabrics have a significant advantage. Tyvek® outperforms MicroMax® NS in abrasion, but does that alone justify the large price premium?

Liquid Penetration Tests: Comparing results for the four common chemicals for which DuPont publishes data under ISO 16602, sulfuric acid (30%), sodium hydroxide (10%), O-xylene, and Butanol-1, MicroMax® NS provides a better barrier than Tyvek®. Safegard® SMS cannot be recommended for two of the chemicals.

Whole Garment Tests: All three fabrics score equally, including against aerosol particles.

Protection Against Infectious Agents: In all four tests against biological agents, Lakeland MicroMax® NS is significantly more effective, performing at the highest possible class in each test. Tyvek® did not meet the minimum performance threshold in protection against blood and body fluids, and only met the minimum classification in the other tests.

Comfort and Breathability: As the summary chart below shows, SafeGard® SMS provides un-matched air permeability and strength. It is a superior choice in hot, humid environments where maximum barrier protection is not required.

MicroMax® NS is very similar in breathability to Tyvek®, with an MVTR (Moisture Vapor Transfer Rate) that is a little better at 119 vs. 111, and Air Permeability that is a little lower at <.5 vs 3.3. (Considering that a typical cotton T-shirt has a cfm of 180, the difference between <.5 and 3.3 cfm is almost meaningless in terms of breathability.)

Summarizing: The data shows that MicroMax® NS provides better overall barrier than Tyvek®, and is essentially identical in terms of breathability. It would be the better choice in most situations even if it cost as much as Tyvek®.

Primary Decision Considerations

So how does the data guide actual product selection?

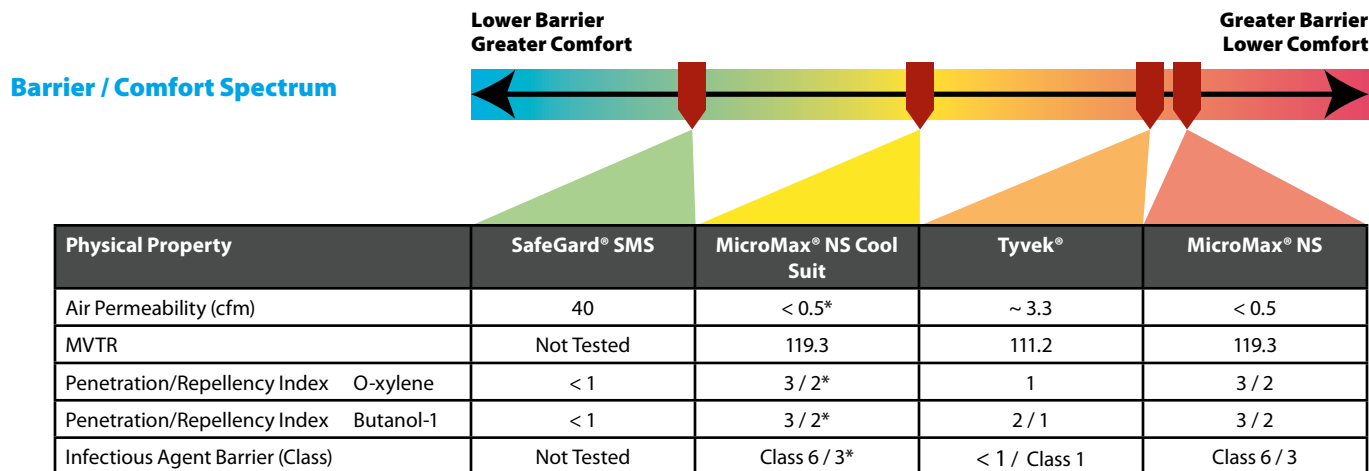
One of the most critical considerations in evaluating fabric performance is the inevitable trade-off between barrier protection and comfort. Protection in the real world is also dependent on the proper wearing of a garment: The less comfortable, the more likely it is to be worn improperly.

While DuPont promotes Tyvek® as a one-size-fits-all product, Lakeland’s approach is to offer multiple tailored solutions to better cover the entire performance spectrum. This allows the user to more precisely target for particular needs, as the “Barrier/Comfort Spectrum” below illustrates.

The Freedom of Choices

SafeGard® SMS and MicroMax® NS “bracket” the performance of Tyvek®: SafeGard® SMS is more comfortable but offers less barrier, while MicroMax® NS offers better barrier with similar breathability to Tyvek®, and far superior protection against infectious agents. It is the clear choice for environments where chemical and infectious hazards are the primary concern, or if blood-borne pathogens may be encountered.

If you don’t want to compromise on either comfort or barrier, you can have the best of both worlds with the MicroMax® CoolSuit - which combines the maximum barrier of the MicroMax® NS coverall with the superior comfort of SafeGard® SMS. By placing SafeGard® fabric in the upper back panel of the garment, away from the chemical threat, the garment is far more comfortable. See the next page for even more choices.



*With exception of SMS back panel

MVTR = Moisture Vapor Transmission Rate: grams/hour/square meter @ 100° Fahrenheit

Data taken from Performance Data Chart on page 2, except for Air Permeability and MVTR data from independent testing

Lakeland Disposable Clothing Applications Guide

Lakeland's application targeting goes even deeper than the three examples above (SafeGard® SMS, MicroMax® NS, and MicroMax® Cool Suit), with the basic ZoneGard®, three variations of MicroMax®, and two of MicroMax® Cool Suit. Additionally, we offer two

Pyrolon® fabrics that combine comfort, barrier, and FR protection. The following two charts will help you to find the optimal protection and comfort for specific hazards.

Lakeland Fabrics	Relative Performance										Hazards / Applications							% Price Difference vs. Tyvek®*			
	Comfort	Barrier	Durability	FR	Dirt, Oil & Grease	Hazardous Dry Particulate	Non-hazardous Liquids	Welding, Cutting & Grinding	Non-hazardous Liquids - Aerosols	Paint & Hazardous Liquids - Spray	Dry Particulate - Aerosols	Flammable Environments	Low Exposure, Low Risk Chemical Splash	Clean Rooms	Bloodborne Pathogens	Waste Water Treatment	Chemical Flash Fire				
ZoneGard®	9	2	2	N/A	●		●													-70%	
SafeGard® SMS	8	3	7	N/A	●	●	●		●	●	●										-56%
MicroMax®	3	9	7	N/A	●	●	●		●	●	●		●	●	●	●					-29%
MicroMax® NS	3	9	6	N/A	●	●	●		●	●	●		●	●	●	●					-38%
MicroMax® NS Cool Suit	5	8	6	N/A	●	●	●		●	●	●										-25%
MicroMax® 3P	3	10	7	N/A	●	●	●		●	●	●		●	●	●	●					-32%
MicroMax® 3P Cool Suit	4	9	7	N/A	●	●	●		●	●	●										-25%
Pyrolon® Plus 2**	7	3	7	10	●	●		●	●	●	●									●	+19%
Pyrolon® XT**	6	4	8	9	●	●	●	●	●	●	●									●	+85%

** Must be worn over thermally protective clothing, such as fire retardant cottons, aramids or modacrylics.

Relative ratings: 1 is lowest, 10 highest, based on EN/ISO test results, and relative differences between fabrics
*Price to distributors for standard coverall with hood and elastic wrists and ankles.

ZoneGard®: 25% heavier spunbonded polypropylene than most competitive offerings for added durability while preserving maximum comfort. Our entry level garment for dirty work.

SafeGard® SMS: Provides a high degree of comfort and durability while offering good barrier to dry particles and liquid hazards.

MicroMax® NS: Microporous film offers excellent barrier to dry particles, aerosols, and liquids; a solid all around performer. MicroMax® fabrics are the clear choice if infectious agents such as blood-borne pathogens may be encountered.

MicroMax®: Same protection as MicroMax® NS with the addition of a rip-stop scrim for added durability.

MicroMax® Cool Suit: The best of both worlds (comfort and barrier): More comfort in warm environments, due to a very breathable back panel. A cool solution when the hazard is mostly in front.

MicroMax® 3P: This non-porous fabric offers maximum protection short of a full chemical suit and at a much lower cost.

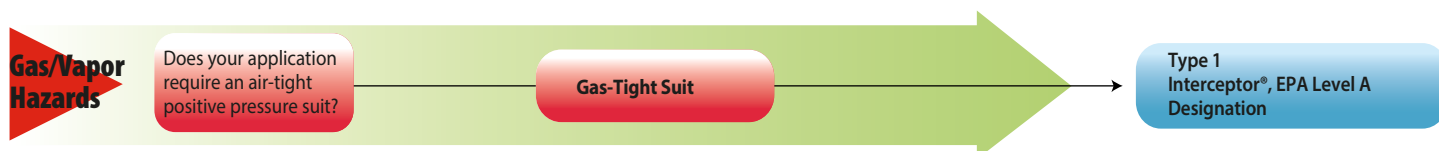
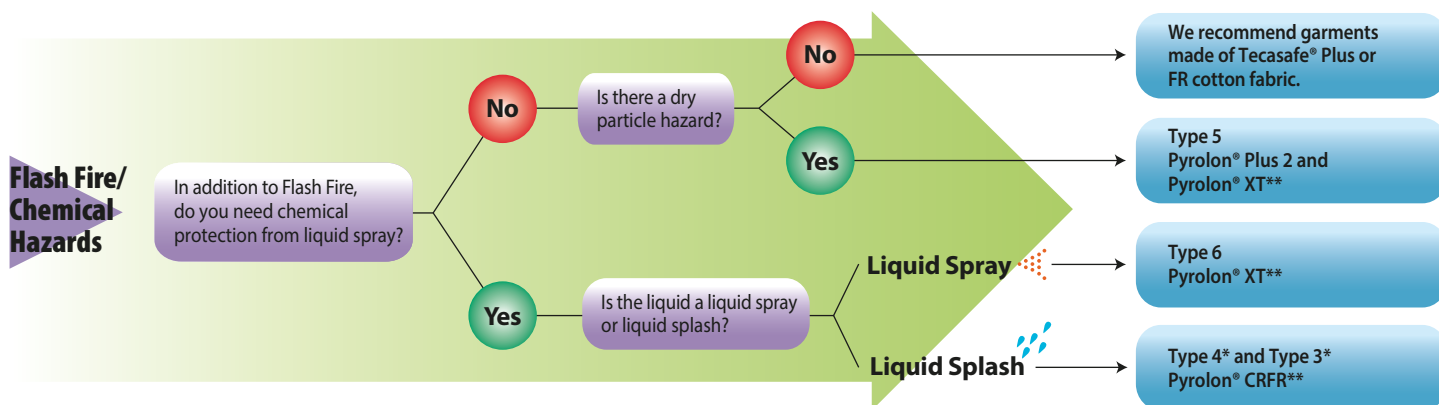
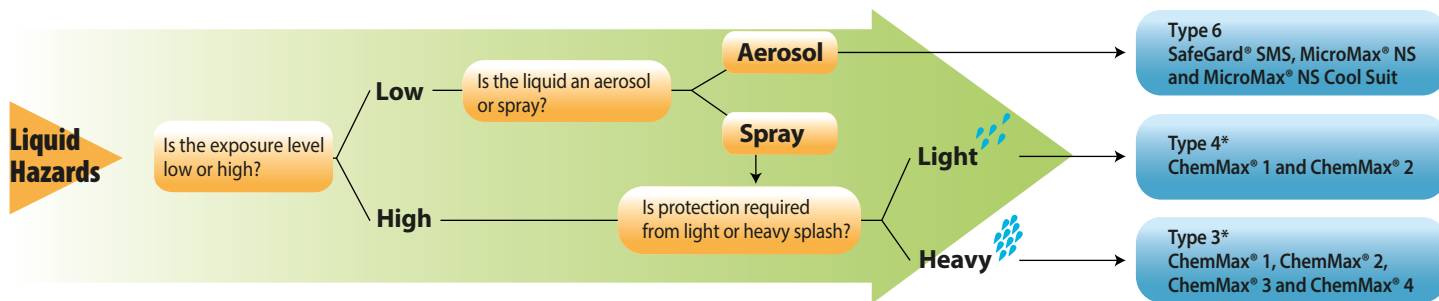
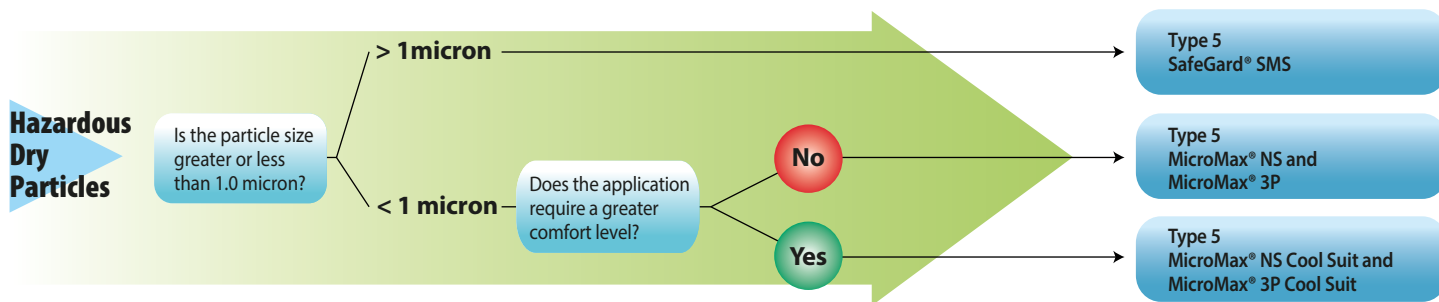
MicroMax® 3P Cool Suit: The excellent barrier of 3P, but with a very breathable upper back for coolness: again, the best of both worlds!

Pyrolon® Plus 2: Flame resistance along with moderate general protection.

Pyrolon® XT: Flame resistance with more durability and protection against liquids and aerosols.



Lakeland Solutions Selection Guide



* For details on Type 4 and Type 3 solutions, contact your Lakeland Sales Representative or call Customer Service at 800-645-9291

** Must be worn over thermally protective clothing, such as fire retardant cottons, aramids or modacrylics.

This is a general guide to selecting garments only, and should not be used as the definitive or only tool in garment selection. It is the responsibility of the user to select garments or products which are appropriate for each intended use and which meet all specified government and industry standards.

Chemical Fabric Selection Guide

Selecting the appropriate chemical suit is a critical and challenging task: the health and well being of a company's employees hangs in the balance. So does productivity and morale... as well as potential liability in the event of an accident.

With so much on the line, and so many different types of hazards and levels of protection available, it can be a daunting task to make the best and most cost-effective choice for a given work environment.

The accepted industry standard ASTM F1001 list can be helpful for comparing the relative barrier capabilities of various suppliers' products. All credible suppliers of chemical apparel provide permeation data for their fabrics for this list of 21 chemicals commonly found in industry, each representing their respective CAS classes.

Additional considerations are strength and durability, and the types of seam construction, since the seam often presents the path of least resistance into a garment.

Because seam construction has a large impact on cost, care must be taken not to let a desire for cost savings potentially compromise safety. For example, a serged seam is far less expensive than bound or sealed, but may negate the protective barrier of a suit whose fabric is otherwise appropriate for the environment. That is cost-effective only until someone is injured.

The chart below summarizes strength and then performance test data against the ASTM F1001 list for the range of Chemical suit fabrics Lakeland offers, shown next to the comparable suit from DuPont. A red or green cell represents a permeation time for a chemical in excess of 480 minutes, the maximum exposure time that is tested for. So the more cells in red or green, the better.

As you can see, at every level the Lakeland chemical suit performs at least as well as the comparable DuPont offering. But in every case, the Lakeland suit costs less. In fact, ChemMax® 4 and ChemMax® 2 with sealed seams also cost less than the DuPont offering at an entire performance level lower. Moving up one level of protection *and* saving money? Now *that* is cost-effective!

Comparative Chemical Fabric Performance Data

(Data as published by Lakeland and DuPont)

	Test Method	ChemMax®1	Tychem® QC	ChemMax®2	Tychem® SL	ChemMax®3	Tychem® CPF3	ChemMax®4	Tychem® BR/LV	Interceptor®	Tychem® TK
Tychem® Cost vs. ChemMax®*			+ 23-41%		+ 7-21%		+ 37%		+ 11%		+ 46%
Basis Weight	ASTM D3776-90 & D751	2.29 oz/y ²	2.5 oz/y ²	4.3 oz/y ²	3.5 oz/y ²	4.5 oz/y ²	4.4 oz/y ²	6.5 oz/y ²	7.4 oz/y ²	9.0 oz/y ²	11.4 oz/y ²
Thickness	D1777-75	15 mil	10 mil	11 mil	13 mil	16 mil	17.5 mil	24 mil	18 mil	25 mil	25 mil
Ball Burst	ASTM D3787	25 lbf	Not Avail.	48 lbf	Not Avail.	55 lbf	68 lbf	141 lbf	79 lbf	173 lbf	205 lbf
Grab Tensile MD	ASTM	35 lbf	41 lbf	47 lbf	41 lbf	59 lbf	Not Avail.	112 lbf	84 lbf	216 lbf	164 lbf
Grab Tensile XD	D5034-90	27 lbf	47 lbf	34 lbf	50 lbf	42 lbf	Not Avail.	90 lbf	83 lbf	165 lbf	159 lbf
Trapezoidal Tear MD	ASTM D5733	14 lbf	7 lbf	30 lbf	9 lbf	26 lbf	21 lbf	52 lbf	26 lbf	44 lbf	69 lbf
Trapezoidal Tear XD		14 lbf	5 lbf	13 lbf	8 lbf	20 lbf	30 lbf	37 lbf	22 lbf	58 lbf	69 lbf
ASTM F1001 Permeation Time: Red or Green denotes >480 minutes											
Acetone											
Acetonitrile											
Anhydrous Ammonia											
1,3 Butadiene											
Carbon Disulfide											
Chlorine											
Dichloromethane											
Diethylamine											
Dimethyl Formamide											
Ethyl Acetate											
Ethylene Oxide											
n-Hexane											
Hydrogen Chloride											
Methanol											
Methyl Chloride											
Nitrobenzene											
Sodium Hydroxide											
Sulfuric Acid											
Tetrachloroethylene											
Tetrahydrofuran											
Toluene											

*Price to distributor for standard suit with elastic hood, wrists and ankles. Where a range, depends on type of seam. Level A for Interceptor® and Tychem® TK

Lakeland Chemical Clothing Applications Guide

The chart below can help you to select the Lakeland Chemical suit most appropriate to your work environment.

The first column indicates which of our range of suits you could consider for the type of hazard listed. Lakeland's Pyrolon® CRFR- the most versatile suit in the business- is also shown: Chemical and FR in the same suit!

This appraisal is only meant as an approximate relative guide, not a recommendation by Lakeland for your specific work environment and its hazards. As always, it is the responsibility of the purchaser and user to select protective clothing that is appropriate to the level and type of exposure, as determined by trained and qualified safety professionals in accordance with OSHA and EPA rules and regulations. Please see the Lakeland Disposable and Chemical Clothing Buyers Guide for details.

Product Applications	General Protection			Aerosol/Spray			Chemical Splash			Hazmat			Critical Environment / Biohazard					
	Dirt, Oil and Grease	Hazardous Dry Particulate	Non-Hazardous Liquids	Welding, Cutting and Grinding	Non-Hazardous Liquids	Paint, Hazardous Liquids	Dry Particles	Flammable Environment	Low Exposure, Low Risk	High Exposure, High Risk	Flammable Liquids	Hazmat, NFPA Certified	Hazmat, Maritime	Hazmat, Non Certified	Paint Booth	Bloodborne Pathogens	Waste Water Treatment	Flash Fire Chemical
Pyrolon® CRFR*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
ChemMax® 1		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
ChemMax® 2				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
ChemMax® 3					•			•	•	•	•	•	•	•	•	•	•	•
ChemMax® 4								•	•	•	•	•	•	•	•	•	•	•
Interceptor®**								•	•	•	•	•	•	•	•	•	•	•

* Must be worn over thermally protective clothing, such as fire retardant cottons, aramids or mono acrylics.
 ** Interceptor meets the requirements of NFPA 1991 limited flash fire for escape only option.

Pyrolon® CRFR: A fabric unique to Lakeland that provides Chemical and Flame Resistance, all rolled into one garment. Pyrolon® CRFR provides both Chemical and Flame Resistance and excellent hold out for gasoline, crude oil and many common chemicals found in the Petrochem market. Pyrolon® CRFR is self-extinguishing, won't melt or drip, and meets the NFPA 2113 requirements for section 5.1.9. It is designed to be worn over woven thermally protective coveralls.

ChemMax® 1: This durable and economical light-weight fabric is constructed with a unique polyethylene barrier film and a continuous filament polypropylene nonwoven. ChemMax® 1 offers good hold out on many acids and bases, and is a good all around choice for general manufacturing, environmental clean up or chemical handling.

ChemMax® 2: This fabric features Dow Saranex 23P film (same as Tychem SL) on two layers of a unique bi-component spunbond nonwoven substrate. ChemMax® 2 offers moderate to high chemical resistance with unparalleled strength and softness. It is a very good choice for chemical mixing and handling, environmental clean up, and hazardous materials remediation and response.

ChemMax® 3: This fabric features a multi-layer film laminated to a heavy polypropylene nonwoven for increased strength and durability. The barrier film is significantly softer than other products on the market, resulting in a quieter, more comfortable garment. It has high chemical resistance and is an excellent choice for Petrochemical and Chemical plants. ChemMax® 3 has also been tested for Chemical Warfare Agents and is an ideal choice for Emergency Response and Homeland Security operations.

ChemMax® 4: This fabric features a 6 layer protective barrier that will stand up to the toughest of hazardous chemical environments. ChemMax® 4 offers excellent chemical resistance with a soft, flexible feel not found in competitive fabrics. This garment is a superior choice for Hazmat operations, Petrochemical and Chemical plants and anywhere operations require a high performance, durable, chemical protective garment.

Interceptor®: This fabric is the apex of Lakeland Industries' chemical protective clothing line. The Interceptor® comes in both NFPA 1991 and CE type 1 Level A configurations along with non-Level A encapsulating and non-encapsulating configurations. When needing protection against extreme chemical and gas/vapor hazards, Interceptor® offers the ultimate margin of safety.

Why Choose Lakeland?



World's Largest Manufacturer of Protective Clothing

As the largest manufacturer, we are better able to deliver the best, most innovative Protective Clothing products and fabric choices available anywhere on earth... and we're stepping on the gas!

Know the Maker- We Manufacture our own Products

Lakeland protects people. It is our core business. Unlike our competitors, we don't use contractors to make our garments. We make them ourselves, so we have maximum control over quality and delivery. We design the fabric, we make the garment, we inspect it, we ship it. And you know who to call.

Broadest Range of Products and Fabrics

From Disposables to Chemical, Reflective to Hand and Arm, Flame/Arc Flash Resistant and Fire Service/EMS, no one else in the Protective Apparel Industry can offer such comprehensive product and fabric choices- or the expertise to guide you. All under one roof.

Award-Winning Service

In recent months, two of our largest customers have both named us best in customer service and support out of all their many suppliers.

Investing for Growth – To Serve You Better

We're doubling our sales and support personnel, increasing R&D and product development efforts, upgrading our systems, and streamlining our operations. You will see the difference.

World-Wide Presence and Growth

Lakeland International is growing rapidly, with production and sales operations in more than 40 countries. So we can bring you the best in fabrics and innovations the world has to offer, and technical expertise for wherever you do business.

Let us help you protect your people, and grow with us!



Please contact Lakeland or your local Lakeland distributor, who will be pleased to help you analyze the hazards of your work environment and select the most appropriate and cost-effective solution.



Protect Your People™

Toll Free: 800-645-9291

Email: info@lakeland.com

www.lakeland.com

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