Protect Your People®

Guide to Apparel for Protection Against Dust and Chemical Hazards in the Mining Industry

Lakeland® | SafeGard® | MicroMax® | ChemMax® | PyroIon® | Interceptor®

Hazards in the Mining Industry

A range of operations result in multiple hazards:

- Dust inhalation causing MDLD (Mining Dust Lung Disease)
- Burns and skin cancers from UV exposure in open cast mines
- Hearing damage from noisy machinery and operations
- Heat stress–mining often occurs in extreme conditions
- Muscular problems from whole body vibration when operating machinery
- Health hazards of chemicals used in a range of processes to extract minerals from ore

Choice of protective apparel plays an important role in keeping people safe, especially in preventing dust inhalation, contact with chemicals, and managing heat stress.

Protect Your People®

The Most Hazardous Industry in the World?

Mining supplies the world with vital minerals and millions of jobs, playing an important and growing role in the global economy.

But it is also one of the most dangerous for workers with multiple hazards, often in extreme conditions. Estimates suggest, whilst representing 1% of the global workforce it accounts for 8% of workplace fatalities, a high proportion occurring in countries and regions with less developed safety cultures and an absence of mandatory safety standards.

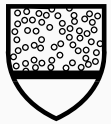
The use of PPE certified to recognized standards and an established safety culture saves lives and reduces lost time incidents.

Lakeland is one of the world's leading manufacturersof protective apparel, with many products applicable to mining hazards and fully certified to global PPE standards including EN, ISO, NFPA and others.

Our Mining Industry Clothing Guide indicates basic garment features and includes a selection chart to help choose the best apparel for the job.

Dust Inhalation	Chemical Hazards	Heat Stress
MDLD (Mining Dust Lung Disease) can take several forms, including: • Silicosis (from silica dust inhalation) • Coal Workers' Pneumoconiosis (CWP) • Mixed Dust Pneumoconiosis (MDP) • Chronic Obstructive Pulmonary Disease (COPD) • Asbestosis • Cancers Protective apparel prevents secondary inhalation - where a worker's own clothing, skin or hair becomes contaminated, and can be inhaled later - not only by them, but by friends and family. Protective apparel is normally CE Type 5/OSHA Level C. However, in some circumstances (high dust concentration or highly toxic dust) higher level protection, including a Type 1 gas-tight suit, mightbe appropriate.	A range of hazardous chemicals may be in use: • "ANFO" Explosive is a mix of 95% ammonia nitrate and 6% fuel oil. Ammonia nitrate is harmful, will irritate and burn skin and eyes and may cause methoglobinemia. It's flammability means protective apparel with FR properties, such as Pyrolon™, should be considered. • Maintenance of machinery uses oils, solvents and cleaning fluids that may have harmful contents resulting in skin irritation, desensitisation or worse. • Numerous chemicals are used to extract minerals from ore in various processes including leaching, extraction, refining and flotation. Protective apparel used is often CE Types 1, 3, 4 or 6 / OSHA levels A,B or C depending on the relative chemical hazard and toxicity, and likely contact type (vapor or liquid, heavy, light or aerosol spray or splash).	Heat stress resulting from working in hot environments is a recognised hazard and ranges from the first stage of heat cramps, through exhaustion (cramps, dizziness, headache, nausea,fainting) and finally heat stroke, which can result in seizures and loss of consciousness. Whilst the primary guard against heat stress lies in managing work practices (shorter work periods, more rest, regular rehydration etc.), and monitoring of staff (consider technology such as Bodytrack [www.bodytrak.co]), choice of protective apparel can contributeto reducing the risk of heat stress. Where possible choose apparel of an appropriate size that: • Is breathable (if protection required allows) • Features design elements that enable breathability (such as Cool Suits®) • Is ergonomically designed to fit well and allow freedom of movement.

'PPE certified to recognized standards and an established safety culture saves lives and reduces lost time incidents'

	Dust & Light Aerosol Spray Protection				Liquid Chemical Protection				Gas & Vapor Protection	
USA	OSHA Level C				OSHA Level B				OSHA Level A	
EU	EN 13034		EN 13982		EN 14605				EN 943	
		**Type 6** Light Aerosol Spray		**Type 5** Hazardous Dusts		**Type 3** Strong Jet Spray		**Type 4** Liquid Sprays		**Type 1** Gases, Vapors
General Features	• Coverall with hood • Breathable or semi-breathable fabrics • Stitched seams				• Coverall with hood • Chemical barrier fabrics • Sealed (taped) seams & sealable front fastening				• Fully sealed, gas-tight encapsulation coverall • Internal SCBA or remote air supply	
	For Lakeland options see page 4				*For Lakeland options see page 5*					

Protective apparel is vital for several types of hazards in the mining industry.

PPE Certification

Statistics suggest less regulated safety standards results in more mining accidents and fatalities.

Certification to standards requires PPE to undergo strict testing to ensure minimum performance requirements are met.

Non-certified PPE may not have been tested at all!

So how do you know it will protect?

- EN standards identify 5 "Types" of clothing to protect against particles, liquid and gases.
- US OSHA defines 4 levels of protection for protective apparel.

Protection against hazardous dusts and light liquid spray

Type 5
EN 13982
Hazardous Dusts

Type 6
EN 13034
Light Aerosol Spray

OSHA Protection Level C





SafeGard® GP	SafeGard® GP *(Orange)*	MicroMax® NS	MicroMax® NS *(White/Orange)*	MicroMax® NS Cool Suit
• Lightweight • Breathable	• Orange with reflective tape • Lightweight • Breathable	• Lightweight • Good liquid repellency • High MTVR	• White/orange with reflective tape • Lightweight • High MTVR	• *"Breathability through design"* • MicroMax® protection with SafeGard™ comfort • Two-tone design with reflective trim for visibility • Dust and aerosol spray protection
Serged seams	Serged seams	Serged/bound seam options	Serged seams	Bound seams

Protection against splashes and strong sprays of liquid chemicals

Protection against gases & vapors

ChemMax.1	ChemMax.2	ChemMax.3	ChemMax.4 Plus
• Lightweight & flexible • High Chemical barrier	• Saranex barrier fabric • High chemical barrier	• Mutli-layer high barrier fabric • Soft & flexible • High chemical barrier	• Multi-layer high barrier fabric • Tough & durable • High chemical barrier
Stitched & taped seams	Stitched & taped seams	Stitched & taped seams	Stitched & taped seams

Type 3
EN 14605
Strong Jet Spray

Type 4
EN 13034
Liquid Sprays

OSHA Protection Level B

Interceptor.Plus
• High barrier, fully encapsulating gastight suit with options for wearing SCBA inside or outside
Stitched & Double taped

Type 1
EN 943
Gas & Vapor Protection

OSHA Protection Level A

Chemical protection with flame resistant (FR) properties

In many applications there is a requirement for chemical, flame, and heat protection at the same time, so chemical protective clothing must be worn over Primary FR clothing.

In this case, standard protective clothing cannot be used; it is based on polymers that will ignite, burn, and ultimately undermine FR protection.

Pyrolon™ uses unique fabric that does not ignite and burn, thus providing the required chemical protection without compromising flame and heat protection.

However, Pyrolon™ garments are designed be worn OVER primary FR workwear and will not provide protection against flames and heat when worn independently.

As well as chemical protection standards, Pyrolon™ garments are certified to standard EN 14116 (Index 1) for Secondary FR Workwear.

Pyrolon® Plus 2	Pyrolon® XT
• Breathable • Certified to EN 14116	• Breathable • Strengthening scrim • Certified to EN 14116
Serged seams	Serged seams

Type 5
EN 13982
Hazardous Dusts

Type 6
EN 13034
Light Aerosol Spray

OSHA Protection Level C

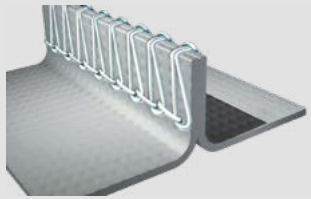
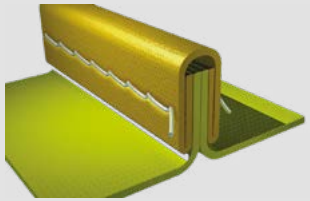
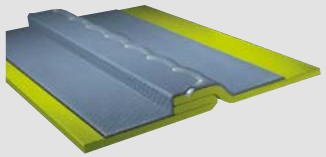
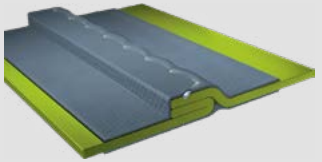
Pyrolon® CRFR	Pyrolon® CBFR
• Chemical barrier fabric • Certified to EN 14116	• Chemical high barrier fabric • Certified to EN 14116 & EN 11612
Stitched & taped seams	Stitched & taped seams

Type 3
EN 14605
Strong Jet Spray

Type 4
EN 13034
Liquid Sprays

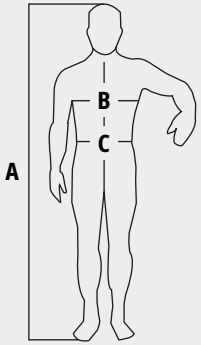
OSHA Protection Level B

Seam Types

Serged (Stitched)	Bound	Stitched & Taped	Stitched & Double Taped
			
• Protects against dust and light liquid/low hazard chemical splash and sprays	• Seam is encased with a strip of additional material • Improves strength and particle repellency compared with a standard serged seam	• Seam is overtaped with an impervious film after stitching • Full seal • Protects against chemical splash and stronger jet sprays	• Seam is overtaped on both sides after stitching • Tougher, stronger, and more secure seal • Protects against high hazards and vaporous/ gaseous chemicals
Suitable only for CE Type 5 & 6, OSHA Level C clothing	Suitable only for CE Type 5 & 6, OSHA Level C clothing	Suitable for CE Types 1-4, OSHA Level B clothing	Suitable for CE Type 1, OSHA Level A gas-tight suits

Garment Sizes

- Most garments are available in sizes **S** to **3XL**.
- All CE certified garments are sized to fit the body height (A), chest (B), and waist (C) of the wearer according to the table below.
- Body Sizes in cm



	A	B	C
SM	164-170	84-92	82-88
MD	170-176	92-100	88-94
LG	176-182	100-108	94-100
XL	182-188	108-116	100-106
2X	189-194	116-124	106-112
3X	194-200	124-132	112-114

EN 1149-5

- Certification to the anti-static Standard EN 1149-5 is indicated by this pictogram on the garment label.
- All Lakeland CE Certified protective clothing except Interceptor® Plus is certified as anti-static.

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Lakeland Industries
1525 Perimeter Parkway NW
Suite 325
Huntsville, AL 35806

Phone: 1-256-350-3873
Toll Free: 1-800-645-9291

Customer Service: info@lakeland.com

Europe: 44-1430-478140
Canada: 519-757-0700
Toll Free: 800-489-9131
Argentina: 5411-4767-9484
Chile: 562-29980545
Uruguay: 5411147679484
Asia-Pacific: 86-10-64379226
Australia: 61-0-437075686
India: 91-120-4249261 / 62

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The Importance of Seam Type

Construction of garments is at least as important as the protective properties of the fabric.

Serged (or stitched) seams are acceptable for low hazard chemicals and light splashes and sprays (Type 5 & 6 protection). However, they feature stitch holes through which a liquid or dust can penetrate.

For Type 3 to 1 protection and for preventing ingress of more dangerous chemicals as well as heavier sprays and splashes, sealed seams are required.

Anti-static Requirements

Explosive or flammable atmospheres require garments that do not generate Electrostatic Discharge (ESD) ATEX regulations exclude certification of protective clothing, but require that it should meet the requirements of standard EN 1149-5.

This ensures fabric resistance is low enough to allow harmless dissipation of a static charge. All garments listed are certified to EN 1149 so are suitable for ATEX zones subject to a suitable risk assessment.

Selection Chart for Mining Industry Applications

Process Type	Chemical/ Hazard	Related Applications	Concentration	CE Type 5 & 6 Protection OSHA Level C					CE Type 3 & 4 Protection OSHA Level B				CE Type 1 OSHA Level A	Chemical Protection w FR*2 Type 5 & 6, Level C		Chemical Protection w FR*2 Type 3 & 4, Level B	
				SafeGard™		MicroMax®			ChemMax®				Interceptor™	Pyrolon™			
				GP	GP Orange	NS	NS White/Orange	NS Cool Suit	1	2	3	4 Plus	Plus	Plus 2	XT	CRFR	CBFR
Misc.	Widespread dust	Generated by a range		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Blasting	*ANFO*	94% Ammonia Nitrate, 6% Fuel Oil. Used as a bulk explosive.														●	●
Machinery	Silica dust	Exposure common in many mining processes including cutting, blasting, and machinery maintenance.		●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Oil, lubricants, & fuels	Commonly used in many processes and applications.				●	●	●	●	●	●	●	●			●	●
	Epoxy resins	Commonly used in machinery maintenance.							●	●	●	●	●			●	●
Solvent Extraction Refining Leaching Flotation Etc.	Sodium Cyanide CAS:143-33-9	White crystalline powder used to separate gold from ore during leaching. Produces hydrogen cyanide gas.	35%						●	●	●	●	●			●	●
			Saturated						●	●		●	●			●	●
	Sulphuric Acid CAS: 7664-93-9	Copper mining. Used in electrolysis to leach copper from copper oxide minerals.	30%						●	●	●	●	●			●	●
			96-98%						●	●	●	●	●			●	●
	Xanthates*4	Used in "Flotation process" to separate small amounts of minerals from ore.							●	●	●	●	●			●	●
	Chlorine CAS: 7782-50-5	Used in electrolyte refining of gold.	99% (gas)							●	●	●	●				●
	Nitric Acid CAS: 7696-37-2	Used in production of ammonium nitrate for ANFO.	70%						●	●	●	●	●			●	●
			90%						●	●	●	●	●			●	●
			99%						●	●	●	●	●			●	●
	Lead Nitrate CAS: 10099-74-8	Organic salt of nitric acid & lead. Used to increase the spread of gold dissolution during leaching (produces the use of sodium cyanide).	70%						●	●	●	●	●			●	●
			90%						●	●	●	●	●			●	●
			99%						●	●	●	●	●			●	●
	Hydrochloric Acid *Hydrogen Chloride* CAS: 7647-01-0	Used in ore processing, extraction, separation, and purification.	99% (gas)						●	●	●	●	●			●	●
	Sodium Hydroxide CAS: 1310-73-2	Used in ore processing and in purification of mine-water.	50%						●	●	●	●	●			●	●
			Saturated										●				
	Hydrogen Peroxide CAS: 7722-84-1	Used to extract gold from used electronics.	50%						●	●	●	●	●			●	●
			70%						●	●	●	●	●			●	●
	Copper Sulphate CAS: 7758-98-7	Used as an activator in flotation process for extraction of lead, zinc, cobalt, and gold.							●	●	●	●	●			●	●
Seam Type: **ST** = Serged (stitched), **B** = Bound, **T** = Stitched & Taped, **DT** = Stitched & Double-taped				ST	ST	ST	ST	B	T	T	T	T	DT	ST	ST	T	T

KEY	
●	●
Recommended	Option (May be suitable)

*1	Most dusts are hazardous if inhaled. However, protective clothing should be worn to prevent contamination of the wearers' skin, hair, and clothing to avoid subsequent secondary inhalation.
*2	Pyrolon™ garments are classed as "Secondary FR Workwear." They can be worn OVER primary FR workwear without compromising FR protection. However, they will not provide FR protection when worn independently.
*3	Garments are certified to the anti-static standard EN 1149-5 indicating surface resistance is sufficiently low to allow dissipation of a static charge without creating an electrostatic spark. This requires enabling a route to earth for the charge (contact Lakeland for more information).
*4	Safegard™ GP Orange, MicroMax® NS white/orange and the MicroMax NS Cool Suits white/orange feature silber reflective strip to increase visibility in dim areas.

Recommendations are for general guidance only. No guarantee of protection is intended or should be interpreted for any individual or specific application. A risk assessment by qualified safety personnel should always be conducted before final selection and use of a garment in any hazardous area.

Options for chemical protection are based on existing chemical permeation data or on Permasure® Toxicity modeling. Contact Lakeland for more information.