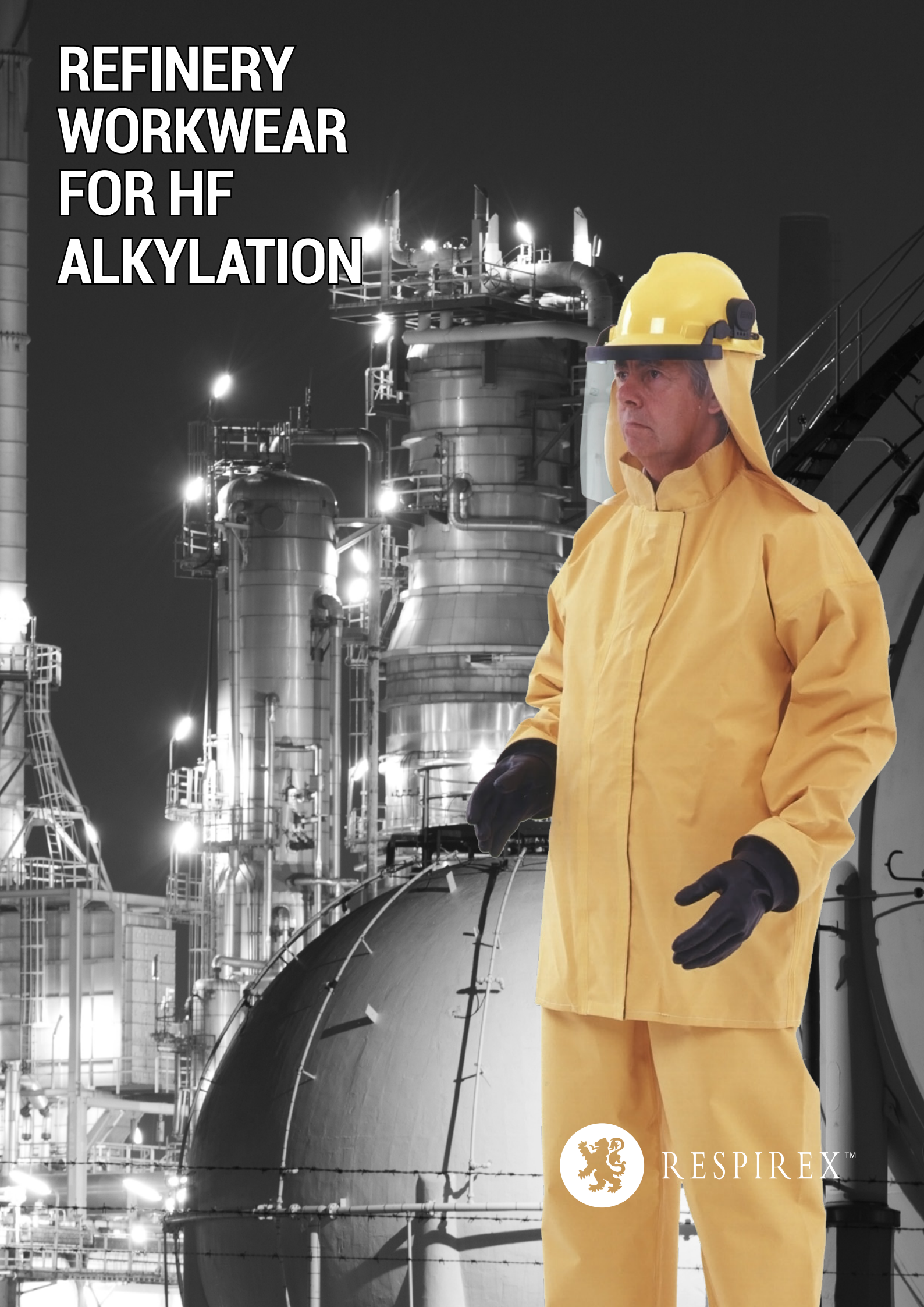
REFINERY WORKWEAR FOR HF ALKYLATION



RESPIREX™

REFINERY WORKWEAR FOR HF ALKYLATION

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About Respirex

Respirex are a world leading supplier of personal protective solutions, specialising in the design and manufacture of high-performance chemical and respiratory protective clothing.

We are unique in offering a complete service that includes standard or tailored equipment solutions combined with unrivalled training, aftercare and support. Our in house testing laboratory is UKAS approved for chemical permeation testing to EN 374-3, EN ISO 6529 and ASTM 739, and continually tests the fabrics and seams used in our clothing to ensure our equipment's performance.

Founded in 1957, Respirex has manufactured protective clothing for the petrochemical industry since the early 1980's, and boasts an enviable list of blue-chip international customers that have come to depend on our products and service.

HF REFINERY WORKWEAR

CLASS A, TWO-PIECE SUIT

To EN 14605 (Type 4) for chemical protective clothing

TYPE 4 JACKET

Jacket in yellow neoprene with mandarin style collar and Nylon zip, fitted from throat centre to waist with plain inner zip flap and single outer zip flap with hook & loop closure. Soft cuffs and cones with optional neoprene gloves. Other cuff options available.

For full protection, the jacket and trousers should be worn with an appropriate helmet and neck protection, gloves and safety boots (see pages 8 and 9).

Sizes:	S, M, L, XL, XXL, XXXL
Product Codes:	
Without gloves	JKT019/17
With gloves	JKT021/17

RESPIREX TYPE 4 TROUSERS

Bib-Trousers in Yellow Neoprene with red webbing braces and buckles at the front. Shown with plain hem legs with hook & loop securing strips. Other ankle options available.

Sizes:	S, M, L, XL, XXL, XXXL
Product Codes:	
Plain hem legs	BTRS001/17
Elasticated legs & stirrups	BTRS002/17

Note: Jacket and trousers individually meet Type 7, but meet Type 4 when worn in combination

CLASS B, ONE-PIECE SUIT

To EN 14605 (Type 4) for chemical protective clothing

TYPE 4 SIREN SUIT

One-piece siren suit in yellow neoprene with mandarin collar, Nylon zip fitted from throat centre to right hand thigh, plain inner zip flap and single outer zip flap with hook & loop closure.

Respirex locking cuff system with reinforced cuffs with optional Neoprene gloves. Elasticated inner and outer legs with elasticated stirrups. Other ankle and hood options available.

Sizes:	S, M, L, XL, XXL, XXXL
Product Codes:	
Locking cuff (no gloves)	COMB041/17
Soft cuff (with gloves)	COMB007/17

Soft Cuff and Cone

This sleeve cuff features a rigid retaining ring with an internal O-ring seal and a soft rubber external seal. The glove is stretched over a cone and is then pushed firmly into the cuff from inside the sleeve, providing a liquid-tight seal.

HF REFINERY WORKWEAR

CLASS C, AIR-SUPPLIED HOOD

To EN 14594 for respiratory protective devices and EN 14605 for protective clothing when worn with Class A or B refinery work wear

SIMPLAIR HOOD

Air supplied hood in yellow neoprene material, with rigid visor and outer disposable visor.

Features:

- Drawstring neck seal
- Three point hanging attachments
- Adjustable waist belt with back pad
- Simplair air system mounted in cape incorporating low flow warning whistle
- Air distribution block with twin breathing hoses to either side of the hood.
- The air pigtail PVC yellow 3/8" bore hose terminates in a ¼" BSP male thread (See Note 4 below)

Product Code: SIMH101/17

Notes: Air-fed Suits and Hoods

1. Requires a minimum of 220 and a maximum of 280 litres/minute (l/m) flow for the hood, 360 l/m min and 440l/m max for the suit
2. The Airline supply pressure must be advised for calibration of the whistle setting
3. Air quality must be in accordance with EN132 Annex A
4. Connectors to suit customer requirements can be supplied at extra cost

CLASS D, AIR SUPPLIED TANK SUIT

To EN 943 Part 1, Type 2 for non gas-tight protective clothing

SIMPLAIR TANK SUIT

Tank Suit in yellow Neoprene material with rigid visor and outer disposable visor.

Features:

- Three point hanging attachments
- 122cm (48") Heavy duty gas tight zip positioned down the right hand side of the suit closing at the top
- Respirex locking cuff system with reinforced cuffs
- Detachable Hazmax™ chemical resistant safety boots or elasticated inner and outer legs with elasticated stirrups
- Adjustable waist belt with back pad
- Simplair air system mounted in suit incorporating low flow warning whistle
- Air distribution block with twin breathing hoses to either side of the hood and cooling hoses to wearer's arms and legs.
- The air pigtail PVC yellow 3/8" bore hose terminates in a ¼" BSP male thread
- Optional lifting eye

Sizes: S, M, L, XL, XXL, XXXL

Product Codes:

With inner and outer legs	SIMT105/17
With Hazmax™ boots	SIMT103/17
With boots & lifting eye	SIMT104/17

HF REFINERY WORKWEAR

CLASS E, GAS-TIGHT SUIT

Fully encapsulating Type 1A gas tight suit covering both the wearer and the breathing apparatus conforming to EN943-2(ET)

LIMITED LIFE GAS TIGHT SUIT

Manufactured from a high performance seven layer polymer fabric developed by DuPont™ Nonwovens the suit is a one piece construction and compatible with a wide range of manufacturer's breathing apparatus.

All Respirex limited-life gas tight suits are manufactured in accordance with the latest European standard for protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles, and are extensively used by emergency teams throughout the world.

Optional air line pass-through that enables supplementary air to be supplied to the wearer's breathing apparatus.

For the pass-through we would need to know the couplings and configuration on the manifold to enable us to attach the corresponding fittings.

Optional labelling in visor and on rear breathing apparatus pouch.

Features:

- High performance lightweight chemical barrier, seven layer non-woven fabric
- Adjustable internal support belt and 'Bat-Wing' sleeves for optimal wearer comfort
- Wide,flexible, chemically resistant and mechanically strong visor providing clear undistorted vision.
- High visibility Lime Green colour
- Available in a wide range of sizes
- Sewn and double-taped seams for maximum performance.
- Respirex locking cuff with dual neoprene and chemical barrier gloves
- Detachable Hazmax™ chemical resistant safety boots, or optional integral socks with outer leg flaps
- Supplied pre-tested in a sealed PVC bag
- EN943 Part 2 approved for emergency team use

Sizes:	S, M, L, XL, XXL, XXXL
Product Codes:	
With Hazmax™ boots	TYFB020/406/97
With socks	TYFB002/406/97

- Specify size of suit and boots when ordering

CLASS E, GAS-TIGHT SUIT

Fully encapsulating Type 1A gas tight suit covering both the wearer and the breathing apparatus conforming to EN943-2(ET)

GTB REUSABLE GAS TIGHT SUIT

Manufactured from a polyester fabric coated on one side with Orange fireproof Viton with a black fireproof Butyl undercoat and one side with Black fireproof Viton with a black fireproof Butyl undercoat. It incorporates the latest technology in both fabric and suit design and is compatible with any manufacturer's breathing apparatus.

Respirex GTB reusable gas tight suits in Viton/Butyl/Viton (VBV) material are protective against liquid and gaseous chemicals, including liquid aerosols and solid particles - For further information refer to Respirex permeation chart.

Optional air line pass-through that enables supplementary air to be supplied to the wearer's breathing apparatus.

For the pass-through we would need to know the couplings and configuration on the manifold to enable us to attach the corresponding fittings.

Optional labelling in visor and on rear breathing apparatus pouch.

Features:

- Strong and flexible five layer high performance chemical barrier fabric
- Wide, rigid, chemically resistant and mechanically strong visor providing clear undistorted vision
- Sewn and double taped seams for maximum performance.
- Available in a wide range of sizes
- Adjustable internal support belt and 'Bat-Wing' sleeves for optimal wearer comfort
- Respirex locking cuff with dual neoprene and chemical barrier gloves
- Detachable chemically resistant Hazmax™ safety boots with steel toecap and midsole
- Optional ventilation to arms and legs (GTVB model)
- Supplied pre-tested in a robust carrying case.
- Optional fall arrest system
- EN943 Part 2 approved for emergency team use

Sizes: S, M, L, XL, XXL, XXXL

Product Codes:

With Hazmax™ boots	GTB203/215/3
With boots & pass-through	GTB201/208/3
With boots, pass-through and fall arrest system	GTB208/208/3

- Specify size of suit and boots when ordering

HF REFINERY WORKWEAR

OTHER PROTECTIVE ITEMS
FACE AND NECK PROTECTION

For use with Respirex Type 4 Jacket and Trousers or Siren Suit

NECK CLOTH (ABOVE)

Yellow Neoprene neck flap with hook & loop strips for attaching to helmet, supplied with or without a compatible helmet with visor.

Product Codes:

Neck flap & helmet	HELMET/VISOR/NECK SKIRT
Neck flap only	NECKFLAP

NECK WRAP (ABOVE)

Yellow Neoprene neck wrap with hook & loop strips for attaching to helmet.

Product Code: NECKWRAP

OTHER PROTECTIVE ITEMS
CUFF & GLOVE OPTIONS

A choice of cuff and glove options are available depending on the environmental requirement

- Quick change soft cuff and cones, neoprene gloves (Class A)
- Respirex Locking Cuff (pictured), neoprene gloves (Class B & D)
- Respirex Locking Cuff (pictured), bonded dual neoprene and chemical barrier gloves (Class D)

HAZMAX™ OVERBOOT

A chemically protective overboot with Anti-static Hazmax material and oil resistant vulcanized rubber sole. Tested against the 15 chemicals in detailed EN 943.

- Kick off lug
- Rear entry for ease of fitting
- Fixing by means of a rubber strap attached at the back of the boot hooked onto a moulded button on the boot front

Certified to:	EN ISO 20347, EN 13832-3 PPE Regulation (EU) 2016/425
Conforms to:	NFPA 1991, ASTM F 2413, CSA Z195

Sizes: Medium (UK 6-8, EU 39-42)
Large (UK 9-11, EU 43-45)
Extra Large (UK12-14, EU 46-48)

OTHER PROTECTIVE ITEMS
CHEMICALLY PROTECTIVE FOOTWEAR

To EN 13832. Conforms to EN 943 and NFPA 1991

HAZMAX™BOOT

A chemically protective anti-static boot with an integral steel toe cap and vulcanized rubber sole for superior slip resistance.

Features:

- Green Hazmax chemically resistant compound shaft
- Conforms to EN 943-1 (Chemical protective clothing) and certified to this standard as part of an appropriate Respirex gas tight suit
- Meets the requirements of NFPA 1991 (Chemical vapour protection)
- 200 Joule Epoxy coated Steel toe cap
- Seamless construction
- Kick off lug
- Adjustable height
- Ankle guard
- Knitted nylon lining
- Comfort insole (removable and machine washable)
- Black vulcanized rubber sole for maximum grip - 30% better than a conventional safety boot sole
- Slip resistance performance twice that required by SATRA TM144 standard
- Two to three times the wear resistance of conventional soles
- Stainless steel, penetration resistant mid-sole
- Fuel and oil resistant
- Greater cut resistance than conventional soles
- Resistance to hot contact 60 seconds 300°C
- Boots are machine washable at up to 40°C
- Optional FPA Heat resistent version to EN 15090 Type F3A

Certified to: EN 13832-3, EN ISO 20345 S5 HRO SRC CI FO E PPE Regulation (EU) 2016/425

Conforms to: NFPA 1991, ASTM F 2413, CSA Z195

Sizes: UK 3-15, EU 35-50

Product Codes: B00847 (UK 3) to B00857 (UK 13) B00998 (UK14), BB00999 (UK15)

OTHER PROTECTIVE ITEMS
AIR SUPPLY EQUIPMENT

QUAD OUTLET PORTABLE FILTER CABINET

A three stage filter set designed to ensure that the breathing air supply is clean and breathable to EN12021: 1999. Cabinet manufactured in durable, lightweight Polyethylene with an easily removable clear polycarbonate front panel with sealing gasket. The unit has an adjustable pressure regulator, pressure gauge and three air supply outlets.

The three-Stage filtration set comprises:

a) Grade AO (First Stage) High Efficiency General Purpose Protection. For the removal of particles down to 1 micron

b) Grade AA (Second Stage) High Efficiency Oil Removal Filtration. For the removal of particles down to 0.01 micron

c) Grade ACS (Third Stage) Activated Carbon Filtration for the removal of oil vapour and hydrocarbon odours

AO and AA Filter housings have sight glasses allowing visual check of liquid collection and drain functions. They also have automatic drain valves as standard so collected condensate is removed.

Product Code: G00580

PVC REINFORCED AIR HOSE TO EN 270

Yellow reinforced PVC hose terminating at each end in a ¼" BSP male thread. Bore size 9.5mm (3/8"), outside diameter 16mm.

Green Heavy Duty reinforced PVC hose terminating at each end in a ¼" BSP male thread. Bore size 9.5mm (3/8"), outside diameter 20mm (thick wall).

Product Codes:

Yellow 10m Hose	10M YELLOW HOSE
Yellow 20m Hose	20M YELLOW HOSE
Yellow 30m Hose	30M YELLOW HOSE
Green HD 10m Hose	10M GREEN HOSE
Green HD 20m Hose	20M GREEN HOSE
Green HD 30m Hose	30M GREEN HOSE

Optional 360º swivelling anti-kink connector available.

HF ACID
AN EXPLANATION

The first thing to note is that the term "HF" is used, and misused, to mean a number of different things. The nomenclature in this area is not standard and there is often some overlap in meanings. If you are not certain then there is no shame in clarifying or confirming the meaning of a term.

HF itself stands for hydrogen fluoride. This is a molecule consisting of one atom of hydrogen attached to one atom of fluorine. This chemical boils at around 19 Celsius, just below room temperature; it is therefore normally a gas. However, if you cool HF slightly, or keep it under a slight pressure, it is a liquid. If you then spill the liquid in an environment at room temperature it will boil, but it takes quite a while for it all to boil away. Both the liquid and gaseous forms are pure hydrogen fluoride with nothing added - no water solutions - so they are both termed "anhydrous" (meaning "without water"). So far we have:

- Anhydrous hydrogen fluoride (or HF) gas
- Anhydrous hydrogen fluoride liquid

If you ask about the concentration of the anhydrous liquid you will get a confusing answer. It is a pure liquid (like water or methanol) and so it is "neat" or 100%. Unfortunately you'll come across "100%" in another context in a minute. One last thing, pure hydrogen fluoride itself (either gas or liquid) is not at all acidic - strange but true.

Anhydrous hydrogen fluoride (we could be taking about liquid or gas here) is very soluble in water. You can dissolve 48g of pure hydrogen fluoride in 100ml water (not a perfectly true statement, but you don't need to worry about that) The concentration of this solution is therefore 48%. This is the maximum concentration for pure hydrogen fluoride in water. This solution is moderately acidic and fumes a bit. It goes under a variety of names:

- Hydrofluoric acid
- HF acid
- 48% HF
- 50% HF (it gets rounded-up in some places)

If you adulterate your 48% solution with things like potassium fluoride you find that you then actually get more hydrogen fluoride to dissolve. In the end you'll find that you can get 72g of hydrogen fluoride in 100ml impure water. This solution is also moderately acidic and fumes quite a lot. It is known variously as:

- Hydrofluoric acid
- HF acid
- 72% HF
- 100% HF

- This is where some confusion sets in. Some people call this solution "100%" because it is the maximum concentration possible. Very misleading, but then so are a lot of industrial terms. If in doubt, ask.

So to summarise, we have HF in the following forms:

- Pure gas
- Pure liquid
- Pure acidic solution
- Stronger impure acidic solution

PPE GARMENT SELECTION

The ideal way to protect yourself from any chemical is to keep well away from it; any other mode of protection is ultimately a compromise. We need to strike a balance that allows essential work to be undertaken with the minimum risk to health.

Consider the following scenario; you are on-site on a sunny afternoon and everything is going well. All of the various forms of HF are present, but safely contained in tanks, pipes, cylinders etc. The site-team are meticulous in their work and there probably isn't a drop of HF anywhere that you could actually come into contact with. But there is always a slight risk - the pipe-joint that was fine yesterday might just start to weep today. The spillage that they thought they had cleaned-up last week might actually have seeped under a tank and is now starting to come out the other side next to the walk-way. So if you are on-site it would be prudent for you to wear some sort of protective clothing. You certainly aren't going to meet a deluge of HF, and you aren't going out with a spanner looking for trouble. You're just wandering around on a walk-about tour of inspection, tapping gauges, checking valves, looking at sight-glasses. You need some "precautionary" protection - jacket and trousers or a Siren suit. You wear it in the same way that you would wear a hard-hat - you're not expecting it to rain bricks but you put it on anyway. The jacket & trousers or Siren suit options are typically termed Class A or B protection. Workwear in our language. With these you need to consider protection for the head and neck, so you should consider a hard-hat with a fitted visor and a neck-cloth or wrap.

Now imagine that you're on site to perform a routine service on a valve. Everything is under control, the relevant section of pipe-work has been isolated and flushed, but you know that as you undo the flange-nuts a bit of hydrofluoric acid is going to dribble out. The acid will probably fume a bit but it won't be a problem - you've done the job 100 times before and you're expecting it. Given that you are now actually expecting to encounter some HF you need to increase the level of your protection. The workwear is fine but you really need to add an air-fed hood. This will give you some respiratory protection and save your face and eyes from fumes and splashes. Or for the same job you might find a tank-suit a bit more comfortable. This level of protection is normally designated Class D.

Lastly, we need to think of a plan for the unexpected. So far, if anything uncontrolled had unexpectedly happened your plan would have been to make a swift exit. Your Class C or D protection would have got you out of the danger-zone perfectly safely, but you wouldn't want to hang around. So imagine that you've had a report of a problem - one of the forms of HF spraying out of a faulty coupling somewhere. The team who found the problem got out quickly and are OK, but now you've got to go in and make an emergency repair. No messing with workwear this time - this is serious. You're not sure what you're going to find when you get out there so you want the best protection available - a Class E gas-tight suit.

It is vital that wearers have full confidence in their protective clothing and as such employers have a moral responsibility to ensure that the PPE they provide gives adequate protection.

HF ACID

REUSABLE VS. DISPOSABLE GARMENTS

Respirex Neoprene chemical workwear is designed to be laundered and re-used, and will provide a lower lifetime cost of ownership than the equivalent number of disposable garments, but there are a number of other advantages:

Reusable Garments	Disposable Garments
Reusable garments cost but offer a long shelf life	Lower purchase cost, but single use only
Can be repaired to further extend their shelf life	Single use, not suitable for repair
Stronger fabrics which are tear resistant and do not puncture easily	Weaker fabrics which tear and puncture more easily
Reinforced cuffs and elbows to prevent abrasion (optional on some items)	Single layer, thinner fabrics which abrade more easily
Rubber cuffs and locking cuff systems preventing any ingress up the sleeve	Lower specification elasticated or taped sleeves with greater risk of chemical ingress
Glove changing quick and fuss free	Glove changing more hazardous with elasticated sleeve and more complicated with taped option
Heavy duty nylon zip	Lightweight nylon zip

Material Selection

The choice of material will determine both the likely life-span of the garment, its operator comfort and the degree of chemical protection it can provide. For HF refinery applications Respirex recommend neoprene for Class A to D applications, as it offers greater chemical protection than PVC and is more flexible, making it more comfortable for the user. It is important to remember that these garments are the routine uniform for the site - they have got to be more than just "wearable".

For workwear and air-supplied suits neoprene has sufficient permeation resistance to anhydrous HF to get you out of danger. For Classes A to D there is no benefit in choosing fabrics like Viton/Butyl/Viton; the level of protection offered by the garment design doesn't warrant such high permeation resistance. If the environment is sufficiently hazardous that you need hours of protection against HF gas you will certainly need gas-tight seams, gas-tight foot-wear options and gas-tight seals everywhere.

However, for the gas-tight suit scenario, where you have accepted that the environment warrants the use of a gas tight suit, you do need the superior permeation resistance of either VBV or DuPont™ seven layer barrier material. The good news is that the design of this suit does warrant this extra resistance.

CHEMICAL PERMEATION

Chemical ingress through protective workwear can occur through permeation or penetration.

Permeation is a complex diffusion process causing degradation of the fabric. It involves molecular diffusion of the chemical through the fabric and does not involve holes in the fabric. Diffusion may also cause degradation of the fabric.

Penetration is chemical ingress through holes in the fabric. Ingress on a non-molecular level through holes in the fabric; stitch-holes; pores, seams; cuffs; zips; leg endings; collar etc.

The European permeation breakthrough times are as follows:

	Neoprene	DuPont 7-Layer	VBV	Hazmax Boot
Anhydrous HF Gas	480	>480	141	60
Anhydrous HF Liquid	56	>480	>480	n/a
73% HF Acid	260	>480	>480	>480
48% HF Acid	>480	>480	>480	>480

Respirex provide permeation data for the fabrics used in our suits and continually test both fabrics and seams during production. The permeation test carried out by our laboratory is under total immersion conditions - continuous contact with the chemical. Although this is the recognized standard for testing, it is not always reflective of a typical spillage on site. The test models continuous-wear conditions as opposed to emergency protection.

TRAINING, CERTIFICATION AND MAINTENANCE

However good the protective equipment chosen for your site, if is not worn correctly or properly maintained, there will be a risk to the user. To ensure that employers can be confident that they have met their health and safety commitments, Respirex offer a range of training courses of the correct use and maintenance of protective garments, and issue certificates to those attending.

We are also able to advise on risk assessment, and best practice for keeping for testing and maintenance records. A repair service is also available, as are a range of spares and consumables.

Combining correct usage and inspection with scheduled servicing and repairs ensures user safety and will greatly extend the service life of your equipment.

RESPIREX™

Living + Breathing Personal Protection

RESPIREX HF REFINERY CUSTOMERS

Big West Refinery
Salt Lake City, UT

Calumet Refinery
Great FAlls, MT

Citigo Refinery
Corpus Christi, TX

Chevron Refinery
Salt Lake City, UT

CHS Refinery
Laurel, MT

CHS Refinery
McPherson, KS

CVR Refinery
Coffeyville, KS

CVR Refinery
Wynnewood, OK

Exxon Mobil Refinery
Billings, MT

Flint Hills Refinery
Corpus Christi, TX

HollyFrontier Refinery
Cheyenne, WY

HollyFrontier Refinery
El Dorado, KS

HollyFrontier Refinery
Woods Cross, UT

Honeywell HF
Claymont, DE

Husky Refinery
Superior, WI

Imperial Oil Refinery (ESSO)
Edmonton, AB, Canada

Marathon Refinery
Gallup, NM

Marathon Refinery
Mandan, ND

Marathon Refinery
St. Paul Park, MN

PBF Refinery
Paulsboro, NJ

PBF Refinery
Chalmette, LA

Phillips 66 Refinery
Ferndale, WA

Phillips 66 Refinery
Billings, MT

Phillips 66 Refinery
Borger, TX

Phillips 66 Refinery
Ponca City, OK

Solvey Fluorides
East St. Louis, IL

Solvey Fluorides
El Paso, TX

Suncor Refinery
Edmonton, AB Canada

Suncor Refinery
Sarnia, ON, Canada

Valero Refinery
Port Arthur, TX

Valero Refinery
Wilmington, CA

Wyoming Refining
Newcastle, WY

YPF Refinery
Buenos Aires, Argentina

YPF Refinery
Mendoza, Argentina

Raízen Refinery
Buenos Aires, Argentina

Viva Energy
Sydney, Australia

Viva Energy
Geelong, Australia

BP Kwinana
Perth, Australia

Caltex
Brisbane, Australia

Total SA
Antwerp, Belgium

Total Raffinage Chimie
Donges, France

Total SA
Feyzin, France

Total SA
Grandpuits, France

Neste Oil
Finland

PCK Refinery
Schwedt, Germany

Sonatrach Refinery
Augusta, Italy

Saras Refinary
Sarroch CA, Italy

PEMEX
Throughout Mexico

Shell Pernis
Pernis, Netherlands

GALP Refinery
Portugal

Samref
Yanbu, Saudi Arabia

Shell SIngapore
Pulau Bukom, Singapore

Petronor Refinery
Bilbao, Spain

Repsol Refinery
Puertellano, Spain

Cepsa Refinery
Algerceras, Spain

BP Refinery
Castillon, Spain

Natref
Sekunda, S. Africa

SAPREF
Durban, S.Africa

Engen
Durban S.Africa

Total Refinery
Immingham UK

Phillips 66 Refinery
Immingham, UK

Valero Refinery
Pembrokeshire, UK

Essar Refinery,
Stanlow, UK

PDVSA
Throughout Venezuela

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