CHOOSING CHEMICAL PROTECTIVE FOOTWEAR

workMaster™
by RESPIREX

WHY DO YOU NEED SPECIALIST CHEMICAL FOOTWEAR?

Harmful chemicals pose a wide range of health hazards (such as irritation, sensitization, and carcinogenicity) and physical hazards (such as flammability, corrosion, and explosiveness).

Employers with hazardous chemicals in their workplaces must ensure that they are labelled correctly, with safety data sheets easily accessible and that employees are trained how to handle them appropriately. Training for employees must also include information on the hazards of the chemicals in their work area and the measures to be used to protect themselves.

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. For this reason, if elimination or substitution of the chemical are not possible, engineering and work practice controls are the preferred means to reduce employee exposure to toxic chemicals, where feasible. Personal Protective Equipment (PPE) is the least desirable measure but is highly effective when used correctly.

Chemical protective footwear forms an important part of an overall PPE solution. Depending on the nature of the chemical and the exposure some or all of the following may be required to provide effective protection.

- Chemical protective clothing
  This could be a single piece suit, or separate jacket & trousers and may incorporate a hood or even completely encapsulate the wearer if their breathing air is supplied by an air-line or breathing apparatus.
- Respiratory protection
  This can range from a simple facemask respirator, to powered respirators or supplied air from breathing apparatus or air-line. If air is being filtered it is vital to check the efficacy of the filter against the chemicals to which the wearer is exposed and that there is sufficient oxygen in the atmosphere.
- Eye protection
  This can be provided by goggles, a full facemask or from a suit with an integral visor.
- Chemical protective gloves
  These need to provide sufficient protection from the chemical to which the wearer may be exposed, but also provide sufficient mechanical protection for the challenges of the job and working environment
- Chemical protective boots
  As with gloves, boots need to protect against the chemicals that the wearer may be exposed, but also provide protection against other environmental risk factors such as slipping on wet floors, injury from falling objects or electrostatic sparks in explosive or flammable environments.

UNDERSTAND THE APPLICATION

How are the boots going to be used?

- Will you be standing in puddles of chemicals or is protection just from accidental contact (spills/splash etc), or perhaps the chemical exposure comes from cleaning/sanitising agents (food industry, pharmaceuticals etc)
- Is contact going to be over a long or short period?

Other environmental factors to consider

- Falling objects/crushing - Toecaps
- Sharp objects - Puncture resistant midsole
- Slip resistance - Wet areas
- Extreme heat or cold - Contact with extremely hot or cold surfaces, heat or flame resistance, low temperature flex cracking
- Potentially explosive environments - ATEX, ESD
- Potential of static damage to sensitive products or equipment - ESD

ASSES THE RISK

What is the state and temperature of the chemical(s)?

- Are they a solid, liquid or gas (this directly affects the type of PPE required)? Temperature is also critical as it significantly affects the permeation rate, but extremes of heat and cold pose their own risks

Establish what the safe exposure levels are for the chemicals you are working with

- Look at chemical permeation data for the boot to asses if it provides sufficient protection

How corrosive are the chemicals

- Look at degradation data to asses if boots will stand up to prolonged exposure without damage. Degradation can result in the material swelling, stiffening, wrinkling, changes in colour and other physical deterioration

How will boots be safely cleaned/decontaminated

-What needs to be done to ensure the boots are safe and clean for the next use. Can boots be washed/laundered? Are there process risks from cross contamination which mean that boots should be isolated to one particular process or area. **Note:** Some highly toxic or aggressive chemicals are extremely difficult to decontaminate safely and boots may need to be disposed of after contact.

How do boots fit into the overall protective solution

-What is the risk to the wearer from exposure; is respiratory protection required, does clothing need to be gas, liquid or splash tight. How do the boots interface with the suit or trousers, are there outer 'splash guard' legs to prevent chemical splash entering the boots or are the boots attached to the suit/ trousers. The PPE selected needs to be sufficiently protective without placing unnecessary burden on the wearer, increasing fatigue and reducing dexterity.

Establish safe decontamination and doffing procedures

-Wearers need to be able to get out of used PPE safely, without risk of contact with chemical contaminants and feel confident that when reusing PPE that it is safe to handle. Training, backed by regular audits and reviews, is key to ensuring safe doffing processes, decontamination and cleaning regimes.

HOW DO YOU KNOW WHICH BOOTS TO CHOOSE?

THE CHEMICAL PPE CHECKLIST

SCOPING

- What is the chemical (or chemicals) & level of risk
- What is the type of exposure (splash, immersion etc)
- What is the length of exposure
- What are the requirements of the task being performed

CHECKING

- Toxicity data and safe exposure limits for chemical(s)
- Permeation & degradation table for boots (& other PPE)
- Cleaning/decontamination procedures

SELECTING

- Short list equipment that provides appropriate permeation & degradation resistance, plus protection against any other environmental/process hazards
- Select equipment that combines together to provide effective overall protection
- Conduct wearer trails to ensure PPE is fit for purpose and asses effectiveness and wearer comfort

DEPLOYING & MAINTAINING

- Train employees on the safe donning, doffing & use of selected PPE
- Ensure procedures are in place for effective cleaning/laundering/sanitising/decontamination
- Ensure equipment is inspected regularly and repaired or replaced as necessary

IF IN DOUBT, ASK

WorkMaster™ boots are manufactured by Respirex™ (www.respirex.com), a leading global manufacturer of chemical PPE including gloves, clothing and boots. With 60 years experience in the supply and support of protective equipment to industry and the emergency services we have a wealth of knowledge on the safe handling of chemicals and our representatives sit on numerous international standards committees.

With extensive experience backed by our in-house chemical permeation testing laboratory, if you are unsure about what boots (or other PPE) will be safe to use with a particular chemical or mix of chemicals, or how to safely clean or decontaminate your PPE after use, just ask us.

ASSESSING THE PERFORMANCE OF CHEMICAL PROTECTIVE FOOTWEAR

EN 13832 FOOTWEAR PROTECTING AGAINST CHEMICALS

- This is the European safety standard for chemical protective footwear and is divided into three parts. Part 1 deals with terminology and test methods, Part 2 with requirements for limited contact with chemicals and Part 3 with requirements for prolonged contact with chemicals. The standard is intended for use in conjunction with EN ISO 20345 (Safety footwear standard), EN ISO 20346 and EN ISO 20347 (Occupational footwear standard)

For certification to EN 13832 Part 3, boots are tested for chemical degradation over a period of 23 hours against a minimum of three chemicals from a list of 15 designated challenge chemicals contained in Part 1 of the standard (the designated letters are the same as for the EN 374 glove standard), after which they must pass a series of mechanical tests. Permeation tests are then performed for the selected chemicals and normalised breakthrough must be greater than 121 minutes.

Footwear approved to EN 138832 Part2 is only intended for limited contact with chemicals and is not recommended for people working with, or in proximity to, dangerous or aggressive chemicals.

Just because a boot is approved to EN13832 does not mean that it is necessarily safe to use with every chemical. Respirex test boots against a broad range of chemicals in addition to those required to pass EN13832 and you should use this permeation data to check suitability against your particular chemical (or mix of chemicals), in the same way that you would check gloves or protective clothing.

PART OF A PPE SOLUTION

Boots are part of an overall PPE solution for the wearer that can incorporate respiratory protection, hand and body protection and head, face and eye protection. The relevant standards are:

EN 943: GAS-TIGHT SUITS

Type 1 Suits provide protection from gaseous chemicals (as well as solid & liquid chemicals) and are worn with self contained breathing apparatus or supplied with breathing air by an air-line for the highest degree of respiratory protection. These will generally include sock feet or boots that are attached to the suit and gloves either permanently attached or attached via a locking ring arrangement.

EN 943: NON GAS-TIGHT SUITS

Type 2 Suits are similar in construction to Type 1 suits but are not fully gas-tight. Instead they use breathable air to provide positive pressure in the suit to prevent ingress of dusts, liquids and vapours.

EN 14605 LIQUID AND SPRAY TIGHT SUITS

Type 3 Liquid tight suits provide protection from liquid chemical jets, while **Type 4** provides protection from chemical spray. Type 3 is a far more demanding test and this is reflected in the more sophisticated design of seams, openings and connections for gloves etc.

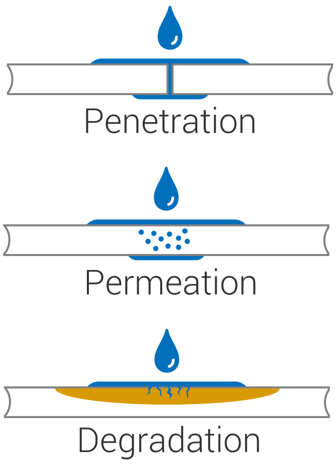
EN 374 CHEMICAL PROTECTIVE GLOVES

Gloves to EN3674 provide protection against chemicals and micro-organisms. Gloves are classified into three types - **Type A**: Protective gloves with permeation resistance of at least 30 minutes each for at least 6 test chemicals, **Type B**: Protective gloves with permeation resistance of at least 30 minutes each for at least 3 test chemicals and **Type C**: Protective gloves with permeation resistance of at least 10 minutes for at least 1 test chemical.

EN 529 RESPIRATORY PROTECTIVE DEVICES.

There are numerous European standards for respiratory protection, but EN 529 provides guidance on the best practice for establishing and implementing a suitable respiratory protective device programme and is a good starting point.

CHEMICAL PENETRATION, PERMEATION AND DEGRADATION



There are three mechanisms that you need to consider when looking at the use of chemicals with personal protective equipment:

PENETRATION:

Chemical penetration is ingress through a material on the non-molecular level - i.e. through holes, cracks, pores, seams etc. This isn't usually an issue with moulded footwear until it starts to age (where on some compounds chemical or UV degradation can cause brittleness and cracking), but can be a big problem with leather or synthetic fabric footwear.

CHEMICAL PERMEATION:

Chemical Permeation is the process by which a chemical passes through a material at the molecular level. The rate of permeation will be determined by the material, its thickness and the temperature.

Actual Breakthrough Time - is the time that the chemical is first detected on the on the inner surface of the material, this will depend to an extent on the sensitivity of the detection equipment and method of analysis.

Normalised Breakthrough Time - is the time taken to reach a specific permeation rate (for European standards this is defined as 0.1µg[min.cm^2], for American standards it is 1µg[min.cm^2]). This is the measure used in permeation tables as it will be consistent between testing laboratories.

DEGRADATION:

Degradation is the physical change to the material caused by the chemical, which can include swelling, stiffening, wrinkling, changes in colour, and other physical deterioration. The slower the degradation occurs in the presence of a chemical, the more protective the material is for that specific chemical.

Degradation tests results are subjective as they are based solely on a visual assessment of the material.

TOXICITY

A toxic chemical is any substance which may be harmful to the environment or hazardous to your health if inhaled, ingested or absorbed through the skin. Toxicity is a measurement of the dosage needed of the substance to damage a living organism.

Any compound can be toxic, depending on the route of exposure and the dose. For example, even water is toxic if you drink enough of it. Toxicity depends on other factors besides dose and exposure, including species, age, and gender.

When assessing PPE requirements for working with chemicals it is essential to ensure that exposure is kept within safe exposure levels. There are various resources available to help you determine safe exposure limits, a selection of which are listed below:

Toxicity Resources:

Workplace Exposure Limits EH40/2005, UK Health & Safety Executive (hse.gov.uk)

NIOSH Pocket Guide to Chemical Hazzards, US National Institute for Occupational Safety and Health (www.cdc.gov/niosh)

Biological Limit Values TGRS 903, German Federal Institute for Occupational Safety and Health [BAUA] (www.baua.de)

In addition to the above, if you are using Chemptotex™ Suits or Kemblok™ gloves from Respirex, you can use Permasure™, our toxicity modelling app to calculate safe working times.

CHEMICAL TESTING AT RESPIREX™

Respirex are one of the few PPE manufacturers with our own chemical permeation testing laboratory. Having a testing lab on-site allows us to comprehensively test our products against a wide range of common chemical hazards; we can also test our products against specific chemicals or combinations of chemicals for customers if we do not currently have results available.

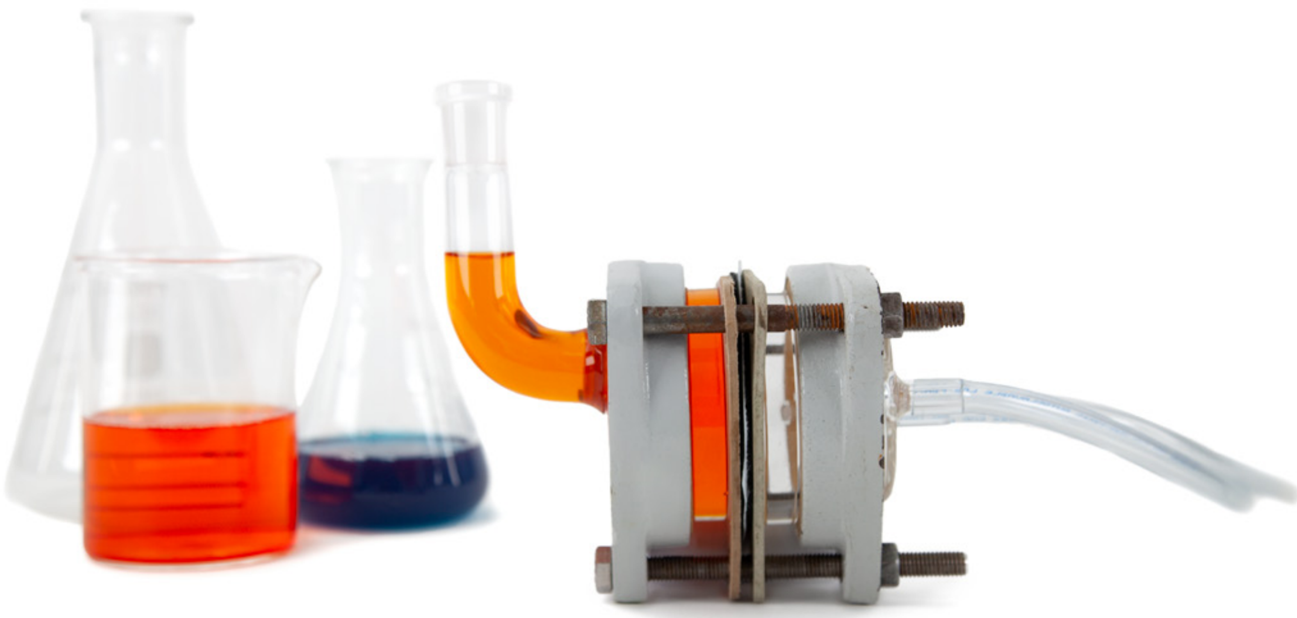
The Respirex Testing Laboratory is UKAS accredited and offers a range of chemical permeation and physical testing of chemical protective clothing, including suits, gloves and boots to European, American and international standards.

Based in Redhill, Surrey, the laboratory has been operating since 1994 and was accredited in 1996. The laboratory tests for chemical permeation according to standards such as: **ASTM F739**, **EN 374-3**, **EN 16523-1**, **EN 16523-2** and **ISO 6529**.

We are experienced at testing gases as well as a wide range of liquid chemicals including most organic or inorganic liquids, mixtures and commercial formulations. We perform tests on all of the chemicals required by standards such as **EN374-1** or **EN 943-2**, but also on many other chemicals or mixtures, depending on their properties or formulation.

We can perform tests against organic liquids and gases by gas chromatography and infrared spectroscopy, inorganic solutions or gases by electrical conductivity and Ion Selective Electrode and many other chemicals by visible spectroscopy or by specialised wet chemical techniques.

We have undertaken several bespoke contracts using our state of the art equipment and the expertise behind it, including many commercial formulations, e.g. petroleum based products, aviation additives, disinfectants, cleaning agents and so on.



Chemical permeation test cell (assembled)

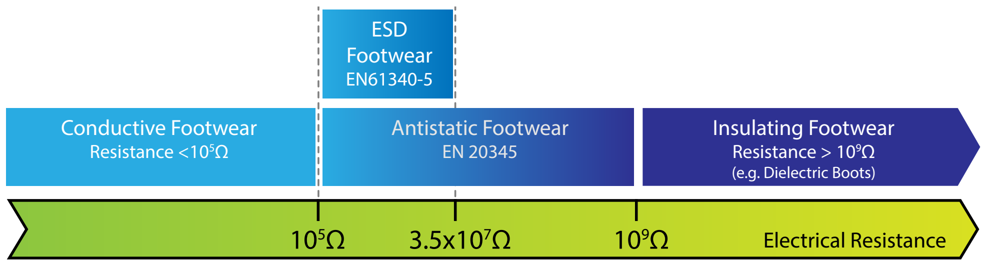
OTHER BOOT FEATURES

ANTISTATIC AND ESD FOOTWEAR

According to EN ISO 20345: 2011, a shoe or boot is considered to be **antistatic** if its' measured electrical contact resistance falls between **100 kΩ** (10^5 ohms) and **1 GΩ** (10^9 ohms). With a lower resistance (less than 100kΩ), a shoe or boot is considered to be conductive and at higher values, to be insulating. This 100kΩ to 1GΩ range is regarded a sensible compromise, giving protection from electrostatic build up and protection from electrical shocks at lower voltages.

For some industries the risk of uncontrolled electrical discharge (sparks) in potentially explosive atmospheres or the protection of sensitive electronic components and devices are also important considerations. In these situations, another standard for **E**lectro-**S**tatic **D**ischarge (**ESD**) control applies: EN 61340-5-1 ("Electrostatics. Protection of electronic devices against electrostatic phenomena").

For **ESD** footwear the lower limit of electrical resistance is **100 kΩ** (the same as for antistatic footwear) and the upper limit is **35 MΩ** (3.5 x 10^7 ohms). This means that a boot that is ESD-capable is by definition also antistatic at the same time. Conversely, not every antistatic boot is ESD-capable e.g. If an electrical resistivity of 100 MΩ is measured, the shoe is antistatic but outside the ESD limits. If the shoe has an electrical resistance of only 1 MΩ, it is both antistatic and ESD-capable.



HEAT & FLAME RESISTANCE

Boots that are resistant to heat and flame for use in areas where there is a risk of sparks from welding or grinding or in proximity to heat and flame. Heat resistant safety boots conform to the EN15090 F3A I_3 fire boot standard for flame resistance, radiant heat (20 kW/m^2) and heat insulation of the sole (250°C for 40 minutes).

SLIP RESISTANCE

There are two slip resistance tests specified in EN ISO 20345:2011 (with the method described in EN13287); the first is soapy water (Sodium Lauryl Suphate solution) on a ceramic tile. If the footwear passes this test then the boot can be marked **SRA**. The second is oil (Glycerol) on a steel plate, if the boot passes this test then it can be marked **SRB**. If a boot passes both the SRA and SRB test then it can be marked **SRC**.

There is a common misunderstanding that SRC is the best for slip resistance - this is not the case! Since the introduction of slip testing, accidents caused by slips have not reduced; this is because to pass the slip requirements on oily steel manufacturers have to sacrifice some slip performance in water, but most slip accidents occur where water is the contaminant (over 95%).

The SRB test (oil on steel) has a very low pass/fail limit and the error in measurement is +/- 50%. The pass value is so low that the probability of a fall in this environment is still high. Because of this it is expected that in the next revision of EN ISO 20345 the SRB test will be significantly changed and SRC removed.

The Workmaster™ vulcanised rubber sole produces very high levels of slip resistance with soapy water on a ceramic tile, and these test results have been confirmed during customer wear tests. Due to the performance characteristics of the sole material, boots with our vulcanised rubber sole also achieve a pass on the SRB (oil on steel test), **without compromising SRA performance** and are marked SRC. Some manufacturers add rubber to PVC to improve its resistance to fuel & oil, but this does not improve slip performance.

UNDERSTANDING BOOT MARKING

Boots are approved to either EN ISO 20345:2011 or EN ISO 20347:2012 depending on their application. These are the specific features and benefits that are covered by these standards and how they are marked on each boot.

S5 Category Safety Boot

Complies with the requirements for safety footwear in EN ISO 20345:2011 and additionally includes a closed heal region, antistatic properties energy absorption of heal region, resistance to fuel oil, penetration resistance and a cleated out-sole.

S4 Category Safety Boot

Complies with the requirements for safety footwear in EN ISO 20345:2011 and additionally includes a closed heal region, antistatic properties energy absorption of seat region and resistance to fuel oil.

SB Category Safety Boot

Complies with the requirements for safety footwear in EN ISO 20345:2011.

04 Category Occupational Footwear

Complies with the requirements for occupational footwear in EN ISO 20347:2012.

Energy Absorbing Heel

Provides a minimum of 20J cushioning at the heel, reducing the risk of fatigue and injury to joints and spine.

Boot Marking: E

Cut Resistant

Resistance to repeated cutting strokes from a sharpened blade (to the method defined in EN 388). Achieves a result of class 4 (minimum pass is 2.5).

Boot Marking: CR

Toecap and Mid-sole

Epoxy coated steel toecap fitted tested for 200J impact resistance and 15kN compression. Stainless steel penetration resistant mid-sole fitted with penetration resistance greater than or equal to 1100N.

Boot Marking: P

Toecap

Epoxy coated steel toecap fitted tested for 200J impact resistance and 15kN compression (as per EN ISO 20345:2011)

Fuel and Oil Resistant

The outer sole is resistant to oil, ensuring the working life of the boot won't be compromised if used in oily environments. The test involves immersion in oil for 22 hours after which the sole is checked for excessive swelling, shrinkage or increased hardness.

Boot Marking: FO

Cold Insulation

The thermal insulation properties of the boot ensure that the temperature decrease inside a boot at 23°C when placed in a cold chamber at -17°C is less than 10°C after 30 minutes when measured at the upper surface of the insole.

Boot Marking: CI

Slip Resistant SRA

Tested and approved for resistance to slip on a ceramic tile floor coated with a dilute soap solution of sodium lauryl sulphate (NaLS). The test measures forward slip on the heel and with the boot flat to the floor.

Boot Marking: SRA

Slip Resistant SRC

Tested and approved for resistance to slip on a ceramic tile floor coated with a dilute soap solution of sodium lauryl sulphate (NaLS) [SRA] **and** Slip resistance on steel floor with glycerol [SRB]. The tests measure forward slip on the heel and with the boot flat to the floor.

Boot Marking: SRC

High Voltage

Dielectric boots that comply with the EN50321 standard for electrically insulating footwear.

Hot Contact

The sole has been tested for contact with a hot metal surface at 300°C for 60 seconds.

Boot Marking: HRO

Heat Resistant

Approved to EN15090:2012 F3A, the fire fighter boot standard.

Antistatic

The electrical resistance of the boot falls between 100 kΩ and 1000 MΩ ensuring that any build up of static charge by the wearer will be conducted safely to earth.

Electro-Static Discharge

This boot is suitable for use in Electrically Protective Areas (EPA) conforming to EN 61340-5. The electrical resistance falls between 100 kΩ and 35 MΩ.

Chemical Protection

EN 13832-3:2006 approval for footwear highly resistant to chemicals.

HAZMAX™ BOOTS

Our Hazmax™ compound provides exceptional protection against broad range of chemicals.

Hazmax™ boots are trusted by first responders and safety experts to provide protection in the most demanding of circumstances and are the ideal choice for dealing with hazardous or aggressive chemicals

HAZMAX™ CHEMICAL SAFETY BOOTS

A chemically protective anti-static boot with an integral steel toe cap and vulcanised rubber sole for superior slip resistance. Applications include petrochemical, pharmaceutical, chemical waste handling and aluminium processing.

- Certified to EN13832-3 (see back pages for chemical permeation data)
- Black high-grip vulcanised rubber sole provides excellent slip resistance (twice that required by SATRA TM144 standard)
- Sole is cut resistant and resistant to hot contact
- Machine washable at up to 40°C for easy cleaning
- Kick off lug for hands-free removal

EN ISO 20345:2011 S5 SRC CI HRO

EN 13832-3 K O R

S5 SRC

HAZMAX™ ESD BOOTS FOR ELECTROSTATIC SENSITIVE APPLICATIONS

A chemically protective safety boot suitable for use in Electrically Protective Areas and conforming to EN61340-5. Suitable for applications such as pharmaceuticals, electronics manufacture and ATEX environments.

EN ISO 20345:2011 S5 SRC CI HRO

EN 13832-3 K O R

Features as Hazmax, Plus:

HAZMAX™ FPA HEAT RESISTANT CHEMICAL BOOTS

A heat-resistant chemical safety boot, conforming to the EN15090 F3A I_3 fire boot standard for flame resistance, radiant heat and heat insulation of the sole. Used by emergency responders, marine chemical transport

EN ISO 20345:2011 S5 SRC CI HRO

EN 13832-3 K O R

EN15090 F3A I_3

Features as Hazmax, Plus:

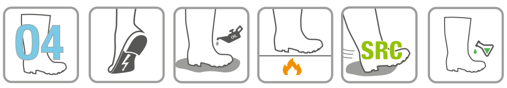
CHEMICAL OVERBOOTS FOR SAFETY BOOTS

For use with safety boots

A chemically protective anti-static overboot with a vulcanised rubber sole for superior slip resistance and designed to be worn over safety boots.

EN ISO 20347:2012 O4 SRC HRO

EN 13832-3 K O R



CHEMICAL OVERBOOTS FOR SAFETY SHOES

For use with safety shoes/trainers

A chemically protective front-opening overboot with a slip resistant sole designed to be worn over safety shoes and trainers.

EN ISO 20347:2012 O4 SRC

EN 13832-3 K O R

FOODMAX BOOTS

Combining cut and chemical resistance with low temperature flexibility & comfort the Foodmax boot is a great all-round food industry boot. Foodmax boots are resistant to the fats and acids commonly found in food production, together with popular cleaning and disinfecting agents.

FOODMAX CHEMICALLY RESISTANT FOOD BOOTS

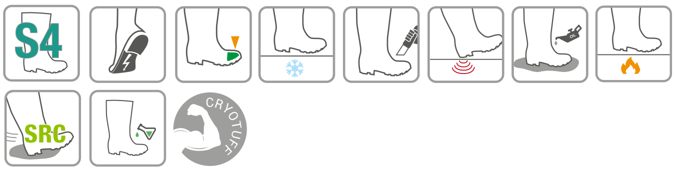
A lightweight safety boot that provides superior comfort, is resistant to the chemicals used in the food processing industry and maintains its flexibility in temperatures as low as -40°C. The boot utilises our Cryotuff compound and includes a blown mid-sole which reduces weight and improves cushioning, a cut and abrasion resistant shaft and a vulcanised rubber sole for superior cut and slip resistance.

- Chemically resistant food boot to EN 13832
- Cut resistant sole & shaft
- Cold insulation and low temperature flexibility (-40°C)
- Class 0 (EN 50321-1:2018) Electrically insulating version available as an option, for live working up at to 1 kV

EN ISO 20345:2011 S4 SRC CI CR HRO

or EN ISO 20347:2011 O4 SRC CI CR HRO *(Soft toe version)*

EN 13832-3 K O R



Also available in Maxi or Compact Overboots:

TASKPRO BOOTS

A high-performance S5 safety boot that features a blown mid-sole for reduced weight and greater cushioning, combined with a durable cut resistant sole and upper. Taskpro boots are resistant to fuel and oil, concrete and a broad range of chemical commonly found in construction, light industry and mining.

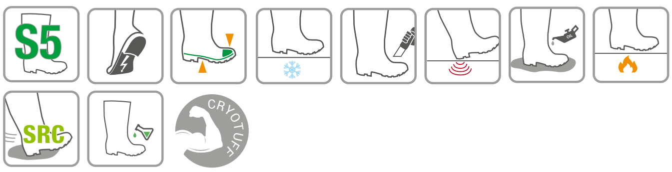
TASKPRO CHEMICALLY RESISTANT UTILITY BOOTS

A durable, high-performance S5 safety boot with excellent cut resistance thanks to its' Cryotuff construction with a hard wearing vulcanised rubber sole for long operational life. Resistant to fuel, oil and a range of industrial, construction and mining chemicals

- Chemically resistant S5 safety boot to EN 13832 ideal for construction & utility use
- Long-life high-grip vulcanised sole & cut resistant shaft
- Blown midsole reduces weight and increases cushioning, significantly increasing wearer comfort and reducing fatigue

EN ISO 20345:2011 S5 SRC CI HRO

EN 13832-3 K O R



HAZMAX™ BOOTS — CHEMICAL PERMEATION

CHEMICAL	CAS NO.	LETTER	METHOD	BREAKTHROUGH
Acetic acid (Glacial)	64-19-7	N	EN 16523	> 12 Hours
Acetone	67-64-1	B	EN374-3	> 2 Hours
Acetone Cyanohydrin	75-86-5		EN374-3	> 8 Hours
Acetonitrile	75-05-08	C	EN374-3	> 6 Hours
Acrylic Acid	79-10-7		EN374-3	> 8 Hours
Acrylonitrile	107-13-1		EN374-3	> 2 Hours
Ammonia 33%	1336-21-6	O	EN 16523	> 32 Hours
Ammonia Gas	7664-41-7		EN374-3	> 8 Hours
Ammonium Hydroxide Solution 5% free NH_3	1336-21-6		EN 16523	> 32 Hours
Ammonium Pentadecafluoro-octanoate (30% in water)	3825-26-1		EN374-3	> 8 Hours
Aniline	62-53-3		EN374-3	> 8 Hours
Anti-knock(Tetraethyl lead 60% Dibromoethane 30%/ Dichloroethane 10% TEL-CB)	78-00-2 / 106-03-4 / 107-06-2		EN374-3	> 8 Hours
Aqueous Phenol 85%	108-95-2		EN374-3	> 8 Hours
Arsenic Acid	7778-39-4		EN374-3	> 8 Hours
Benzene	71-43-2		EN374-3	> 4 Hours
Benzyl Chloride	100-44-7		EN374-3	> 8 Hours
Bromine	7726-95-6		EN374-3	> 7 Hours
Buta-1,3diene Gas	106-99-0		EN374-3	> 3 Hours
Butyl Acetate	123-86-4		EN374-3	> 6 Hours
Cable oil			EN374-3	> 8 Hours
Carbazole	86-74-8		EN374-3	> 8 Hours
Carbon Disulphide	75-15-0	E	EN374-3	> 1 HOUR
Chlorine Gas	7782-50-5		EN374-3	> 3 Hours
Chloroacetic Acid 85%	79-11-8		EN 16523	> 32 Hours
Chromic Acid	1333-82-0		EN374-3	> 8 Hours
Cyclohexylamine	108-91-8		EN374-3	> 8 Hours
Dichloromethane	75-09-02	D	EN374-3	> 1 HOUR
Diethylamine	109-89-7	G	EN374-3	> 2 Hours
Diethylene Glycol dimethylether	111-46-6		EN374-3	> 8 Hours
Dimethyl Formamide	68-12-2		EN374-3	> 8 Hours
Dimethylformamide	68-12-2		EN374-3	> 3 Hours
Epichlorohydrin	106-89-8		EN374-3	> 7 Hours
Ethanol (Ethyl Alcohol)	64-17-5		EN374-3	> 8 Hours
Ethyl Acetate	141-78-6	I	EN374-3	> 4 Hours
Ethylene Glycol	107-21-1		EN374-3	> 8 Hours
Ethylene Dichloride	107-06-2		EN374-3	> 8 Hours
Ethylene Oxide	75-21-8		EN374-3	> 2 Hours
Ethylenediamine tetra-acetic acid tetrasodium salt (EDTA) 5%	64-02-8		EN374-3	> 8 Hours
Formaldehyde 37%	79-11-8	T	EN374-3	> 8 Hours
Formic Acid 65%	64-18-6		EN374-3	> 8 Hours
Heptane	142-82-5	J	EN374-3	> 8 Hours
Hexane	110-54-3		EN374-3	> 7 Hours
Hydrazine	302-01-2		EN374-3	> 8 Hours
Hydrazine 5%	7803-57-8		EN374-3	> 8 Hours
Hydrochloric Acid 37%	7647-01-0		EN 16523	> 32 Hours
Hydrofluoric Acid 48%	7664-39-3	S	EN374-3	> 66 Hours
Hydrofluoric Acid 73%	7664-39-3		EN374-3	> 8 Hours
Hydrogen Chloride Gas	7647-01-0		EN374-3	> 8 Hours
Hydrogen Fluoride gas anhydrous	7664-39-3		EN374-3	> 1 HOUR
Hydrogen Peroxide (10 volume (3%) solution)	7722-84-1		EN374-3	> 8 Hours
Hydrogen Peroxide 50%	7722-84-1	P	EN374-3	> 8 Hours

CHEMICAL	CAS NO.	LETTER	METHOD	BREAKTHROUGH
Iso-butane	75-28-5		EN374-3	> 8 Hours
Iso-butane followed by Hyrdrofluoric acid 71-75%	75-28-5 + 7664-39-3		EN374-3	> 8 Hours
Iso-propanol (IPA)	67-63-0		EN 16523	> 32 Hours
m-Cresol	108-39-4		EN374-3	> 8 Hours
Methanol	67-56-1	A	EN374-3	> 8 Hours
MethyL Ethyl Ketone (M.E.K) 2-Butanone	78-93-3		EN374-3	> 2 Hours
Methyl Iodide 99%	74-88-4		EN374-3	> 1.5 Hours
Methyl Methacrylate	80-62-6		EN 369	> 3 Hours
methyl-1,2-pyrolidone	872-50-4		EN369	> 8 Hours
Methylene Chloride Gas	74-87-3		EN374-3	> 1 Hour
Monochloroacetic acid	79-11-8		EN374-3	> 8 Hours
Naphalene	91-20-3		EN374-3	> 8 Hours
N,N-Dimethylaniline	121-69-7		EN374-3	> 8 Hours
N,N-dimetyl acetamide	127-19-5		EN374-3	> 8 Hours
Nitric Acid 50%	7697-37-2	M	EN 16523	> 32 Hours
Nitric Acid 70% conc	7697-37-2		EN 16523	> 32 Hours
Nitric Acid Etchant 80/20	7697-37-2		EN374-3	> 8 Hours
Nitro Benzene	98-95-3		EN374-3	> 3 Hours
Oleum 40% SO_3	8014-95-7		EN374-3	> 8 Hours
Oxalic Acid saturated solution	6153-56-6		EN374-3	> 8 Hours
Phenol 50% in Methanol	108-95-2/ 67-56-1		EN374-3	> 8 Hours
Phosphoric acid 25%	7664-38-2		EN 16523	> 32 Hours
Phosphoric acid 75%	7664-38-2		EN 16523	> 32 Hours
Propylene 1,2 oxide	75-56-9		EN374-3	> 1 Hours
Red Fuming Nitric acid	7697-37-2		EN374-3	> 4 Hours
Sodium Cyanide 30wt%	143-33-9		EN374-3	> 8 Hours
Sodium Hydroxide 40%	1310-73-2	K	EN374-3	> 8 Hours
Sodium Hypochlorite 16%	7681-52-9	R	EN374-3	> 8 Hours
Styrene	100-42-5		EN374-3	> 8 Hours
Sulphuric Acid 96%	7664-93-9	L	EN374-3	> 8 Hours
Tetrachlororethylene	127-18-4		EN374-3	> 3 Hours
Tetraethyl Lead (Octel Anti Knock)	78-00-2		EN374-3	> 8 Hours
Tetrahydrofuran	109-99-9	H	EN374-3	> 3 Hours
Toluene	108-88-3	F	EN374-3	> 4 Hours
Toluene 2,4 Diisocyanate	584-84-9		EN374-3	> 8 Hours
Trichloroethane	71-55-6		EN374-3	> 6 Hours
Trichloroethylene 1,1,2	79-01-6		EN374-3	> 3 Hours
Triethanol-amine	102-71-6		EN374-3	> 8 Hours
Triethylene Glycol	112-27-6		EN374-3	> 8 Hours
Trigonox K-80 Cumyl hydroperoxide 80% / 20% Cumene	80-15-9/ 98-82-8		EN 369	> 8 Hours
Xylene	1330-20-7		EN374-3	> 4 Hours

Chemicals in **bold** are the 15 standard test chemicals defined in EN943-2:2002

WARFARE AGENT	CAS NO.	METHOD	BREAKTHROUGH TIME
Cyanogen Chloride	506-77-4	NFPA	No permeation detected
Lewisite	541-25-3	NFPA	No permeation detected
Mustard Gas	505-60-2	NFPA	No permeation detected
Saren Gas	107-44-8	NFPA	No permeation detected
VX	50782-69-9	Finabel 0.7.C.	> 48 Hours
GD (Soman)	96-64-0	Finabel 0.7.C.	> 24 Hours

FOODMAX BOOTS — CHEMICAL PERMEATION

CHEMICAL	CAS NO.	METHOD	BREAKTHROUGH TIME
Acetone	67-64-1	EN374-3	Over 0.5 HOUR
Acetonitrile	75-05-08	EN374-3	Over 1 HOUR
Ammonia Gas	7664-41-7	EN374-3	Over 4 HOURS
Carbon Disulphide	75-15-0	EN374-3	Over 1 HOUR
Chlorine Gas	7782-50-5	EN374-3	Over 8 HOURS
Dichlorobenzene	95-50-1, 106-46-7, 541-73-1	EN374-3	Over 7 HOURS
Dichloromethane	75-09-02	EN374-3	Over 1 HOUR
Diethylamine	109-89-7	EN374-3	Over 2 HOURS
Dimethyl Formamide	68-12-2	EN374-3	Over 1 HOUR
Ethanol	64-17-5	EN374-3	Over 8 HOURS
Ethyl Acetate	141-78-6	EN374-3	Over 2 HOURS
Hexane	110-54-3	EN374-3	Over 3 HOURS
Hydrogen Chloride Gas	7647-01-0	EN374-3	Over 8 HOURS
Lactic acid	50-21-5	EN374-3	Over 8 HOURS
Methanol	67-56-1	EN374-3	Over 4 HOURS
Nitro Benzene	98-95-3	EN374-3	Over 8 HOURS
Oleic acid	112-80-1	EN374-3	Over 7 HOURS
Phosphoric acid	7664-38-2	EN374-3	Over 8 HOURS
Potassium Hydroxide 40%	1310-58-3	EN374-3	Over 8 HOURS
Sodium Hydroxide 40%	1310-73-2	EN374-3	Over 8 HOURS
Sodium Hypochlorite 16%	7681-52-9	EN374-3	Over 8 HOURS
Sulphuric Acid 96%	7664-93-9	EN374-3	Over 8 HOURS
Tetrachloroethylene	127-18-4	EN374-3	Over 2 HOURS
Tetrahydofuran	109-99-9	EN374-3	Over 0.5 HOURS
Toluene	108-88-3	EN374-3	Over 3 HOURS

TASKPRO BOOTS — CHEMICAL PERMEATION

CHEMICAL	CAS NO.	METHOD	BREAKTHROUGH TIME
Acetone	67-64-1	EN374-3	Over 0.5 HOUR
Acetonitrile	75-05-08	EN374-3	Over 1 HOUR
Ammonia Gas	7664-41-7	EN374-3	Over 4 HOURS
Carbon Disulphide	75-15-0	EN374-3	Over 1 HOUR
Chlorine Gas	7782-50-5	EN374-3	Over 8 HOURS
Dichlorobenzene	95-50-1, 106-46-7, 541-73-1	EN374-3	Over 7 HOURS
Dichloromethane	75-09-02	EN374-3	Over 1 HOUR
Diethylamine	109-89-7	EN374-3	Over 2 HOURS
Dimethyl Formamide	68-12-2	EN374-3	Over 1 HOUR
Ethanol	64-17-5	EN374-3	Over 8 HOURS
Ethyl Acetate	141-78-6	EN374-3	Over 2 HOURS
Hexane	110-54-3	EN374-3	Over 3 HOURS
Hydrogen Chloride Gas	7647-01-0	EN374-3	Over 8 HOURS
Methanol	67-56-1	EN374-3	Over 4 HOURS
Nitro Benzene	98-95-3	EN374-3	Over 8 HOURS
Oleic acid	112-80-1	EN374-3	Over 7 HOURS
Phosphoric acid	7664-38-2	EN374-3	Over 8 HOURS
Potassium Hydroxide 40%	1310-58-3	EN374-3	Over 8 HOURS
Sodium Hydroxide 40%	1310-73-2	EN374-3	Over 8 HOURS
Sodium Hypochlorite 16%	7681-52-9	EN374-3	Over 8 HOURS
Sulphuric Acid 96%	7664-93-9	EN374-3	Over 8 HOURS
Tetrachloroethylene	127-18-4	EN374-3	Over 2 HOURS
Tetrahydofuran	109-99-9	EN374-3	Over 0.5 HOURS
Toluene	108-88-3	EN374-3	Over 3 HOURS

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Boots

UK	3	4	5	6	7	8	9	10	11	12	13	14	15
EU	35	36	37	39	41	42	43	44	45	46	47	49	50
US	4	5	6	7	8	9	10	11	12	13	14	15	16

Overboots

	Medium	Large	Extra-Large
UK	6 - 8	9 - 11	12 - 15
EU	39 - 42	43 - 45	46 - 50
US	7 - 9	10 - 12	13 - 16

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