

UNDERSTANDING SKIN IRRITATION IN THE WORKPLACE

Hand Protection Whitepaper

INTRODUCTION

Damage to the hands is one of the most common occupational injuries¹, with skin infections and irritations among the most typical conditions suffered by workers².

After providing a brief introduction to the skin and its main functions, this whitepaper explores the most common sources and causes of skin damage and irritation in the workplace that need to be considered in order to protect a worker's hands effectively. It also looks at the effects of hand skin damage, from physical injuries through to the potential financial consequences, and highlights why protecting a worker's hands should be at the heart of every employer's health and safety strategy.

Finally, the whitepaper offers an overview of the legislation and standards that are in place to protect workers against hand injuries and explains how personal protective equipment (PPE) can mitigate injuries and irritations to help employers ensure compliance.



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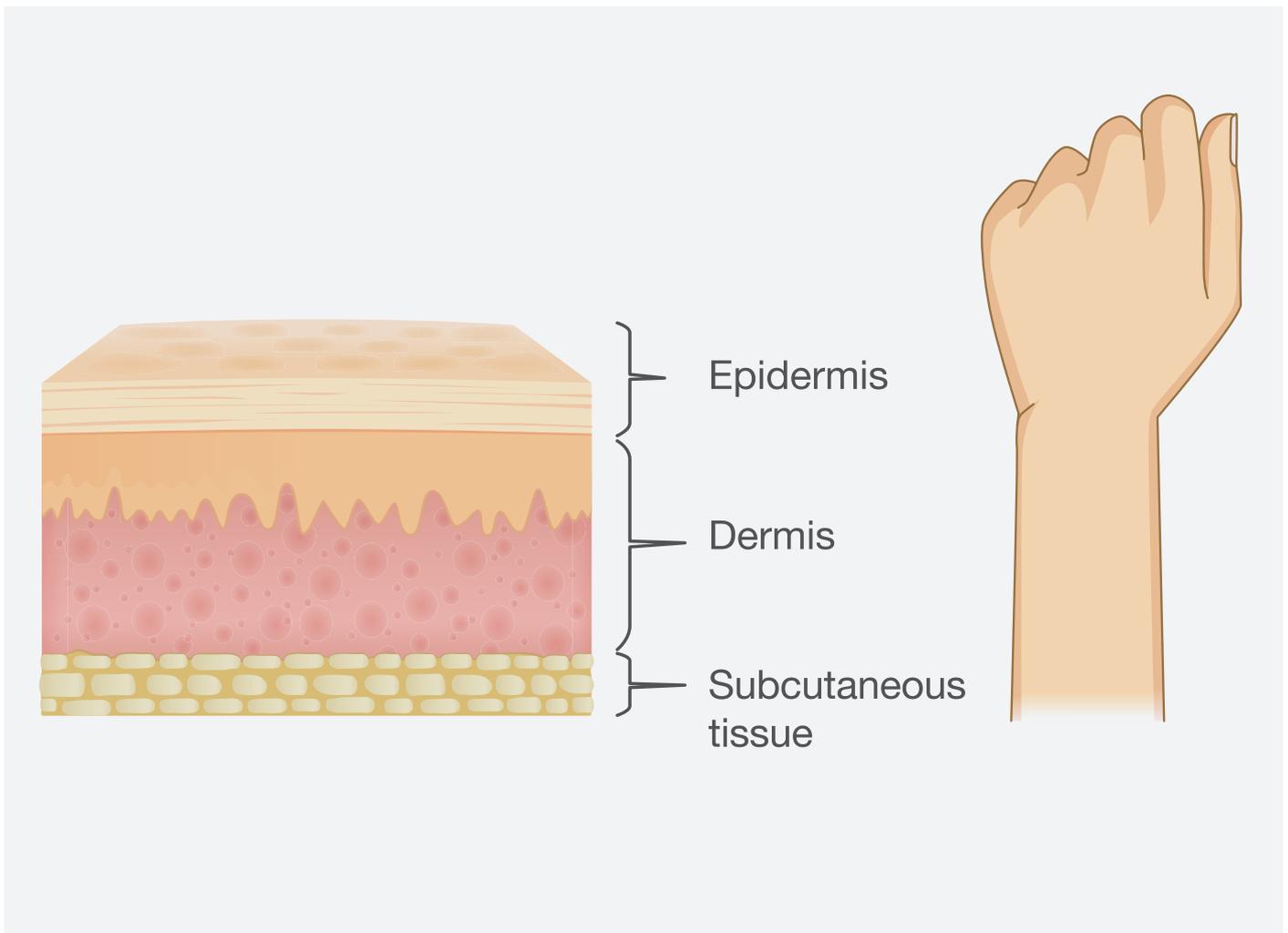
THE SKIN: WHY IT MATTERS

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The skin is the largest organ of the human body. It is the soft outer tissue that guards and protects our muscles, bones, ligaments and internal organs. A strong yet also delicate organ, its thickness varies depending on where it is on the body. For example, the skin is at its thinnest under the eyes and around the eyelids, and thickest on the palms of the hands and the soles of the feet (around 4mm thick).

STRUCTURE

The skin consists essentially of two layers – the epidermis and the dermis. However, these are separated and joined by a basement membrane and the dermis is divided into two areas - the papillary region and the reticular region.



THE EPIDERMIS

The epidermis comprises the outermost layers of the skin. It forms a protective barrier over the surface of the body while retaining water and acting as a barrier against pathogens. It is made up of five further layers, which provide mechanical strength. The epidermis contains no blood vessels and cells in the deepest layers are nourished by diffusion from blood capillaries, which extend to the upper layers of the dermis.

THE BASEMENT MEMBRANE

The epidermis is separated from the dermis by the basement membrane, which is essentially a thin sheet of fibres that is created through the action of both tissues.

The basement membrane controls the movement of the cells and molecules between the dermis and the epidermis and also acts as a reservoir for the controlled release of growth factors during repair processes.

THE DERMIS

The dermis provides tensile strength and elasticity to the skin through a matrix made up of collagen fibrils, microfibrils and elastic fibres. The dermis contains the nerve endings responsible for sensing touch and heat. It also contains hair follicles, sweat and sebaceous glands, lymphatic vessels and blood vessels.

Structurally, it features two areas – the papillary region and the reticular region. The former provides the dermis with an irregular surface, strengthening the bond between the two layers of skin. The reticular region lies deep in the papillary region and is made of dense, irregular connective tissue.

It has a high concentration of collagenous, elastic and reticular fibres to give strength, extensibility and elasticity to the dermis.

Seven Functions of the Skin

The skin is one of the most versatile and vital organs of the human body, performing a number of important functions:

1. It allows sensation: It contains nerve endings which react to heat and cold, touch, pressure, vibration and tissue injury.
2. It helps to control body heat: Sweat glands and dilated blood vessels aid heat loss, while constricted vessels reduce blood flow and conserve heat.
3. It controls evaporation: It provides a relatively dry, semi-impermeable barrier to reduce fluid loss.
4. It acts as a storage centre for water and lipids.
5. It can absorb small amounts of oxygen, nitrogen and carbon dioxide.
6. It acts as a water-resistant barrier to prevent the loss of essential nutrients.
7. It acts as an anatomical barrier to pathogens and protects the body from the outside environment.

GENERAL SOURCES OF SKIN DAMAGE AND IRRITATION

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Despite its versatility, the skin is also vulnerable. There are three main sources of potential damage, infection and irritation:

- Mechanical and electrical
- Radiological and environmental
- Chemical

Some of these sources can be found in a domestic environment, but are more often found in the workplace where they are at their most dangerous.

MECHANICAL, THERMAL AND ELECTRICAL SOURCES

Although the skin has great elasticity and strength, it can be easily cut by sharp objects. It can also be bruised by strong forces that it comes into contact with and burnt by excessive ambient heat or cold. These potential dangers are common in many industries and will be discussed in more depth later in this paper.

RADIOLOGICAL AND ENVIRONMENTAL SOURCES

The most common form of radiological skin damage results from over-exposure to UV radiation. Whereas 'sun bathing' is often seen as a pleasurable activity during leisure time, UV exposure can pose a serious threat to workers spending long periods outdoors, particularly in hot, sunny climates or even in closed rooms, working e.g. with UV lamps.

CHEMICAL SOURCES

A wide range of chemicals can cause damage or severe skin irritation. But what is a chemical? Essentially, a chemical is any substance consisting of matter. It can be liquid, solid or gas. It can be a pure substance or an element from the periodic table, or it can be a mixture of elements. Chemicals occur naturally and can also be made artificially.

Artificial chemical compounds can be found in all areas of our lives but especially in the working environment. Such chemicals are developed for specific purposes. Detergents, for example, are produced for cleaning, while epoxy resins are used in a variety of industries as coatings and adhesives. Unfortunately, prolonged and sometimes even limited exposure to certain chemicals can damage the skin, cause irritation or even long-term diseases.

CAUSES OF SKIN IRRITATION AND DAMAGE AT WORK



CUTS, ABRASIONS AND BURNS

Anyone who works with sharp or pointed tools, products or equipment is at risk of cuts and abrasions. Similarly, anyone working within proximity of unguarded machinery, or in areas where materials or products are transported nearby, can suffer cuts and abrasions. Burns can be caused by unwanted exposure to hot surfaces and serious burns can be caused by an unearthed electricity supply, arcing systems or electrostatic discharge. They can also be caused by exposure to extreme cold. These dangers are present in a number of industries and frequently found in engineering, automotive, construction, oil and gas, aerospace, logistics, maintenance, food and beverage and manufacturing environments.



CHEMICALS

It is not just the chemical or petrochemical sectors that use chemicals. There are many other industries in which chemicals are routinely used. Metal and foundry workers, for example, use oils and greases, as do motor mechanics. These are chemicals. Various chemicals are also used in catering, printing and even in hairdressing environments. Chemicals that can cause damage or irritation range from lubricating oils to epoxy resins, from acids and alkalis to detergents and antiseptics. These are discussed in more detail, together with the types of irritation they can cause, in Chapter 4.



PERSONAL PROTECTIVE EQUIPMENT (PPE)

The most effective and reliable way to prevent skin problems in the workplace is to develop processes to avoid contact with harmful substances or objects that can cause cuts or bruises. When this is not possible, PPE such as safety gloves can play a key role in protecting a worker's hands. However, what is sometimes not realised is that, unless carefully selected, the gloves themselves can actually cause skin irritation or damage. For example, a worker can suffer a hand injury if they are allergic to the glove's material or if there are broken glass fibres in mechanical protection gloves. With this in mind, gloves should always be selected based on the specific task at hand. Similarly, gloves can get old and lose their protective ability. To prevent damage resulting from insufficient protection, they should be regularly inspected and discarded or replaced if needed.

CHEMICALS IN THE WORKPLACE AND THEIR DANGERS

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Work-related skin problems are very common¹ and are often caused by exposure to, or contact with, a wide range of chemicals. They can also be caused by having wet hands for long periods, particularly in combination with soaps and detergents.

With this in mind, employers need to be able to identify any chemicals that could cause problems. As mentioned earlier, a wide range of chemicals is used in industry and commerce and, by law², hazardous chemicals should always be labelled. A label should include:

- The name of the substance
- The origin of the substance
- A danger symbol or pictogram
- An indication of the danger involved in using the substance
- A reference to the special risks arising from such dangers (typical symbols indicate that a substance is explosive, an oxidizer, flammable, harmful, a toxic irritant, corrosive or harmful to the environment).



SKIN INFECTIONS AND IRRITATIONS ARISING FROM EXPOSURE TO CHEMICALS

There are two basic substances which cause irritation to the skin: irritants and allergens. Both of these can cause contact dermatitis. Contact dermatitis is a type of eczema, triggered by contact with a particular substance. It causes the skin to become red, blistered and dry. This reaction usually occurs within a few hours or days of exposure to the irritant or allergen and symptoms most commonly affect the face or the hands.

In some cases, contact dermatitis can occur as allergic contact dermatitis. Typical symptoms include itching, blistering and reddening of the skin. The first time a person is exposed to an allergen (a substance they are allergic to) the body becomes sensitized to it, but doesn't react. However, when exposed to that substance again, the body's immune system reacts and causes the symptoms mentioned.

In some cases, an allergic reaction may cause urticaria or hives. This presents itself as a raised itchy rash, which can vary in size from a few millimetres to the size of a hand. It occurs when a trigger causes high levels of histamine and other chemical messengers to be released in the skin. These substances cause the blood vessels in the affected area of the skin to open up and become leaky. The extra fluid in the tissue causes swelling and itchiness. Typical causes of urticaria in the industrial environment include an allergic reaction to latex, pressure to the skin or a change in water composition.



MOST COMMON PROFESSIONS WHERE CHEMICALS ARE A RISK

Many workers in many industries regularly come into contact with substances that can cause irritation or damage to the skin. These include:

1. Agricultural workers
2. Beauticians and hairdressers
3. Chemical workers
4. Cleaners
5. Construction workers
6. Cooks and caterers
7. Metal workers
8. Machine operators
9. Health and social care workers
10. Aerospace production workers
11. Workers in the electronics industry
12. Mechanics and vehicle assemblers in the automotive sector
13. Textile workers
14. Pharmaceutical workers
15. Workers in the oil and gas sector
16. Workers in the rubber and plastics industries

While the above list isn't exhaustive, it does provide some indication of the size of the problem.

A WIDESPREAD ALLERGEN: EPOXY RESINS

Epoxy resin formulations are used across a wide variety of industries. They find use as coatings and adhesives and are widely used in composites engineering in carbon fibre and fiberglass structures, especially in the aerospace sector. They are also used in the electronics industry in motors, generators, transformers, switchgear and insulators, as they have excellent insulating properties. In the U.S. alone, the epoxy market is currently worth more than \$22 billion³.

The primary risk associated with epoxy use is often related to the hardener component and not the epoxy resin itself. Amine hardeners are particularly corrosive but may also be toxic or even carcinogenic.

Liquid epoxy resins, in their uncured state, are mostly classed as irritant to the eyes and skin. One particular risk is sensitisation and this risk has been shown to be more pronounced in epoxy resins containing low molecular weight epoxy dilutants. Exposure to epoxy resins over time can also produce an allergic reaction, in the form of allergic contact dermatitis as outlined above.

TEN MOST COMMON IRRITANTS CAUSING CONTACT DERMATITIS:

1. Soaps and detergents
2. Solvents
3. Regular contact with water
4. Antiseptics and antibacterials
5. Perfumes and preservatives in toiletries or cosmetics
6. Machine lubricating or cutting oils
7. Disinfectants
8. Acids and alkalis
9. Cement
10. Powders, dust and soil

However, some substances that are not considered hazardous, and are consequently not labelled, can also cause skin irritation and damage, as discussed later in this whitepaper.



EFFECTS AND COSTS OF SKIN IRRITATION OR DAMAGE AT WORK

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FINANCIAL COSTS TO EMPLOYERS

When employees are injured, they often have to take time off work. And, if the injury is work-related, the employer must continue to pay the worker's wages, as well as any insurance contributions. A worker's absence also has to be covered by other workers and re-training costs may well be incurred as a result. In addition, further administration-related costs can be suffered. Workplace injuries and new cases of work-related ill health cost British employers £2.9 billion in the financial year 2016¹.

In serious cases, skin damage or irritation may result in litigation. The costs of which have to be borne by the company if it's proven that reasonable protection was not provided.

Finally, there is the significant cost of damage to a company's reputation, especially if the accident receives extensive publicity.

Consequently, it is vital that employers are aware of the legislation covering accidents at work, paying particular attention to regulations affecting skin damage at work.

OVERVIEW OF EUROPEAN LEGISLATION AND STANDARDS COVERING SKIN DAMAGE AT WORK

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Employers must control exposure to materials that cause skin diseases and to substances that can enter the body through the skin and cause other problems. According to various European regulations and guidelines, employers must provide employees with appropriate PPE if it isn't possible to prevent cuts, abrasions or exposure to hazardous chemicals. The times of PPE use should be documented.

Evidence suggests that the hands are the most vulnerable part of the body in the workplace and they are most likely to suffer damage or skin irritation. According to the German Official Accident Insurance office (DGUV), 33% of all reportable industrial accidents and injuries in 2015 are related to the hands³. Consequently, protective gloves are one of the most used forms of PPE.

However, it is important to select gloves which are fit-for-purpose, in line with the latest European and national standards. For example, gloves that are used to protect against mechanical risks are covered by the European standard EN 388, while gloves that protect against chemicals are governed by EN 374⁴. There are further European standards that establish fitness for purpose of gloves used in extreme cold, extreme heat, anti-static environments, gloves made of insulating materials and others.

Gloves manufactured to EN 388 are subjected to stringent tests to prove their resistance to cuts and abrasion, while gloves manufactured to EN 374 must prove to be resistant to various chemicals. This resistance must be against penetration by chemicals and also against permeation⁵. In addition, permeation resistance must be proven to last for minimum periods of exposure to specific chemicals.

It is important to remember that no one pair of gloves provides protection against all chemicals. Gloves are tested for protection against specific chemicals and care must be taken in selecting gloves to ensure that they are suitable for particular tasks.

More information on the European standards on hand protection can be found in our Technical Guide on Standards.



Legislation, both at European and national levels, exists to ensure that employees are protected from work-related skin damage and irritation¹.

PROTECTING THE HANDS AND THE ROLE OF PPE

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As previously mentioned, the first line of defense should always be to try and avoid contact with materials and substances that cause skin injuries or diseases. Additionally, employers are legally required to provide workers with appropriate health and safety training¹, which is vital to raise awareness of hand-related risks. However, whenever a task that can put a worker's hands at risk cannot be avoided, an employer's duty of care towards their employees includes providing the correct PPE for the tasks at hand.

Having identified the substances to be handled, all other risks involved in the tasks should then be identified, for example cut or puncture risks during use. In this instance, a glove that provides both chemical and mechanical protection should be considered.

Comfort is another major consideration in glove selection and although, generally speaking, thicker gloves provide greater protection, they can be more uncomfortable and cumbersome to wear. Similarly, if the contact with the substance is by immersion, rather than occasional splashing, then longer gloves covering the forearms should be considered. The glove material itself is important as some people suffer a reaction to latex, so other materials should be considered. The type of material must especially be considered to identify the best level of protection against certain chemicals.

Finally, it is fundamental that any gloves selected should conform to European and national standards. Specific requirements at a company level should also be considered after a risk assessment has taken place. Consequently, employers should work with a trusted supplier to ensure that gloves are of sufficient quality and are certified fit-for-purpose. It is vital that employers seek expert consultation to obtain information such as detailed permeation times for certain chemicals and select the most appropriate gloves against different types of chemical risks.

Five main considerations for glove selection:

1. Identify the substances to be handled (know your chemicals)
2. Identify all other hand injury risks involved in the tasks
3. Identify the type and duration of contact with the substance
4. Ensure that the gloves fit well, are suitable for the task and are made of a material which doesn't cause skin irritation
5. Ensure that the gloves conform with current standards



CONCLUSIONS

There is a wide variety of industries in which a worker's hands are at risk from skin irritants and conditions that deserve particular attention from employers. Whilst some may be more obvious or more serious than others, in all cases, they should be managed carefully. Chemicals and other substances can result in serious injuries and diseases, which can translate into significant human as well as financial costs. With this in mind, knowing the chemicals and other risks that workers may be exposed to is vital to provide them with the level of hand protection they need.

Guidelines and legislation are in place both to inform and regulate this protection. Specifically, these stipulate that where risks cannot be controlled at source, appropriate PPE should be provided. This is a real responsibility and can only be achieved by choosing PPE that is fully certified for specific tasks and obtained from a reliable and trusted supplier.

*Author : Stéphanie Quilliet,
Former Strategic Product Leader EMEA for Head and Body at Honeywell*

NOTES

Introduction

- ¹. *Statistics of Deutsche Gesetzliche Unfallversicherung (DGUV) 2015*
- ². <https://www.iosh.co.uk/en/Books%20and%20resources/Our%20OH%20toolkit/Skin%20disorders#Statistics>

Chapter 4

- ¹. <https://www.iosh.co.uk/en/Books%20and%20resources/Our%20OH%20toolkit/Skin%20disorders#Statistics>
- ². EC 1272/2008. Labelling law also known as the CLP Regulation
- ³. Acmite Market Intelligence – Global Epoxy Resin Market Report 2017

Chapter 5

- ¹. <http://www.hse.gov.uk/statistics/overall/hssh1617.pdf>

Chapter 6

- ¹. Directive 98/24/EC - risks related to chemical agents at work <https://osha.europa.eu/en/legislation/directives/75>
- ². The Framework Directive 89/391/ECC, with its wide scope of application, and further directives focusing on specific aspects of safety and health at work are the fundamentals of European safety and health legislation. For further information visit: <https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/the-osh-framework-directive-introduction>. European Directives 89/686/ECC (repealed with effect from 21 April 2018 by Regulation (EU) 2016/425), ensures common standards for personal protective equipment (PPE) in all Member States in terms of protection of health and the safety of users. For further information visit: <https://osha.europa.eu/en/legislation/directive/regulation-eu-2016425-personal-protective-equipment>.
- ³. *Statistics of Deutsche Gesetzliche Unfallversicherung (DGUV) 2015*
- ⁴. Part of European Standards for Protective Gloves are:
EN 420 Basic standard
EN 388 Protection against Mechanical Damage
EN 374 Protection against Chemicals
EN 511 Protection against Low Temperatures
EN 407 Protection against High Temperatures
EN 16350 Anti-static Gloves
EN 60903 Gloves made from Insulating Material
- ⁵. Penetration is the flow of chemicals and micro-organisms through porous material, seams, small holes or other small defects in the glove material. Permeation occurs when chemicals pass through the glove material on a molecular level.

Chapter 7

- ¹. <https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1>

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For more information

sps.honeywell.com

Honeywell Safety Products UK LTD

Honeywell House, Skimped Hill Lane,
Bracknell, Berkshire RG12 1EB
United Kingdom
Phone: +44 (0) 1256 274938
Email: info-uk.hsp@honeywell.com
www.sps.honeywell.com/gb/en

Honeywell Safety Products Nordic AB

Box 15 147
SE-167 15 Bromma – Sverige
Phone: +46 (0) 424480433
Email: info-nordic.hsp@honeywell.com
www.sps.honeywell.com/gb/en

www.honeywell.com

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