Honeywell | Hand Protection

TECHNICAL GUIDE

Understanding Key Hand Protection Standards
for Heavy-Duty Industrial Workplaces

Introduction

From operating complex machinery to handling hazardous substances, workers in industrial workplaces are particularly vulnerable to hand injuries. It's a far-reaching problem that affects worksites across the globe. In the United States, hand injuries are consistently #1 on the list of recordable incidents each year for industries like oil and gas.[1] These incidents add up – compounding the problem with lost time and profits. Over 3.2 million workplace accidents resulted in lost time for workers in the European Union during 2015.[2]

This technical guide will highlight several of the most common – but avoidable – risks to worker safety, as well as the impact of these risks on company productivity. Health and safety managers will learn about recent and upcoming changes to regulations and standards for personal protective equipment (PPE), and how to select the right hand protection for the unique needs of their environment and tasks.

Knowing and understanding how to comply with these standards and regulations are key to ensuring that workers in highly dangerous environments are able to perform their jobs effectively while remaining safe and healthy.

Table of contents

The causes and costs of hand-related injury

of U.S. workers who injured their hands **WEREN'T WEARING GLOVES.**[3]

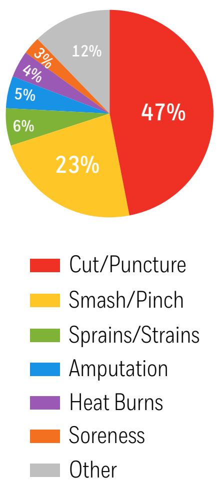
When it comes to risk reduction on industrial worksites you need a full hierarchy of controls: from the perspective of both engineering and administration, as well as the selection of personal protective equipment (PPE), each level plays an important role in mitigating hand injuries.

That's critical because in heavy-duty environments there is no shortage of hazards that can injure unprotected hands. With 27 separate bones articulated by a complex web of tendons, ligaments, muscles and nerves, the hand is as precisely engineered as any tool on the job. It's this incredible precision that makes hands so adept at complicated tasks – and so vulnerable to injury.

This vulnerability makes consistently wearing hand protection a top safety priority. 70% of U.S. workers who've injured their hands on the job weren't wearing gloves at the time.[3] As many as 20 amputations, 180 fractures and 455 lacerations each year result from being caught in, or struck by tools or similar machinery.[4] That's what makes hands the fifth most common occupational injury, according to the Bureau of Labor Statistics.

The world over, hands are your workers' most vital and vulnerable tool. Understanding the hazards workers encounter is the first step to keeping them safe.

The hazards



23%
of all injuries reported were to fingers and hands.[4]

47%
of hand injuries are cuts and punctures.[5]

The types and sources of hand injuries may be more prevalent than you realize. The threat of smashes and pinches is present wherever heavy tools or materials are being handled. According to a US Department of Labor study, injuries to fingers and hands accounted for more than 23% of all injuries reported, making them the highest in preventable injuries and in terms of lost work days.[4] A less obvious impact on hand health is vibration from equipment like jackhammers, drills or even sledgehammers, which can lead to compromised grip strength over time.

Common building materials such as glass, metal and wood can result in cuts and slices when not handled correctly. The tools workers use – box cutters, knives, punch presses and other edged machinery – also come with the potential for danger. A wide array of common industrial materials can result in abrasions from slings and wire ropes, nails and screws, even steel shims or scrap metal.

Punctures can be large wounds caused by objects like wood slivers or metal burrs, but they can also result from smaller materials, such as frayed wires. The latter often go unnoticed or neglected, which can lead to infection. There's also the risk of lacerations, which usually start as punctures, dragging and then tearing the skin as the hand makes contact. Together, cuts and punctures account for 47% of hand injuries in the U.S.[5]

The costs

$21,918
average cost per injury.[7]

$151.1 BILLION
spent in 2016 on workplace injuries.[9]

No matter the cause, when injuries occur on the job everyone pays the price. According to the Bureau of Labor Statistics and the National Safety Council, the financial toll of the 186,830 hand injuries reported in the U.S. during 2012 had an average cost of $21,918 per injury.

That price tag includes medical costs and indemnity but does not factor in the loss of time. Hand injuries combined for over 100 million days lost in the U.S. during 2016. Many workers go on to require rehabilitation, an additional investment of time that varies greatly based on the severity of the injury. An additional 55 million additional days are projected to be lost in future years due to injuries from 2016.[6] In some cases, workers never regain adequate hand function, which effectively ends their career. This also results in the loss of years of experience when they exit the workforce.

Across Europe, hand injury payouts are as common as they are costly. Moderate hand injuries involving cuts and crushes in the U.K. during 2018 led to settlements ranging between £800 and £3,800. In extreme cases, such as amputations, the cost can reach as high as £177,000 for pain and suffering.[8]

All together, The National Safety Council estimates that the financial cost of work-related death and injuries in 2016 totaled up to $151.1 billion when factoring in income not received or expenses incurred. [9]

The choices

The negative impact of hand injuries is apparent. The right solution, less so. Heavier-gauge gloves offer greater hand protection against cut and abrasion injuries, while thinner ones provide more dexterity and tactile sensitivity. For gloves intended to be worn all day, prioritizing comfort becomes vital. In cold weather or around molten metals, insulation becomes a deciding factor. And let's not forget enhanced grip for slippery objects, or chemical protection for dangerous substances. There is so much to consider.

It's critical to assess the unique hazards of each worksite, whether they be cuts, abrasions, chemical exposure or extreme temperatures. Personal protection equipment is crucial in any safety program and has been proven to reduce the risk of hand injury by as much as 60%.[7]

Health and safety managers have more choices than ever when it comes to PPE for hands. Much of this is due to advances in technology and the development of new materials. Manufacturers now produce a wide range of gloves – each with unique characteristics and advantages – to protect workers in a variety of high-risk industries. From this abundance of choice arises complexity and with it a need for a baseline of performance and reliability.

The absence of any comprehensive performance standard makes evaluating and comparing the impact protection of similar products difficult. As managers try to balance correctly equipping their workers with the need to stay cost-effective, ambiguity around how a glove will meet the needs of the job becomes a dangerous gamble.

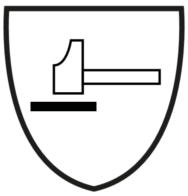
There is no one-size-fits-all solution for hand protection. However, when paired with a thorough understanding of the latest hand protection standards, proper glove selection can be a valuable way to create a safer workplace, bolster employee morale and help increase overall productivity.

Hand protection standards

In both the U.S. and Europe, existing standards for industrial gloves have addressed cuts, abrasion, punctures and chemical exposure. Impact injuries, to which the back of the hand is particularly vulnerable, only recently became included in that standardization; first with Europe establishing guidelines in 2016, and the U.S. now following suit.

The American National Standards Institute (ANSI) administers and coordinates the U.S. voluntary standards and conformity assessment system. The International Safety Equipment Association (ISEA), which is accredited by ANSI, works with manufacturers, test labs, subject matter experts, end-users and government agencies in the standards development process. The results of each test are assigned a rating that can be found printed on the glove.

EN 388



EN 388: 2016 Protective Gloves Against Mechanical Risks (European Standard)

The EN 388: 2016 standard relates to gloves providing protection against mechanical risks: abrasion, cutting, tearing and puncture, and an option for impact-resistance. To meet this standard, gloves must pass a series of tests against these risks:

1. **Abrasion** tests are usually carried out in a Martindale Abrasion Tester, where samples are cut from the palms of gloves and are subjected to rubbing against glass paper until a sample wears and a hole appears. The performance of the sample is measured as the number of abrasion rubs before sample breakthrough, from Level 1, which is awarded if the sample can withstand up to 100 rubs, to Level 4, where the accepted limit is 8000 rubs. The achieved level of abrasion resistance is indicated on the glove. Recent changes to this test have resulted from the change of specification of the abradant paper.

2. **Cut** resistance testing equipment, such as the TDM-100 that's used for EN ISO 13997 standardization, is specially designed for testing gloves. It involves lowering a horizontal blade onto a clamped sample of the glove material and then passing this blade back and forth across the sample until penetration occurs. The number of cycles of the rotating blade is used to determine the cut index, which ranges from Level 1, indicating one or two cycles, to Level 5, indicating 20 cycles.

   There have been recent changes to this test method (known as the Coupe test), to mitigate the effect of dulling of the test blade. The new TDM-100 test, according to EN ISO 13997, is applied to materials prone to blunting the blade, and gloves are now rated from A to F as shown in the table below. Gloves tested using the Coupe test are marked 1 to 4 and, in addition to that, those which have been subjected to the new test are marked A to F. All gloves from Level 4, according to the Coupe test, must also be tested to EN ISO 13997. Honeywell already exceeds these requirements as all gloves from Level 3 undergo this test.

Honeywell EN 388 guide, according to the EN ISO 13997 TDM cut test method:

	LOW Cut protection level	MEDIUIM Cut protection level	HIGH Cut protection level		EXTRA HIGH Cut protection level	
Peformance level rating	A	B	C	D	E	F
Cut resistance (Newton)	› 2	› 5	› 10	› 15	› 22	› 30
Suggested applications	Light material handling without sharp-edged objects, part assembly, automotive maintenance, construction, multipurpose.	Packaging, warehouse, light metal stamping, automotive and white goods parts assembly.	Light-duty sheet metal and glass handling, metal stamping, plastics, tire production, automotive and white goods industries.	Sheet metal and glass/bottle handling, metal stamping, light duty meat and poultry handling, carpentry, printing.	Heavy-duty sheet metal handling, plate glass handling, metal recycling, waste management, meat and poultry handling, printing.	Heavy-duty sheet metal handling, metal recycling, waste management, heavy-duty meat processing, slaughterhouses.

3. **Tear** resistance tests are carried out by clamping a sample of material in the jaws of a strength testing machine and measuring, in newtons, the force required to tear the material. Gloves tested for tear resistance are then marked from 1 to 4, where 1 indicates a tearing force of 10 newtons and 4 indicates a force of 75 newtons.

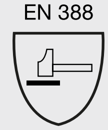
4. **Puncture** resistance tests are based on the amount of force, in newtons, required to pierce a sample with a standard-sized point. Again, gloves are rated from 1 to 4 and this is indicated on the glove.

5. **Impact,** an optional test EN13594:2015, is adapted from protection standards for motorcycle gloves, which focuses on impact-resistant features added to the back of the hand or the knuckles. It is performed by dropping a 2.5kg weight that lands with 5 joules of force on the glove. The letter “P” is the new rating mark added to gloves that have passed.

In addition to the cut test, a protection against impact test will also be administered. Gloves will receive either a Pass or Fail rating based on the results of the impact protection test. Both of the new test results will be indicated as the last two alphabetical letters beneath the EN 388 shield.

This is an example of glove marking in line with the latest version of the EN 388:2016 standard:

EN 388



4X43CP

4 Abrasion (Cycles) > **1 to 4**
X Cut (Coupe Test) > **1 to 5, X if not tested**
4 Tear > **1 to 4**
3 Puncture > **1 to 4**
C New Cut (TDM Testscore) > **A to F, or X**
P New Impact Protection > **P *(if passed)**

* If the glove passes Impact protection standard > Possible to claim impact protection in adding “P” on marketing

ANSI
A6
Cut

ANSI-105: 2016 revision (U.S.) protective gloves against mechanical risks.
ANSI / ISEA 2016 is the latest revision to the voluntary industry standard used to help workers understand classifications that assist employers and product users in the selection of gloves for specific workplace exposures. The major change surrounds classification for cut resistance.

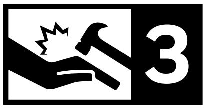
Why update the standard?
The old system had a disparate gap among the higher-level ratings. The newly updated standard includes additional classification levels to correct this. There was also a need to model the approach used in similar international guidelines.

What's been updated?
There are now nine levels of classification. See below comparison table of how the restructured ANSI cut levels compare to the previous ones. In order to limit the confusion of the old classifications to the current one, an "A" has been added. As an example, if a glove is classified as cut-level 1 using the updated standard, the glove would be rated an ANSI level A1 for cut protection

Old ANSI CUT-RESISTANT LEVELS (GRAMS)	**Updated ANSI** CUT-RESISTANT LEVELS (GRAMS)	
1 (≥200)	A1	200-499 grams to cut
2 (≥500)	A2	500-999 grams to cut
3 (≥1000)	A3	1000-1499 grams to cut
4 (≥1500)	A4	1500-2199 grams to cut
5 (≥3500)	A5	2200-2999 grams to cut
	A6	3000-3999 grams to cut
	A7	4000-4999 grams to cut
	A8	5000-5999 grams to cut
	A9	6000+ grams to cut

new levels

ANSI / ISEA 138



ANSI/ISEA 138: New Impact Protection (U.S.)

ISEA is made up of the leading PPE manufacturers, including glove manufacturers, as well as other safety product suppliers.

ISEA 138, the American national standard for performance and classification for impact-resistant hand protection, aims to improve on the fairly limited treatment of impact performance recently incorporated into the main European hand protection standard, EN 388. That standard took its cues from an existing motorcycle impact standard for hand protection. The ISEA 138 standard, by contrast, is specifically designed for industrial gloves and the special protection they offer to workers. The proposed ISEA 138 standard will, for the first time in the United States, provide industry-accepted test criteria to measure how effectively different dorsal impact protective gloves reduce peak impact force across the hand.

The ANSI/ISEA 138 standard's stated scope is to establish "minimum performance, classification and labelling requirements for hand protection products designed to protect the knuckles and fingers from impact forces, while performing occupational tasks."

It aims to evaluate compliant gloves "for their capability to dissipate impact forces on the knuckles and fingers" and to classify them accordingly. "The resulting classifications can be used by employers as a reliable means of comparing different products on an equal basis when selecting hand protection relative to the tasks being performed."

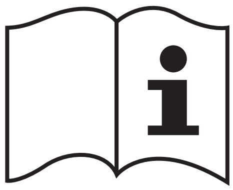
There are three performance levels specified by the standard, which offer a numerical representation for the impact protection a glove will offer, with the lowest protection offered by level one and the highest by level three. Under the standard, a higher performance level indicates a greater degree of protection.

Both EN 388 and ANSI/ISEA 138 use essentially the same test method, but there are key differences between the two:

- EN 388 is a pass/fail result, while ANSI/ISEA 138 incorporates three performance levels, giving greater choice and flexibility to the end user.
- EN 388 only covers knuckles, but ANSI/ISEA 138 will cover knuckles and fingers, which is critical for industrial glove users where the fingers are frequently at risk.

EN 388 (EUROPE)	**ANSI/ISEA** (USA)
Pass/Fail result	Incorporates three performance levels, giving greater choice and flexibility to the end user
Only covers knuckles	Will cover knuckles and fingers, which is critical for industrial glove users where the fingers are frequently at risk
EN 388 XXXXXP	ANSI / ISEA 138 1 ANSI / ISEA 138 2 ANSI / ISEA 138 3

EN 420



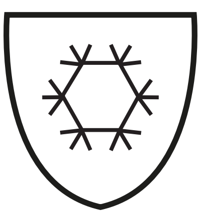
EN 420: General requirements and test methods for protective gloves (European Standard)

All protective gloves, no matter what their specific protection function, must comply with EN 420. This standard ensures that the glove materials are tested so that they don't put the workers that have to wear them at risk. Specifically:

- The pH of the gloves should be as close as possible to neutral.
- Leather gloves should have a pH value between 3.5 and 9.5.
- The highest permitted value for chromium is 3mg/kg.
- They should be sized by reference to an agreed common European hand size.
- If gloves have seams, they should not reduce their performance.
- Natural rubber gloves should be tested on extractable proteins to ensure they do not cause allergic reactions.
- For reusable gloves, the level of performance should not be reduced even after the maximum number of washes.

All relevant information, in line with the PPE regulations described above, should also be displayed on the glove packaging. Only when the requirements for EN 420 have been met can gloves progress to testing to meet other, more specific standards. As the EN 420 does not cover the protective properties of gloves, it should never be applied in isolation, but only in combination with the relevant specific standards.

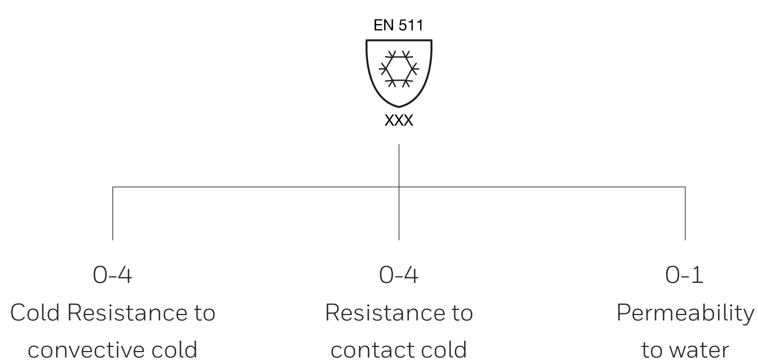
EN 511



XXX

EN 511: Protective gloves against cold (European Standard)

The pictogram for gloves providing protection against cold carries three digits. The first digit shows resistance to convective cold (0 to 4). The second digit shows resistance to contact cold (0 to 4) and the third digit shows permeability to water (0 or 1, where 0 signifies water penetration after 30 minutes and 1 means no water penetration after 30 minutes).



Conclusion

Since hand injuries are one of the most common injuries in many tough industrial environments, safety standards are continuously changing. And with the introduction of new heavy-duty equipment and better safety technologies, the standards often get more strict with each iteration. Keeping compliant can be difficult and expensive if you are not prepared. That's why when sourcing PPE for your workers, it's good to choose a partner who is constantly investing in design, technological research and user experience, and can help you stay ahead of safety legislation and will provide cutting-edge equipment that will help keep your workers safer.

Honeywell is innovating for safety.
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