Ultimate Industrial

HAND PROTECTION
STANDARDS & REGULATIONS 2019

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Guide to Hand Protection Standards

EN 420

General requirements and test methods

EN 420:2003+A1:2009 – 'Protective gloves. General requirements and test methods', is designed to ensure that the gloves themselves do not cause harm to the wearer and are comfortable to wear. EN 420 is currently under revision and will become EN ISO 21420 once the standard has been updated.

• **Length** - EN 420 includes a list of minimum lengths for each glove size, however, gloves for special purpose are permitted to be below the minimum length if they are 'fit for special purpose'.

• **Sizing** - Gloves are fitted on a hand of the size that they are intended to fit and comments are made regarding comfort and fit. The wearer then tries to pick up pins of varying size to provide an indication of dexterity.

• **pH Value** - The determination of pH value of both leathers and textiles on a glove is required. This pH value shall be greater than 3.5 and less than 9.5.

• **Chrome VI** - Each type of leather on a glove shall be tested separately and comply with the requirement of less than 3mg/kg of chromium VI.

EN 388:2003

Mechanical Risks

(Now revised to EN388:2016)

This is the most common European Standard for testing gloves to be used in general industrial applications. It is also referred to in many of the specialist glove standards, for activities such as welding and handling of chemicals. EN 388 was first published in 1994 and subsequently revised in 2003 and 2016. It includes four main physical tests to assess the resistance of the gloves palm area to mild abrasion, cutting, tearing and puncture. The performance of the glove is graded in accordance with four or five performance levels (the higher the number, the greater the protection). The end user is then able to select a glove with a performance level profile that suits a particular work activity.

A) Resistance to Abrasion (0-4) – Based on the number of cycles required to abrade through the sample given.

B) Blade Cut Resistance (0-5) – Based on the number of cycles required to cut through the sample at a constant speed.

C) Tear Resistance (0-4)– Based on the amount of force required to tear the sample.

D) Puncture Resistance (0-4) – Based on the amount of force required to pierce the sample with a standard sized point.

EN 388:2016

Mechanical Risks

On 2nd November 2016, a new version of the glove standard EN 388: Protective gloves against mechanical risks was published, superseding the previous version EN 388:2003. This EN388:2016 revision contains significant changes, most notably the methods employed to measure cut resistance and subsequent marking of products. The below will explain what has changed, why it has changed and how our products marking has changed.

Important to note:

• This revision will only affect new product certification and will not apply retrospectively.

• Gloves may continue to be sold under both versions of the standard until 2023, when, under the new PPE Regulation, their certification will need to be renewed.

• This renewal of certification must be to the latest version of the standard.

A) Resistance to Abrasion (0-4)– The internationally accepted Martindale Abrasion Tester is used to measure the wear of fabrics and can also be used to determine a fabrics susceptibility to pilling.

• The number of cycles required to make a hole in the test material relate to the 1-4 levels of abrasion performance. Product marked level '4' abrasion provide the highest level of abrasion resistance.

• The specification of the abrasive paper used in this test has changed.

• This revision, along with a number of additional minor changes to test materials, means that it is possible some abrasion scores may change when a product is recertified under the new test conditions.

Continued

EN 388:2016

Mechanical Risks

B) Blade Cut Resistance by Coupe Test (0-5)

Number of cycles required to cut a sample using a stainless steel circular blade under constant speed and a low force of 5 Newtons. For materials that dull the blade after 60 passes, it becomes mandatory to then test using the ISO 13997:1999 cut resistance method. (See below for further details)

C) Tear Resistance (0-5)

Force required to tear apart a sample of the gloves palm using a standard tensile test machine.

D) Puncture Resistance (0-4)

Samples are taken from the palm of a glove and the force required to penetrate the sample with a defined stylus using a compression test machine is measured. Four performance levels are defined in EN 388 ranging from level 1 = Puncture force > 20N to Level 4 = Puncture force > 150N.

E) Blade Cut Resistance (ISO cut test – A-F)

The Coupe test has been revised - limiting the maximum number of passes the blade makes to 60, if cut through has not occured. Under this revised standard, if a sample blunts the blade during the maximum 60 passes the blade can make during the Coupe test, it becomes mandatory to then test using the ISO 13997 cut resistance method, and this result is used to assess the gloves' performance and becomes the reference cut resistance value.

Force in Newtons (N) required to cut through a sample using a rectangular blade. This test is optional unless the blade in the Coupe Test becomes 'dull'. If this occurs, the ISO cut test becomes the reference performance result. A letter value is assigned as illustrated to the left.

Overview of Changes in Cut Resistance Testing Under EN388:2016:

• The revised standard now employs two cut resistance test methods; the 'Coupe Test' and the ISO 13997 cut resistance method.

• The ISO 13997 result becomes the reference to be used when assessing a glove's performance against cut hazards if the sample is proven to blunt the blade in the coupe test by more than a factor of 3 during the 60 cycle test.

• In this instance, an 'X' may be displayed in the place of a Coupe Test result as the second digit under the EN 388 pictogram.

Key Points to Remember

• The new EN 388 standard states there is no correlation between the 'old' Coupe test scores and the 'new' ISO test scores.

• Cut levels under the ISO test are categorised A-F - A being the lowest average load required to achieve the moment of cut-through, after the blade has travelled 20mm, and F being the highest (measured in Newtons).

• However, it is pertinent to remember both of these tests (Coupe and ISO Cut Test) will not always be used and even when they are both used, the new revision explicitly states there is no correlation between these two test methods. As there is no correlation, a user whose glove was previously marked under one test will not easily be able to identify a corresponding glove marked under the second, and the same glove now tested under the second method will have different markings that cannot be related to its previous one.

(F) Impact Resistance (P)

The old EN 388:2003 standard does not include a test to assess impact protection. Manufacturers now have the option to design gloves to offer protection against impacts, usually added to the back of the hand and/or knuckles. Testing is carried out in accordance with EN 13594:2015 6.9 'Protective Gloves for Motorcycle Riders' with the area of protection secured over a domed anvil and impacted at a strike energy of 5J. These gloves are then marked with a letter P after their other markings to show they have met this standard.

Level of Protection	1	2	3	4	5	
A: Abrasion Resistance (No of Cycles)	100	500	2000	8000	N/A	
B: Blade Cut Coupe Test (Index)	1,2	2,5	5	10	20	
C: Tear Resistance (Force in Newtons)	10	25	50	75	N/A	
D: Puncture Resistance (Force in Newtons)	20	60	100	150	N/A	
	A	B	C	D	E	F
E: ISO Cut (Force in Newtons)	≥ 2	≥ 5	≥ 10	≥ 15	≥ 22	≥ 30
F: (Force in Newtons)	Pass P	Fail				

EN 407:2004

Protection Against Thermal Hazards.

A general standard designed to be used for any glove which is to be designed and sold as providing protection against thermal hazards. The standard includes six thermal tests: burning behaviour, contact heat, convective heat, radiant heat, small and large splashes of molten metal plus reference to EN 388: 2016 and EN 420: 2003 for mechanical and general performance requirements.

	Performance Levels		1	2	3	4
a	Burning behaviour	After flare time	<= 20 s	<=10 s	<=3 s	<= 1 s
		After glow time	Not reqd.	<=120 s	<= 25 s	<= 5 s
b	Contact heat	Contact temperature	100 C	250 C	350 C	500 C
		Threshold time	>= 15 s	>= 15 s	>= 15 s	>= 15 s
c	Convective heat	Heat transfer delay	>= 4 s	>= 7 s	>= 10 s	>= 18 s
d	Radiant heat	Heat transfer delay	>= 7 s	>= 20 s	>= 50 s	>= 95 s
e	Small drops molten	Number of drops	>= 10	>= 15	>= 25	>= 35
f	Large quantity molten metal	Mass in grams	30 g	60 g	120 g	200 g

X in this test denotes NOT TESTED

BS EN 12477:2001 + Amendment No.1:2005

Welding and Allied Processess

This standard is specifically intended for gloves designed to be used during welding operations and allied processes. It includes reference to EN 420 requirements to ensure that the gloves themselves do not cause harm to the wearer, are comfortable and correctly sized.

Type B gloves are more suitable where a higher dexterity but lower protective properties would be required (such as during TIG welding) and Type A gloves are for more general welding and cutting operations where higher protection would be needed. Various requirements for thermal and mechanical testing are needed in order to mark product Type A or B.

EN 511:2006

Protective Gloves Against Cold

A general standard designed to be used for any glove which claims protection against cold environments. The standard includes two specific tests for assessing thermal insulation: convective cold and contact cold plus other low temperature performance tests in addition to requirements from EN 388 and EN 420. The glove's insulation properties may be affected by for example air temperature, humidity, wind speed, time of exposure, activity level, health and well being of the user. If wet, the glove may lose its insulative properties.

Gloves that pass the tests specified in this standard must also attain at least a performance level of 1 in the EN 388 abrasion and tear tests. If gloves attain less than a performance level of 2, then their resistance to both convective cold and contact cold must be reported as, maximum, level 1.

The pictogram (to the left) will be accompanied by a 3-character code:

A - Resistance to convective cold = based on the glove's insulating properties, this measures the transfer of cold through convection (performance levels 0 to 4, with 4 being the highest).

B- Resistance to contact cold = based on the glove's thermal capacity when in contact with a cold object (performance levels 0 to 4, with 4 being the highest).

C- Permeability to water = Glove's capacity to resist water penetration (0 = Fail; 1= Pass).

0 = Water penetration after 5 minutes (replaces the previous standard of 30 min).

1 = No water penetration after 5 minutes (replaces the previous standard of 30 min).

X = Not Tested

Explanation on levels of performance (Table relevant in ambient air temperature at a wind speed below 0,5 m/s.)

Performance Level	Minimum Using Conditions (˚C) Low Activity	Minimum Using Conditions (˚C) Medium Activity	Minimum Using Conditions (˚C) High Activity
1	-	10	-15
2	-	0	-30
3	8	-15	-
4	-10	-30	-

Risks Related To Food Contact

This symbol means the product is made from food approved constituents. Migration testing is performed to ensure that the article in contact with food meets the required standards. If both of these criteria are met, the Food Contact symbol can be applied to the glove and/or packaging. The framework regulation for food contact is Regulation (EC) 1935/2004. The materials and articles must be manufactured in accordance with good manufacturing practice so that, under normal or foreseeable conditions for their fair use, they do not transfer their constituents to food quantities which could:

- Present a danger to human health.
- Result in an unacceptable change in the composition of the foodstuffs or deterioration in the organoleptic characteristics thereof, for example affect taste, smell or appearance.

EN ISO 374-1 :2016

The ISO 374-1:2016 Standard has now been published; it specifies the requirements for protective gloves intended to protect the user against dangerous chemicals. The Standard stipulates the requirements for Permeation, Penetration and Degradation. This supersedes the previous standard EN 374:2013.

According to the new standard, gloves are classed as: **Type A, Type B** or **Type C** depending on their performance level and number of chemicals they can protect against. The table below lists the performance level and number of chemicals required for each type:

Marking of **Type C** Gloves (1 Chemical)

EN ISO 374-1:2016 TYPE C

X

Marking of **Type B** Gloves (3 Chemicals)

EN ISO 374-1:2016 TYPE B

XXX

Marking of **Type A** Gloves (6 Chemicals)

EN ISO 374-1:20016 TYPE A

XXXXXX

Classification	Minimum Performance Level required	Minimum number of Chemicals from the 18 listed
Type A	2 (min 30 minutes breakthrough)	6
Type B	2 (min 30 minutes breakthrough)	3
Type C	1 (min 10 minutes breakthrough)	1

The list of test chemicals has been increased from 12 in EN374-1:2003 to 18 in EN ISO 374:2016 to cover a wider range of potential applications. The full list of chemicals are:

	Code	Chemical	CAS Number	Class
	A	Methanol	67-56-1	Primary alcohol
	B	Acetone	67-64-1	Ketone
	C	Acetonitrile	75-05-8	Nitrile compound
	D	Dichloromethane	75-09-2	Chlorinated hydrocarbon
	E	Carbon disulphide	75-15-0	Sulphur containing organic compound
	F	Toluene	108-88-3	Aromatic hydrocarbon
	G	Diethylamine	109-89-7	Amine
	H	Tetrahydrofuran	109-99-9	Heterocyclic and ether compound
	I	Ethyl acetate	141-78-6	Ester
	J	n-Heptane	142-82-5	Saturated hydrocarbon
	K	Sodium hydroxide 40%	1310-73-2	Inorganic base
	L	Sulphuric acid 96%	7664-93-9	Inorganic mineral acid, oxidizing
NEW	**M**	**Nitric acid 65%**	**7697-37-2**	**Inorganic mineral acid, oxidizing**
NEW	**N**	**Acetic acid 99%**	**64-19-7**	**Organic acid**
NEW	**O**	**Ammonium hydroxide 25%**	**1336-21-6**	**Organic base**
NEW	**P**	**Hydrogen peroxide 30%**	**7722-84-1**	**Peroxide**
NEW	**S**	**Hydrofluoric acid 40%**	**7664-39-3**	**Inorganic mineral acid**
NEW	**T**	**Formaldehyde 37%**	**50-00-0**	**Aldehyde**

EN 374-2:2014

Resistance to Chemical Degradation

This standard replaces EN 374-2:2003. There are no major or technical changes. This standard specifies a test method for the penetration resistance of gloves that protect against dangerous chemicals and/or micro-organisms (water leak and air leak test).

The main changes in comparison to EN 374-2:2003 are:

- Reference to EN 374-3 has changed to EN 16523-1:2015 +A1:2018 – this is the new test method for chemical permeation.
- Performance levels (AQL) for use in production control still given in Annex A. As it is impractical in most cases to test every glove for possible pinholes a random sampling of gloves is carried out as defined by ISO 2859-1 to measure the statistical probability of defects in a particular batch of gloves.

Performance Level	AQL	Inspection level
Level 3	<0.65	G1
Level 2	<1.5	G1
Level 1	<4.0	S4

EN 374-3:2003

Determination of resistance to permeation by chemicals

Replaced by test method EN 16523-1:2015 'Determination of material resistance to permeation by chemicals. Part 1: Permeation by liquid chemical under conditions of continuous contact'.

The test method for chemical permeation EN16523-1 is similar to the EN 374-3 method.

EN 16523-1:2015

NEW - Resistance to chemical permeation

Permeation is a more complex test which measures the ability of the glove to prevent the test chemical moving through the glove. The critical measurement here is the breakthrough time, which in very simple terms is the time taken for the test chemical to pass through the glove. There are 6 standard permeation performance levels based on breakthrough times from >10 to >480 minutes as shown in table 2. The 3 test specimens for this test are taken from the palm area of glove, however, for gloves longer than 400mm and where the cuff is claimed to provide protection (or appears to offer protection) then a further 3 samples are tested from the cuff area. Additionally if the glove contains a joint or seam then this must also be tested.

Table 2: Classification of permeation performance levels

Measured Breakthrough time (min)	Permeation performance level
>10	1
>30	2
>60	3
>120	4
>240	5
>480	6

EN 374-4:2013

Resistance to Chemical Degradation

This is a new requirement in EN ISO 374-1 and the glove must be tested for this after exposure to every chemical shown on the User Instructions and glove markings. Degradation is basically a change in the material properties after exposure to the test chemical. Changes may be softening, hardening, swelling, thinning etc. and this is calculated by measuring the force needed to puncture the sample before and after exposure. These two results must be shown on the User Instructions for every chemical tested but are not shown on the glove markings.

EN 374-5:2016

Protection Against Micro-organisms

This standard specifies performance requirements for gloves that protect the end user against micro-organisms.

- Microbiological agents are: bacteria, virus or fungi.

Penetration testing is required for all gloves claiming micro-organisms protection; the test method is described in EN 374-2:2014, air-leak and water-leak. The test method has not changed. Gloves offering protection against viruses shall additionally pass a penetration test according to ISO 16604:2004 (method B). Determination of resistance of protective clothing materials to penetration by blood-borne pathogens.

For gloves longer than 400 mm, and if the cuff is claimed to protect against micro-organisms risks additional test specimens shall be taken from the cuff area and tested to ISO 16604.

Marking/Pictograms used for gloves protecting against bacteria and fungi:

Marking/Pictograms used for gloves protecting against virus, bacteria and fungi:

VIRUS

EN 455-1

Parts 1-4 (Medical gloves for single use)

This includes tests to assess the freedom from holes which is based on a penetration resistance test similar to that of EN 374 Part 2, plus tests to assess the dimensions of the gloves and the mechanical strength of its materials, both before and after an ageing process.

EN 455 was originally written to support the Medical Devices Directive, but since the various amendments enabling CE marking of products as both Medical devices and PPE, the annex ZAs of more recent versions of EN 455 also make reference to the PPE Directive.

Part 1

EN 455-1 covers requirements and testing of gloves for freedom from holes. For this the standard uses a water leak test that is carried out using AQL statistical sampling techniques based on production batch sizes.

Part 2

EN 455-2 covers requirements and tests for physical properties such as dimensions (length & width) and force at break both before and after heat ageing.

Part 3

EN 455-3 covers requirements and tests for biological evaluation.

This part of the standard includes test procedures for measuring endotoxin contamination of sterile gloves, powder residue for powder free gloves and leachable proteins in natural rubber latex gloves.

Part 4

Covers requirements and testing for shelf life determination.

This part of the standard covers protocol to be followed to evaluate the glove's shelf life by using real time studies or a suitably validated alternative.

CE Category

CAT I - Simple Design for **Minor Risks**

- Such as Mechanical action whose effects are minimal and easily reversible.
- Handling hot components not exposing the wearer to temperatures above 50 ˚c.
- Atmospheric agents of neither exceptional nor extreme nature.
- Minor impacts and vibrations which do not affect vital areas of the body and where the effects cannot cause irreversible lesions.

CAT II - Intermediate Design for Reversible Risks

- Products in this category are for 'intermediate risks' where there is a specific risk which may result in injury.
- Typical applications include mechanical protection where there is a risk of cuts or puncture to the skin.
- Product in this category must be tested by an approved notified body which has its own identification number. the name of the notified body and their address must be shown on the accompanying user instructions.

CAT III - Complex Design for **Irreversible or Mortal Risks.**

- Product in this category are for the highest level of risk where serious harm or irreversible side effects could occur.
- Typical applications would include chemical protection for more aggressive chemicals.
- Product in this category must be tested by an independent notified body and the manufacturer must have an approved quality system which must be checked and approved by a notified body annually. The name and address of the notified body must be included on the accompanying user instructions and the identification number of the notified body undertaking the annual quality assurance procedures present on both the user instructions and the product itself.

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