
**Wildland firefighting personal
protective equipment —
Requirements and test methods —**

**Part 1:
General**

*Équipement de protection individuelle pour la lutte contre les feux
d'espaces naturels — Exigences et méthodes d'essai —*

Partie 1: Généralités

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Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Design and performance requirements for PPE items and ensembles	2
4.1 Innocuousness.....	2
4.2 PPE Ensembles.....	2
4.3 Combination of items of PPE.....	2
5 Marking	2
5.1 General.....	2
5.2 Compliance marking requirements for an item of PPE.....	2
5.3 Additional marking for compatibility.....	3
6 Manufacturer's instructions to be supplied with each item of PPE	3
6.1 User's information.....	3
6.2 Additional user information for compatibility.....	4
Annex A (informative) Information on risk assessment	5
Bibliography	13

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Personal protective equipment*, Subcommittee SC 14, *Firefighters' personal equipment*.

This first edition of ISO 16073-1, together with ISO 16073-2 to ISO 16073-8, cancels and replaces (ISO 16073:2011). The main changes are as follows:

- the content has been reviewed and separated into several parts;
- the respiratory protection has been deleted from the document.

A list of all parts in the ISO 16073 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Wildland firefighting involves work carried out mostly in summer temperatures and for many hours, during which the firefighter can develop high levels of metabolic heat. As a consequence, the personal protective equipment (PPE) is required to be light, flexible and commensurate with the risks to which the firefighter can be exposed in order to be effective without introducing excessive heat stress to the wearer.

It is important to train firefighters in the selection, use, care and maintenance of the PPE covered by this document, including an understanding of its limitations.

It is intended that a risk assessment be undertaken to determine if the PPE covered by this document is suitable for its intended use and the expected exposure, see [Annex A](#).

This document provides minimum performance requirements for wildland firefighters' personal protective equipment (PPE) designed for use for extended periods during wildland firefighting.

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Wildland firefighting personal protective equipment — Requirements and test methods —

Part 1: General

1 Scope

This document specifies the minimum performance requirements and methods of test for personal protective equipment (PPE) covering the torso, neck, arms, hands, legs, feet, head, eyes and hearing that is used for wildland firefighting.

This document covers the general design of the PPE, the minimum levels of performance for the materials employed and the methods of test used. The PPE is not intended to provide protection during fire entrapment.

This document does not cover PPE for structural firefighting (see ISO 11999 series), for use against chemical, biological, radiological and nuclear hazards, or for use where a reflective outer surface is required (see ISO 15538).

Activities in support of wildland firefighting, such as the cutting of trees and the use of a chainsaw can require additional protection to that provided in this document. Users are directed to those relevant standards for the requirements associated with such protection.

To assist with selection of the right PPE, a risk assessment (see [Annex A](#)) can be conducted to determine the type of PPE, and performance levels, for different categories of protection are required.

This document describes performance requirements for PPE and includes requirements for marking and manufacturer's instructions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 11999-2, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 2: Compatibility*

ISO 13688, *Protective clothing — General requirements*

ISO/TR 19591, *Personal protective equipment for firefighters — Standard terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 19591 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Design and performance requirements for PPE items and ensembles

4.1 Innocuousness

PPE shall not adversely affect the health or hygiene of the user. The materials shall not, in the foreseeable conditions of normal use, release substances generally known to be toxic, carcinogenic, mutagenic, allergenic, toxic to reproduction or otherwise harmful.

NOTE For more detail either see specific parts of ISO 16073 or see more detail in either ISO 13688 or ISO 21420 used respectively for garment and gloves.

4.2 PPE Ensembles

An ensemble of PPE items is classified as meeting the requirements of this document if every item in the ensemble meets the appropriate requirements of the relevant parts of ISO 16073 series and provide as an ensemble protection to the whole body of the firefighter for wildland firefighting operations.

For example, the items or items of PPE of a PPE ensemble, which are intended to provide protection for the firefighter's upper and lower torso, head, neck, arms, hands, legs and feet, shall conform to the requirements of ISO 16073-3 to ISO 16073-9.

Nevertheless, an item of PPE, which is conforming to the requirements of one of ISO 16073-3 to ISO 16073-9, can individually be designated and marked as design and performance requirements for that item of PPE conforming to the relevant part of the ISO 16073 series.

4.3 Combination of items of PPE

A combination of two or more items of PPE, of which each item individually meets the requirements of the relevant part of ISO 16073 series, shall also meet the relevant fitting/interface compatibility requirements detailed in ISO/TS 11999-2.

NOTE A combination is more than a single item of PPE but less than an ensemble, i.e. it is not an offering protection for the whole firefighter.

5 Marking

5.1 General

Marking requirements shall be as specified in ISO 13688 and in this clause.

Any marking in the form of labels shall not adversely affect the performance of any item to which they are attached or present a hazard to the wearer.

Labels shall be tested for flammability according to the requirements for labels in ISO 16073-3 only where placed on the exterior of the garment. Labels (interior and exterior) and closure systems shall be tested to the relevant requirements according to the PPE item they are attached to.

Marking of PPE shall also be in accordance with the specific requirements of the item as detailed in the relevant parts of the ISO 16073 series.

5.2 Compliance marking requirements for an item of PPE

Each item of PPE, for which compliance with this document is claimed, shall have a label permanently and conspicuously attached in accordance with ISO 13688 and upon which the following information is printed in letters at least 2 mm high:

- a) Where practical, the pictogram given in [Figure 1](#).
- b) Identification of product standard — ISO 16073-Y:XXXX where Y is part and XXXX is year.

- c) The name, trademark, or other means of identifying or tracing back to the manufacturer.
- d) The manufacturer's model number and/or user's specified number.



**Figure 1 — Protective equipment for wildland firefighting
(ISO 7000-3636)**

5.3 Additional marking for compatibility

All items of PPE, which are intended to be worn together in order to form a specific combination of PPE items or a specific mixed ensemble, and which are intended to be certified together and put together on the market, are to be tested together according to the respective compatibility requirements of ISO 16073-2. An additional marking is to be added to the items' individual markings, stating each item that it is "Compatible with — Compatible with [using information in 5.2 c) and d)]".

6 Manufacturer's instructions to be supplied with each item of PPE

6.1 User's information

The manufacturer shall meet the requirements of ISO 13688 and the minimum requirements in 5.1 and 5.2. Manufacturers shall also add additional relevant information from each part of ISO 16073.

The manufacturer shall provide user information including, but not limited to, data in accordance with the relevant part(s) of 16073 series, any additional data required by this standard, the results of any optional tests undertaken, warnings, information, and instructions with each PPE.

Instructions shall be supplied in the official language(s) of the country of destination.

The manufacturer shall provide at least the following instructions and information with each PPE:

- a) Safety considerations.
- b) Information about the markings.
- c) Limitations of use.
- d) Preparation for use.
- e) Sizing and details if gender specific.

- f) Recommended storage practices.
- g) Inspection frequency and details.
- h) Donning and doffing procedures.
- i) Maintenance and cleaning.
- j) Retirement and disposal.
- k) Known shelf life limitations.
- l) Information about the use of integrated devices.

The manufacturer shall attach the manufacturer's instructions, or packaging containing this information, to the relevant item of PPE in such a manner that it is not possible to use the item of PPE without being aware of the availability of the information and that a deliberate action is necessary to remove it.

The manufacturer shall provide notice that the information is to be removed ONLY by the end user.

Instruction's shall give the following additional information:

- In the situation where a combination of PPE items or an ensemble, do not have the same rating, for example different levels of heat and flame protection, the manufacturer's instructions shall indicate additional effects and risks which may result.

6.2 Additional user information for compatibility

Combination of PPE items which are intended to be worn together and or assembled together, shall be tested together according to the respective compatibility requirements of ISO/TS 11999-2 and meet the requirements of the individual parts of the ISO 16073 series.

For the compatible items of PPE, the manufacture shall provide a declaration for each item of compatible PPE, additional information on the conformance to the requirements of ISO/TS 11999-2, and any additional checks or warnings, such as but not limited to:

- compatible with [using information in [5.2 c\)](#) and d)]
- testing and classification of performance for items of PPE, for combinations of items of PPE for ensembles
- additional compatibility testing, including detailed instructions, that shall be completed by the end user prior to wearing the PPE in hazard situations.

Annex A (informative)

Information on risk assessment

A.1 General

Personal protective equipment is only one part of an effective system of firefighter safety. Well-trained, closely supervised and properly staffed fire departments are equally essential elements of minimizing the operational risk.

Regardless of location, the primary goals of wildland firefighting are to control an incident as quickly as possible and at the same time take steps to minimize eventual damage to and loss of life and property. In order of priority, the objectives of a firefighter reaching an incident are to:

- save lives and to prevent or minimize injury;
- prevent or minimize damage to property;
- prevent or minimize damage to the environment.

The role of firefighters' personal protective equipment (PPE) is to protect the firefighter and to enable the firefighter to achieve these objectives.

However, at an incident where the firefighter is unable to achieve these objectives, the PPE should also provide sufficient protection to enable the firefighter to escape whilst eliminating or minimising the possibility of injury. The choice of PPE and the protection it offers should be selected on the basis of a risk assessment specific to the incidents and where hazards are identified and selecting specific performance requirements for the PPE used which eliminate or reduce these hazards.

A.2 General approach for conducting a risk assessment

The three major steps of the risk assessment process are as follows.

- a) **Risk identification:** for every aspect of the operation of the fire department or brigade, list potential problems and hazards. The following are examples of sources of information that may be useful in this process:
 - a list of the risks to which members are or may be exposed;
 - records of previous accidents, illnesses, and injuries, both locally and nationally and internationally;
 - facility and apparatus surveys, inspections, etc.
- b) **Risk evaluation:** evaluate each item listed in the risk identification process using the following questions.
 - What is the level or potential severity of the occurrence?
 - What is the potential frequency or likelihood of the occurrence?
 - What are the potential consequences of the occurrence?

This will help to set priorities in the developing specifications for PPE performance. Some sources of information which may be useful are:

- safety audits and inspection reports;
- prior accident, illness, and injury statistics;
- application of national data to local circumstances;
- professional judgement in evaluation risks unique to the jurisdiction.

c) **Risk control:** once the risks are identified and evaluated, a control for each should be implemented and documented. The hazard controls in the hierarchy are, in order of decreasing effectiveness represented in [Figure A.1](#):

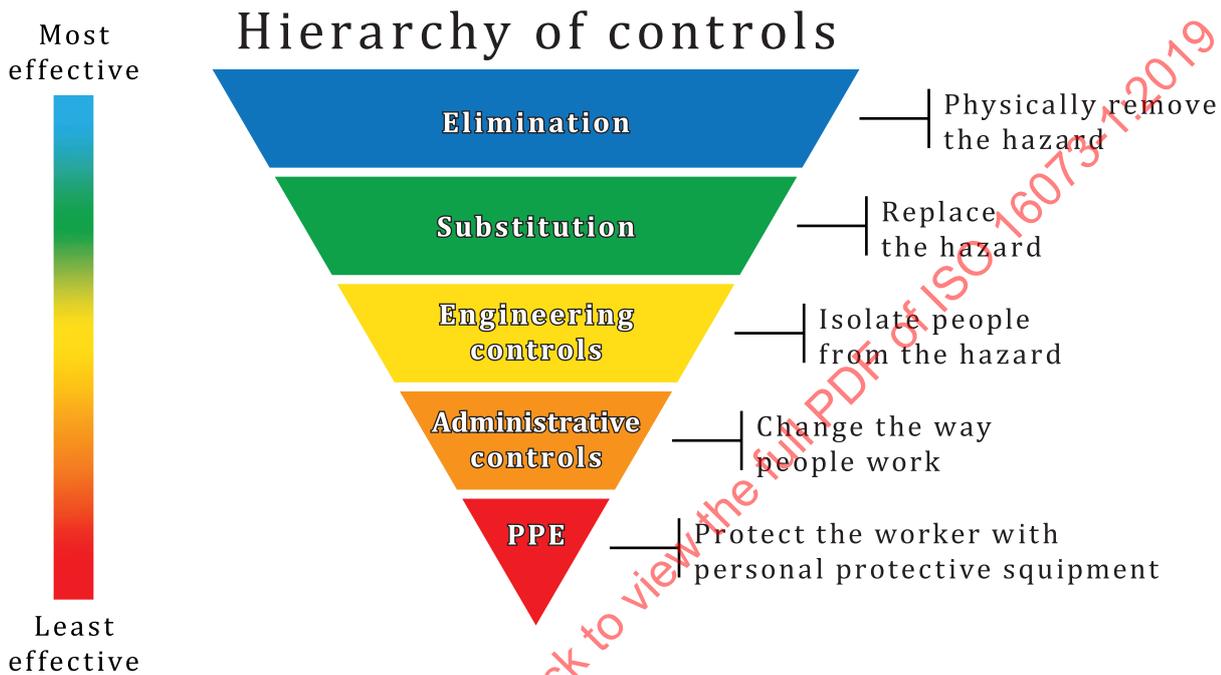


Figure A.1 — Hazard controls in the hierarchy

— Elimination

Eliminating the hazard - physically removing it - is the most effective hazard control. For example, if employees work high above the ground, the hazard can be eliminated by moving the piece they are working on to ground level to eliminate the need to work at heights.

— Substitution

Substitution, the second most effective hazard control, involves replacing something that produces a hazard (similar to elimination) with something that does not produce a hazard.

To be an effective control, the new product should not produce another hazard.

— Engineering

The third most effective means of controlling hazards is engineered controls. These do not eliminate hazards, but rather isolate people from hazards.

— Administration

Administrative controls are changes to the way people work. Examples of administrative controls include procedure changes, employee training, and installation of signs and warning labels (such as those in the Workplace Hazardous Materials Information System. Administrative controls do not remove hazards, but limit or prevent people's exposure to the hazards, such as completing road construction at night when fewer people are driving.

- Personal protective equipment

PPE is often referred to as the Last Line of Defence. Additionally, some PPE in the Firefighting service is designed to protect the firefighter from an unforeseen event or exposure and to better facilitate their retreat to a safe place.

Firefighters often use some or a combination of all of these controls at emergency incidents.

In the case of PPE, this should include determining the appropriateness of specific tests and requirements for eliminating or reducing risk. Normally, the two primary methods of controlling risk, in order of preference, are as follows:

- wherever possible, totally eliminate and/or avoid the risk or activity that presents the risk;
- where it is not possible to or practical to avoid or eliminate the risk, steps should be taken to manage it.
- such as developing appropriate PPE specifications.

Specification of appropriate PPE should be part of any overall safety program which includes Standard Operating Procedures, training, and inspections. As with any program, it is important to evaluate whether the plan is working. Periodic evaluations should be made, and if the program elements are not working satisfactorily, then modifications to the program should be made. If the methods are changed, a new risk assessment should be performed.

A.3 Recommended factors for identifying and evaluating firefighter risks

In using this document for purchasing appropriate clothing, some of the factors that should be considered in a risk assessment, include the following:

- **The level of training and experience.** Well-trained and experienced firefighters are more likely to recognize hazards and appropriately respond in ways to minimize their potential for injury. The quality, amount, and frequency of training will also have an impact on the firefighter's potential for injury. Firefighters should be specifically trained in the use of the selected PPE.
- **The level of fitness and health of the firefighter.** Firefighters who are in good health and physical shape are more likely to respond safely and be less subject to stress-related injuries than firefighters having poor health and physical conditioning.
- **The function of the firefighter at the incident scene.** Some organizations may segregate firefighter responsibilities and subsequently require different levels of protection. Other organizations may require each firefighter to be equipped to perform any function at the incident scene, recognizing the possibility that any individual may be required to respond under emergency conditions. In all cases, the specific activities of firefighters in responding to incidents should be accounted for in determining risk of injury.
- **Environmental conditions at the incident scene.** Hot and humid conditions as well as cold conditions can affect firefighter protection at the response scene. In addition, the physical environment in which the response is conducted and its impact on firefighters performing assigned duties should be accounted for. For example, firefighters may become wet. Water inside clothing systems may have a negative impact on its performance.
- **Specific hazards to be faced at the incident scene.** Thermal as well as physical and other hazards should be considered in evaluating response risks. The type, level, and duration of heat exposure as well as the physical environment in which it is contained will have a significant effect on the potential risks faced by firefighters. Other hazards, low visibility, stored chemicals, and rough physical surfaces are known to create additional risks for injury at the fire or rescue scene.
- **Known limitations of the protective clothing and other PPE.** While protective clothing is designed to prevent or minimize injury, the specific limitations of protective clothing in providing protection under all situations should be recognized. Clothing performance may be limited and

based on certain design features or material performance characteristics. In addition, these characteristics may be diminished as the clothing is worn. Protective clothing should be properly maintained to ensure continued performance. Methods for integrating other PPE such as helmets, gloves, boots, and self-contained breathing apparatus should be done in a manner that provides complete protection to the wearer.

- **Type and application of command system at the incident scene.** The amount of discipline and coordination of firefighters at the accident/response scene can have an impact on the risk of injury. Firefighters who have clear responsibilities and are closely supervised are less likely to be injured as compared to firefighters who act more independently and in a less coordinated fashion.

Consideration should also be given to the build-up of heat stress by prolonged use of the PPE when undertaking wildland firefighting activities. Heat stress and other stress-related conditions are some of the more frequent causes of firefighter fatalities and injuries. Heat stress is affected by a number of factors including those described above.

A.4 Recommended approach

A.4.1 Introduction

During wildland firefighting operations being undertaken by firefighters, many different hazards may be encountered. Where possible, the level of risk that each hazard presents to the firefighter should be eliminated or reduced to an acceptable level. The guidance given in this document indicates how to carry out a risk assessment by acknowledging the hazards that may be present, the likelihood of the firefighter becoming exposed to them and the possible consequences of such exposure.

These guidelines have been produced to assist employers in making the decision on choosing the correct type of PPE for firefighters for whom they are responsible.

A.4.2 Basis of this guideline

A definition of "risk" is "the probability that the harm or damage from a particular hazard is realized". Risk reflects both the probability and consequences of the harm (see [Tables A1](#) and [A.2](#)).

A.4.3 Risk assessment formula

$$R = L \times S$$

where

R is the risk;

L is the likelihood of the firefighter being exposed to the hazard;

S is the severity/consequences to the firefighter if exposed to the hazard.

PPE should be chosen based on protecting the firefighters against the identified risks.

NOTE Values of *L* and *S* are listed in [Table A.1](#).

A.4.4 Values of *L* and *S*

Table A.1 — Values of *L* and *S*

Value	Likelihood	Severity/Consequence
0	Never	Nil
"0" should only be allowed where there is absolutely NO chance of the hazard being encountered.		

Table A.1 (continued)

Value	Likelihood	Severity/Consequence	
1	Exceptional	LOW	e.g. Minor injury: small cuts; etc.
2	Occasional	MODERATE	e.g. Major injury; broken bones; etc.
3	Very likely	HIGH	e.g. Life threatening
4	Always	EXTREME	Death

"0" should only be allowed where there is absolutely NO chance of the hazard being encountered.

A.4.5 Risk assessment guidelines

Table A.2 — Hazard $L \times S = R$

Hazard origin and type	Likelihood of firefighter being exposed to hazard	Severity consequences to the firefighter if exposed to hazard	Risk (Total of $L \times S$)	Control measures
1. Electrical hazards				
a. Electric arc				
b. Static electricity				
c. Electrical current, high voltage				
d. Low voltage				
2. Heat and Flame hazards				
a. Contact heat				
b. Convective heat				
c. Radiant heat				
3. Environmental hazards				
a. Ambient cold				
b. Ambient hot				
c. Contact heat				
d. Cold surfaces				
e. Air velocity — mechanical				
f. Air velocity — wind				
g. Rain				
h. Splashes				
i. Work in water				
l. Falling in water				
4. Mechanical hazards				
a. Penetration				
b. Cut				
c. Abrasion				
d. Falling objects				
e. Impact				
f. Falling/slipping				
5. Non-visibility hazards				
a. Not being seen				

Table A.2 (continued)

Hazard origin and type	Likelihood of firefighter being exposed to hazard	Severity consequences to the firefighter if exposed to hazard	Risk (Total of $L \times S$)	Control measures
6. Biological/chemical hazards				
a. Liquid				
b. Contamination by body fluids				
c. Gas				
d. Smoke				
e. Radioactivity				
7. Other hazards				
a. Physiological/heat stress				

A.4.6 Other factors to be considered

The training, tactics and operational procedures of each organization will have an impact on any risk assessment and will probably dictate how each hazard is regarded and indicate the figures to be applied to L and S .

Even if not identified as a potential serious risk under paragraph 7a of the Hazard Table, the physiological aspects of wearing PPE should also be considered when carrying out the risk assessment as these can have a serious impact on the Health and Safety of the firefighter.

Decide whether the risk assessment is carried out for the actual incident or from when the firefighter leaves the station until he/she returns e.g. environmental issues may not be a serious hazard whilst tackling the incident but may be, if a firefighter stands by in bad weather conditions whilst waiting to tackle the incident.

Consider whether the risk assessment is carried out on the basis of the firefighter having no protection or having existing levels of protection, e.g. under normal conditions, firefighters wearing full ISO 16073 compliant clothing will have reasonable protection from unintentional exposure to heat sources.

It may be decided by some that even with different risks being identified by the risk assessment, the decision taken will be to provide protection against the risk of highest severity protection to ISO 16073 will be required.

The introduction of national databases for recording incidents of firefighters being exposed to hazards would be a valuable source of information when assessing the likelihood of events occurring.

A.4.7 Electro-static hazards

Firefighters need to be aware of the hazards of static electricity. This is because under certain conditions, less than one millijoule (mJ) of energy, much less than the static that builds up in the human body can ignite hydrocarbon vapour/air mixtures, and other explosive gases. Also, nuisance static can cause clothing to be uncomfortable to wear.

Energy stored in the body poses a much greater hazard than static clothing, because the body is made almost entirely of water and electrolytes and can store up to 40 mJ of energy.

Garments and fabrics used for protective clothing for firefighters often have anti-static fibres built into the fabric to reduce static hazards. There are two basic types of anti-static fibre. Conductive fibres and inductive or non-conductive fibres.

The fabrics containing conductive fibre may be tested according to EN 1149-1, to measure the surface resistivity of the fabric. The performance should be evaluated according to EN 1149-5.