TECHNICAL REPORT

ISO/TR 21808

First edition
2009-11-01

Guidance on the selection, use, care and maintenance of personal protective equipment (PPE) designed to provide protection for firefighters

Guidage sur la sélection, l'utilisation, le soin et l'entretien des équipements de protection individuelle (PPE) conçus pour pourvoir à la protection des pompiers

Reference number
ISO/TR 21808:2009(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword iv

Introduction v

1 Scope 1

2 Terms and definitions 1

3 General 2

4 Selection 2
4.1 General 2
4.2 Identify risk and assess 2
4.3 Defining the level of protection required for each activity from the PPE 3
4.4 Collecting information on available PPE 3
4.5 Wearer trials 3
4.6 Additional testing 4
4.7 Other considerations 5

5 Use 6
5.1 General 6
5.2 Training 6
5.3 Introducing PPE into service 6
5.4 Record keeping 7
5.5 Routine examination 7
5.6 In-service evaluation and monitoring 7

6 Care 8
6.1 Manufacturer information 8
6.2 Cleaning 9
6.3 Decontamination 9
6.4 Storage 10

7 Maintenance 10
7.1 Manufacturer information 10
7.2 Inspection 11
7.3 Repairs and alterations 12
7.4 Disposal 12

Annex A (informative) **Risk assessment** 13

Annex B (informative) **Guidance on some of the items that may be addressed in labelling, subject to the required use of the PPE** 14

Bibliography 15

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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.

ISO/TR 21808 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 14, *Fire-fighters' personal equipment*.

Introduction

The information in this Technical Report is designed to assist in making the necessary decisions regarding the selection, use, care and maintenance of personal protective equipment (PPE) for firefighters.

Guidance on the selection, use, care and maintenance of personal protective equipment (PPE) designed to provide protection for firefighters

1 Scope

This Technical Report sets out guidance for the selection, use, care and maintenance of PPE designed to provide protection for firefighters while carrying out their duties.

The PPE covered in this Technical Report is intended for firefighting personnel exposed to risks associated with, but not necessarily limited to, the following activities:

— structural firefighting;

— wildland firefighting;

— incidents involving hazardous materials;

— incidents involving motor vehicles;

— urban search and rescue;

— swift water rescue;

— emergency medical response;

— storm and flood recovery.

The purpose of this Technical Report is to highlight the main areas that an organization needs to consider when providing PPE to its members. Most paragraphs of the document contain bullet lists; these lists are provided for guidance only and they are not exhaustive.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
personal protective equipment
PPE
equipment that can include, but is not limited to, clothing, gloves, helmets, footwear and face protection

2.2
hazard
substances, situations or events that can cause harm/injury

2.3
risk
factor, R, that reflects both likelihood, L, of the occurrence of a hazard in a particular situation and severity, S, of the consequences or extent of harm to the individual to be expected from the hazard

$$R = L \times S$$

2.4
selection
process of determining the type of personal protective equipment that is necessary for the protection of firefighters and other response personnel from an anticipated, specific hazard, or other activity, the procedure of the appropriate PPE, and the choice of the proper PPE for a specific hazard or activity at an emergency incident

2.5
use
application of personal protective equipment considering its limitations

2.6
care
keeping in good working order, including procedures for cleaning, decontamination and storage

2.7
maintenance
preserving from loss or deterioration, including procedures for inspection, repair and ultimate removal from service

3 General

An organization should develop and implement a structured training programme for all firefighters on the selection, care, use and maintenance of PPE.

4 Selection

4.1 General

Subject to requirements, the process of selecting PPE can be divided into a number of stages.

4.2 Identify risk and assess

The process of carrying out a risk assessment should include:

a) identification of the activities to be undertaken by person(s) wearing the PPE;

b) a list of the hazards present;

c) a quantification of the risks that would result from exposure to the hazards;

d) considerations of the protection provided by other control measures before the application of PPE;

e) determination of the level and extent of protection required from the PPE (in absolute or relative terms);

f) frequency of use of the PPE;

g) organization's knowledge;

h) type of incident;

i) geographical location and climate;

j) evaluation of risks resulting from the use of the PPE.

A number of risk assessment models may be used to determine the level of risk associated with the activities. See Annex A.

4.3 Defining the level of protection required for each activity from the PPE

a) determine which parts of the body require protection;

b) identify what kind of protection is required;

c) identify the appropriate standards or methods that provide the required protection;

d) determine the level(s) of protection required (for the relevant parts of the body) in relative or absolute terms for each item of PPE.

4.4 Collecting information on available PPE

a) carry out market research to determine products that are available;

b) obtain information from the potential suppliers on performance levels and manufacturer's information including the compliance to relevant standards and certification by a recognised independent certification body;

c) gather information from comparable organizations using similar items of PPE for similar tasks;

d) determine compatibility of all items of PPE to be used.

NOTE If, after collating all available information, it is established that suitable PPE is not available, then it might be necessary for an organization to carry out research and development work.

4.5 Wearer trials

The purpose of a wearer trial is to assess the compatibility and the ergonomic practicality of the PPE. Obtaining feedback from the intended users is imperative at this stage, as such information will provide valuable data relating to the practical performance of the PPE, and also give confidence to the users, thus ensuring that the selected items are used.

Structured trials with participants undertaking standardized, representative tasks are recommended.

When conducting wearer trials, a systematic approach should be adopted with the following issues considered:

a) ease and speed of putting on and taking off;

b) ease and extent of adjustability;

c) acceptance in terms of comfort, weight and metabolic heat release;

d) compatibility with all other items of PPE;

e) ability to undertake all tasks expected without hindrance or difficulty;

f) preservation of the protection in all working positions;

g) selection of participants based on a cross section of the relevant occupational group (height, weight, age, gender, etc.);

h) participants' evaluation of each individual item of the PPE on trial;

i) evaluation feedback, obtained in a structured manner allowing for both qualitative and quantitative data collection and analysis; using a structured questionnaire, structured or semi-structured interviews and/or group discussions;

j) sufficient number of participants to ensure that the results obtained are statistically significant and representative of the total workforce;

k) performance of the garments after a number of cleaning cycles according to the manufacturer's instructions;

l) objective physiological measurements should be used to determine thermal impact (metabolic heat release/retention).

NOTE 1 For consistency of data, the same participants should be used to conduct the wearer trials.

NOTE 2 Further guidance on the ergonomics of PPE in general can be found in EN 13921. A detailed test protocol, specifically for firefighters' PPE, can be found in BS 8469.

4.6 Additional testing

4.6.1 Additional whole product testing

The following might be required to assist in any decision making:

— instrumented manikin testing.

4.6.2 Laboratory material testing

Examples of tests that may be carried out to determine PPE durability are:

— resistance to/behaviour after laundry/cleaning;

— resistance to/behaviour after decontamination;

— resistance to/behaviour after UV exposure;

— abrasion resistance;

— durability of the properties (protective or other) of the garment after extended period of use;

— resistance of seams and/or other assembling systems;

— chemical repellence;

— flex fatigue;

— liquid barrier properties.

4.7 Other considerations

In order to establish the overall performance and the total cost of ownership of the PPE, the following considerations might need to be made:

a) is training offered as part of the procurement package (including training provided by third parties)?

b) is a post procurement service offered?

c) what quality assurance measures are in place prior to the delivery?

d) what are the quality procedures of subcontractors for, e.g., care and maintenance of the PPE?

e) what are the requirements for cleaning and decontamination?

f) what are the inspection and maintenance requirements?

g) what are the replacement requirements and considered life cycle of PPE?

h) what is the delivery time for standard and special sizes?

i) what sizes are available?

j) are stock items held by the supplier?

k) what are the collection and delivery arrangements?

l) should stock be held within the organization?

m) how is the internal distribution to the users to be organized?

n) how is the PPE to be safely disposed of?

o) can corporate/role identity (e.g. badges on garments) be incorporated without adversely affecting performance?

p) compliance and certification of PPE?

q) how is the contaminated PPE to be disposed of?

r) in the case of leased PPE, what are the guarantees of quality offered by the rental company?

s) in the case of leased PPE, does the rental company ensure care and maintenance of PPE?

When the outcome of a selection process results in the employer providing a number of items of PPE for different tasks/activities, the user/wearer may be permitted (after being provided with appropriate training) to select the item(s) that provide the necessary protection at the time of use. Any selection made at that stage must be based upon the risk assessment carried out by the employer and based upon an informed dynamic risk assessment by the user at the time of use.

5 Use

5.1 General

It is the employer's responsibility to define conditions in which the PPE has to be used, in particular, as regards the period for which it is to be worn, which shall determine the basis of the seriousness of the risk, the frequency of exposure to the risk, the characteristics of the work place of each worker and the performance of the PPE.

After the selection of the PPE, a number of stages should be followed to ensure its correct use.

5.2 Training

It is strongly recommended that all firefighters be trained how to use their PPE correctly prior to the PPE being introduced into service. The basis for this training is the instructions for use as provided by the manufacturer.

Such training should include:

a) information concerning limitations and capabilities of the PPE;

b) what the PPE will protect from;

c) what the PPE will not protect from;

d) what the effects are (if any) of long term use;

e) how to care for and maintain PPE according to the manufacturer's specifications;

f) how to undertake routine inspections of PPE before and after use;

g) how to use/wear the PPE;

h) the importance of complying with the manufacturer's or supplier's instructions;

i) how to store the PPE when not in use;

j) information concerning arrangements for cleaning and decontamination;

k) how to determine when the PPE is no longer fit for purpose;

l) how to obtain replacements;

m) the importance of using PPE that is fit for purpose and has been cleaned and maintained in accordance with the manufacturer's instructions.

NOTE The instructions and training provided to the wearer/user will depend on the level of risk and complexity of the PPE to be provided. The provision of written instructions or information might not be sufficient and the firefighters might need to be involved in practical demonstrations, training and exercise.

5.3 Introducing PPE into service

Before individual items of PPE are introduced or replaced, care should be taken to ensure that the compatibility and interfacing of the PPE is maintained and satisfactory training has been provided.

5.4 Record keeping

In the overall management of PPE, consideration should be given to build a full life history for each item, from manufacture to disposal.

Record keeping should incorporate the following:

a) the specification of the PPE (manufacturer, delivery date, batch number);

b) the service history of the PPE (date of issue, name of wearer);

c) training records of operatives using the PPE, including the duration of exposure to risks and the identity of the risks;

d) details of hazards to which the PPE has been exposed;

e) information relating to care:

   1) cleaning;

   2) decontamination;

   3) storage;

f) records of maintenance:

   1) inspection;

   2) damage and repair;

   3) disposal;

g) problems arising from the use of the PPE.

NOTE These records should be easily available to the current user.

5.5 Routine examination

Each individual item of PPE should be examined before and after use by the user. Routine examinations should include checks for:

a) soiling;

b) physical damage (rips, tears, cuts, damage to seams and/or other connections non-functional or missing hardware and other components, e.g. reflective/fluorescent applications etc.);

c) thermal damage (charring, burn holes, melting, change in colour);

d) ongoing evaluation of system fit and interfaces/overlaps and closure systems.

5.6 In-service evaluation and monitoring

A system should be in place to ensure that the performance of all PPE is constantly evaluated and monitored.

The items to be monitored can include:

a) accident/injury statistics;

b) failure rates of PPE including trends for similar repairs;

c) feedback from users;

d) feedback from service company;

e) changes in working conditions and available PPE on the market.

6 Care

6.1 Manufacturer information

All items of PPE should be provided with manufacturer information, including care instructions (both on a label attached to the item and separately in writing).

Care arrangements should include

a) cleaning:

   1) what cleaning methods should be used?

   2) capabilities of the institution cleaning the PPE;

   3) when should the items be cleaned?

   4) third party collection and deliveries;

   5) is re-application of finishes/treatments necessary?

   6) practices or cleaning agents to be avoided (e.g. bleach on some flame resistant fibres);

   7) effects of cleaning on the performance properties of PPE;

b) decontamination:

   1) what are the established decontamination procedures?

c) storage:

   1) what are the parameters for the storage of the PPE (e.g. humidity, temperature, time, light)?

   2) where should the PPE be stored?

   3) soiled protective clothing should be cleaned and dried before storage;

   4) manufacturers should indicate any specific requirements;

   5) is the life cycle of the PPE influenced by storage (this should be indicated by the supplier)?

   6) how are the items stored

      i) prior to issue?

      ii) when being worn?

      iii) when not being worn?

NOTE Clear care instructions must be provided with each item of PPE, and all firefighters should be made aware of these instructions. See Annex B.

6.2 Cleaning

Organizations should identify a means for having PPE cleaned and decontaminated.

The cleaning practice should ensure that

— there is limited deterioration to any components of the PPE;

— the integrity of the protection is preserved;

— the items are visibly clean;

— the PPE is hygienically clean;

— no unpleasant odour remains;

— there are no residues of the cleaning products;

— re-application of finishes/treatments is done according to the instructions of the supplier.

WARNING — Inflammable residues in PPE after cleaning can ignite in proximity to an ignition source.

NOTE 1 In some cases the number of cleaning cycles can be a determinant of the operational life of the PPE. In this case it is essential to have a system to monitor the number of cleaning cycles and compare this with the maximum number of cycles authorized by the manufacturer.

NOTE 2 The effectiveness of the cleaning process might need to be confirmed by (batch) testing.

6.3 Decontamination

Items of PPE require decontamination when a hazardous substance (both inflammable and hazardous for the health of the wearer/user) is present. Examples of hazardous substances include asbestos, fuel, greases, paint, body-fluids and chemicals.

In order to avoid the risk of cross-contamination and re-contamination of PPE, both for individuals and the environment, decontamination procedures should be set in place, giving instructions for the

— removal;

— handling;

— segregation;

— storage;

— transportation;

— treatment;

— disposal;

of all items of PPE.

Personnel decontaminating PPE need to be protected and their health and/or safety considered during the decontamination process. PPE users who have contaminated PPE shall provide the particulars of the contaminant to the organization or users carrying out the decontamination.

Technical advice from the manufacturer of the PPE, the institution undertaking the decontamination or other knowledgeable organizations and/or persons should be obtained with regard but not limited to

— effect of contaminating agent on the PPE;

— possibility, feasibility and economic acceptability of the decontamination;

— effect of the decontamination on the whole life of the PPE.

6.4 Storage

— the storage of PPE should be organized so that it remains hygienic and clean until it is required for use;

— the method of storage should not adversely affect the performance characteristics of the PPE;

— soiled PPE should be cleaned and dried before storage;

— PPE should be stored in a clean, dry, well-ventilated area at a temperature that will not adversely affect the items;

— manufacturers should indicate any specific storage requirements.

7 Maintenance

7.1 Manufacturer information

All items of PPE should be provided with manufacturer information, including maintenance instructions.

The employer should make arrangement for maintaining the PPE in accordance with the manufacturer's recommendations and they should inform all parties involved.

a) Maintenance should arrange:

   1) what inspection criteria to be applied;

   2) who should carry out the inspections;

   3) when inspections should be done.

b) Repairs:

   1) what kind of repairs are acceptable?

   2) who will be responsible for the repairs?

c) Removal from service and ultimate disposal:

   1) when must the PPE be disposed of?

   2) how should the PPE be disposed of ensuring no damage to the environment or inadvertent re-use?

NOTE Only trained and competent personnel should perform maintenance.

7.2 Inspection

7.2.1 General

Regular inspection of the PPE is essential to ensure that it will provide the protection intended.

Any elements suspected of being contaminated with hazardous materials or biological agents should be decontaminated in accordance with decontamination procedures at the time of contamination and before reaching the regular inspection process.

A person with appropriate skills appointed to this task should additionally inspect the PPE. This person needs to be familiar with the PPE and the types of wear and tear that could influence the performance. Inspections are necessary to establish that the PPE is fit for purpose and that it still meets with the initial requirements.

An inspection programme should be drawn up for each type of PPE and should include

a) an inspection schedule;

b) elements to be inspected;

c) the decisions and actions based on the inspection results;

d) effectiveness of closure system.

7.2.2 Inspection schedule

This should include

a) regular inspections, taking into account any recommendations from the manufacturer;

b) inspections out of the regular scheme:

   1) after every deployment to an incident;

   2) whenever the user suspects that the PPE is no longer fit for purpose;

   3) after any repair;

   4) prior to re-issue;

c) inspections after re-calling a whole batch or type of PPE, if damage to the PPE, or injury to users, is frequent.

7.2.3 Elements to be inspected

a) soiling;

b) material integrity (including all accessories); effects of chemical or UV-degradation (e.g. discoloration, flaking);

c) damaged/non-functional or missing hardware (all components);

d) integrity/legibility of the label;

e) contamination of the PPE from hazardous materials or biological agents;

f) physical damage to all layers of the PPE including inner liners (this is not always possible without destruction);

g) thermal damage to all layers of the PPE including liners;

h) loss or shifting of liner material;

i) loss of seam integrity; broken or missing stitches;

j) effectiveness of closure systems.

NOTE Technical documentation should be available on the pass/fail criteria for all the above elements. In addition to the inspections, it is important to carry out testing (in some cases destructive) to validate the inspection criteria.

7.2.4 Decisions

The decisions based on the inspection results include whether or not the PPE

a) is fit for use;

b) is fit for limited use only (in this case the label must be adapted to show this lower level of protection);

c) requires repair/alteration;

d) requires cleaning/decontamination;

e) must be removed from service and destroyed.

7.3 Repairs and alterations

Repairs and/or alterations to PPE should only be carried out, following the manufacturer's instructions, by individuals or organizations trained to do so. No repair should adversely affect the performance of the PPE. The materials used must be of comparable or higher performance to the original. After repair/alteration, the PPE should be inspected by a suitably qualified person.

7.4 Disposal

PPE that is no longer fit for purpose must not re-enter service.

A number of factors should be considered when disposing of protective clothing:

a) the environment;

b) the chosen method of disposal which should not compromise the health and safety of anyone coming into contact with the (contaminated) PPE.

NOTE When an item of PPE has been identified as no longer fit for purpose, it should be marked accordingly or kept in a container that clearly identifies the items that should not be used and are awaiting disposal.

Annex A
(informative)

Risk assessment

Organizations are responsible for carrying out a risk assessment in determining the level of and the type of PPE that is required for their employees. National risk assessment modals and standards should be used as guidance on this subject.

Examples of risk assessments for PPE can be found in EN 469:2005, Annex G, and NFPA 1851.

Annex B
(informative)

Guidance on some of the items that may be addressed in labelling, subject to the required use of the PPE

When the PPE is first issued to the user, a manufacturer's information sheet should be provided with the items concerned. This information sheet, however, cannot remain with the item of PPE, and therefore a label must be referred to for guidance on use/cleaning etc. Labels are a valuable source of information, it is therefore important not only that the correct information is provided but that it remains legible throughout the life of the item.

Even though it is the manufacturer's responsibility to ensure the correct labelling of the PPE, it is important that users know what to expect and have a clear understanding of the topics included on the labels.

Guidance regarding labels:

a) Standardization of labelling – size, materials, wording, layout.

b) Specification of what is safety critical.

c) If the PPE is to be domestically cleaned, warning should be given, e.g. certain types of contaminant can cause contamination of other domestic or protective items cleaned at the same time or after the contaminated item of PPE if cleaned in the same machine.

d) The influence of common domestic cleaners or detergents is not always known and could in some cases damage the characteristics of the PPE. The user should be warned about this risk.

e) All the procedures used in the cleaning, repair, tracking etc. of the PPE and their reporting should be in a form that recognises that the organization – not the user – is responsible for the performance and maintenance of the PPE.

f) Realistic industrial cleaning instructions should be provided to enable the removal of soiling but without affecting the function of the PPE (see 7.2).

g) Instructions should be provided regarding the removal of hazardous substances, e.g. body-fluids; fuel; asbestos; etc.

h) Information should be provided regarding the drying of the items of PPE.

i) Details should be provided regarding any special treatment/finishing used and how these should be rejuvenated/replaced.

j) Labels should include unique information for tracking the PPE item, including, but not limited to, one or more of the following:

   1) lot number;

   2) serial number;

   3) manufacturing date;

   4) bar code.

Durability testing of labels/inks, to the specified cleaning methods, should be carried out prior to the use of the label in the PPE.

Bibliography

[1] EN 469:2005, *Protective clothing for firefighters — Performance requirements for protective clothing for firefighting*

[2] EN 13921, *Personal protective equipment — Ergonomic principles*

[3] BS 8469, *Personal protective equipment for firefighters. Assessment of ergonomic performance and compatibility. Requirements and test methods*

[4] NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*

ICS 13.340.10

Price based on 15 pages