KAN Report 39

Consideration of time-related PPE performance aspects in standards

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1. Introduction

As a result of the adoption of European Directive 89/686/EEC [27], European standardization of personal protective equipment (PPE) has taken on a more significant role. Based as it is on the principle of the New Approach, the Directive only sets out the essential health and safety requirements, whilst detailed product-specific requirements are specified in harmonized European standards. The latter can be used by manufacturers in the production of PPE and serve as a basis for testing and certification bodies' work in the field of personal protective equipment. Furthermore, they can be used by the authorities responsible for market surveillance.

There are now around 250 standards and 80 draft standards on PPE. Some of them have already been or are being revised with the aim of improving them and updating them in line with new technical and legislative developments and tasks. The case of electrostatic filters designed in accordance with EN 143:2000 drew attention to the problem that the standards do not always give sufficient consideration to possible declines in the protective effect of PPE – be they due to intensity and/or duration of use, maintenance or storage. It has been observed that the performance of electrostatic filters, particularly with regard to resistance to liquid aerosols containing oil, deteriorates when used for an extended period but also when re-used. In accordance with the test method set out in EN 143:2000 for particle filters, the filter efficiency is measured three minutes after testing begins. However, it is possible that, after those three minutes, the filter efficiency might change dramatically and the filter might no longer meet the requirements for the efficiency class to which it was assigned. The test method for measuring filter penetration is thus not a suitable means of ensuring that the essential health and safety requirements specified in the European Directive are completely adhered to. The Directive states that PPE must be so designed and manufactured that in the foreseeable conditions of use for which it is intended the user can perform the risk-related activity normally whilst enjoying appropriate protection of the highest possible level. It became necessary to amend the standard by specifying additional testing requirements. Since the test method stipulated in EN 143:2000 is referred to in a range of standards, those standards are also being amended now that the altered version of EN 143:2000 has been published.

The debate concerning the EN 143:2000 issue prompted the *Commission for Occupational Health and Safety and Standardization (KAN)* to commission a study on the "Consideration of time-related PPE performance aspects in standards". The aim was to examine the existing harmonized PPE standards and draft PPE standards in order to ascertain whether and how the issue of time-related changes in the performance of PPE and its components is taken into consideration.

The task of producing the study was assigned to the BG BAU (statutory accident insurance institution for the construction industry) in view of its experience and knowledge of occupational safety and health (OSH) matters and its close collaboration with the experts on the BG Expert Committee on Personal Protective Equipment (FA PSA).

The present report begins by explaining how the study was conducted, i.e. how the list of standards was compiled, how the experts were surveyed and how the results were evaluated. This is followed by a presentation of the survey results concerning the requirements in the standards for each area of PPE. The report closes with a general summary, assessing the consideration given to performance aspects influenced by time and use by the PPE standards.

The study covers the majority of standards relating to personal protective equipment. It does not take into account personal protective equipment for sports and leisure activities, work on live parts of electrical installations or for users of hand-held chainsaws. In view of the current volume of standards and their ongoing development, the study makes no claim to be exhaustive.

2. Procedure employed in the study

2.1 Compilation of the list of standards

In the first phase of the study, a list of the existing standards and draft standards was compiled in order to create as up-to-date an overview as possible of standards in the area of personal protective equipment. Information was drawn from sources such as the lists of standards of the individual standards committees, lists from databases (e.g. the DIN[1] and CEN[2] databases) and lists of the standards published in the Official Journal of the European Union [22], creating a list of harmonized standards and draft standards as at 16 January 2006 (Annex A).

Standards and draft standards published after that date were generally not taken into account. However, in a small number of cases, the standards which had not been or have not yet been finally adopted were sufficiently well known to be included in the experts' assessment. Where this is true, it is pointed out in the sections presenting the results.

Standards and draft standards specifically relating to PPE for sports and leisure activities were not included in the study because they are of minor significance to the commercial sphere and the criteria concerning ageing and declining performance cannot be compared directly with those concerning PPE used for commercial purposes. For instance, changing fashion trends mean that PPE for sports and leisure activities is more likely to be replaced more frequently. Due to time constraints on the survey, it was not possible to consult the experts on PPE for users of hand-held chainsaws and so the standards for such products were not dealt with in the study. CENELEC standards on work on live parts of electrical installations were also not included.

2.2 Expert survey

In addition to an evaluation of the standards' content, the assessment of the current standards and draft standards was based on survey, which asked experts about their experience in their particular fields. Most of the experts were employees from "Berufsgenossenschaft" institutions for statutory accident insurance and prevention who work in the areas represented by the Expert Committee on Personal Protective Equipment (FA PSA). Not only do they have in-depth knowledge of the way in which PPE is used in their fields, they are also generally involved in the development of the related standards and, in most cases, in testing and certification of PPE. It can therefore be assumed that they have a high level of expertise and experience with regard to the current contents of standards, knowledge of current accident incidence and experience with problems in the use of PPE. This know-how provides a basis upon which to assess time-related changes in performance and the possibilities for using suitable test methods and requirements for the information supplied by the manufacturer to take possible changes in performance into consideration. In addition, individual experts from testing and certification bodies for PPE with extensive experience concerning the requirements in the standards and the test methods were consulted, as were representatives of well-known PPE manufacturers (especially since they have substantial industry-specific knowledge plus many years of practical experience in the manufacture and use of PPE).

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1 www.din.de
2 www.cen.eu

In view of the large number of standards and the fact that it is easier to explain examples of real-life practice in person, the survey mostly took the form of one-to-one interviews, in which the experts for the different types of PPE were asked questions about each standard in their field.

The survey concentrated on product standards although the testing standards were also used as support. Although a standard might not include direct test methods for testing performance aspects influenced by time and use, the test methods might include specifications which take such aspects into consideration. For example, a test method might call for temperature conditioning in order to determine factors such as the effect of a change between hot and cold on the PPE's ability to function. Since it is possible that product requirements alone might not cover the requirements concerning time-related performance aspects, the study also looked at material requirements specified for PPE by the standards.

In addition, the requirements specified in relation to the content of the information leaflet supplied by the manufacturer and the marking of PPE were assessed with the aim of establishing whether they take into consideration the issue of time-related performance aspects and whether the details in the information leaflet and the marking on the PPE provide users with an adequate basis for judging whether the PPE in question offer a permanent protective effect.

2.3 Evaluation of the results

The content of the standards was analysed, taking into account information from such sources as research reports and articles by specialists. The results of the survey were also evaluated and summarized. It became apparent that certain statements regarding the consideration given to time-related changes in performance applied to entire areas of PPE and could not be said to be limited to individual standards and/or draft standards. Depending on the nature and form of the details given on the various types of PPE, generic and standard-specific aspects are either discussed separately or together in the presentation of the results. Finally, each area is assessed as a whole, based on the results.

Given that standards are constantly evolving, it should be pointed out that some of the shortcomings mentioned may already have been dealt with in revised versions of the standards.

Sections 3.1-3.9 present the results of the study separately for each type of PPE, subdivided in accordance with the specialist areas of the Expert Committee on Personal Protective Equipment (FA PSA).

3. Assessment of standards for the different types of PPE

3.1 Respiratory protection

Safety requirements and test methods for respiratory protective devices are specified in harmonized European standards drawn up by CEN/TC 79 “Respiratory protective devices”. Annex A1 contains a detailed list of these standards.

In accordance with the Vienna Agreement[3], the process of revising the standards relating to respiratory protective devices takes place at the international level. The technical committee responsible for this area, ISO/TC 94/SC 15 "Respiratory protective devices" (RPDs), evolves standards in line with technical progress and an approach designed to cater for the needs of the international market.

The results of the expert survey tended to be of a generic nature, applying to all standards. Opinions expressed with regard to the consideration given to time-related performance aspects in individual/specific areas of standards are cited as examples along with the standards or draft standards to which they relate.

3.1.1 Generic requirements for filtering facepieces

General requirements for filtering facepieces

For the most part, the standards relating to filtering facepieces do take time-related performance aspects into consideration. The standards’ requirements concerning hard-wearingness are of a general nature, i.e. the filters (particle, gas or combined filters) have to be made of materials which can withstand normal use, temperature influences, moisture and corrosive conditions. They also require the inside of the filter to be resistant to corrosion caused by the filter media. A visual inspection and a mechanical strength test (vibration test) are used to determine whether the requirements are complied with. The vibration test also simulates transport situations and the handling of the filter during use. In addition, the filters undergo temperature conditioning, the requirement being that they must not display any damage after the testing.

In principle, the long-term efficiency of particle filters in terms of filtering solid aerosols (dusts) can be said to increase with use. This is because a “dust cake” forms on the filter, increasing breathing resistance, on the one hand, but also improving filtering efficiency. It has been observed that the filtering efficiency of electrostatic filter materials, particularly when filtering oily or liquid aerosols, can decrease when the filter is used for an extended period but also following re-use. In accordance with the current test method set out in EN 143:2000 for particle filters, filtering efficiency is measured three minutes after the beginning of testing. However, it can change dramatically after those three minutes to the extent that the filter no longer corresponds to the efficiency class to which it was assigned. This means that the test method used to measure filter penetration does not ensure that the essential health and safety requirements of EC Directive 89/686/EEC are met. A test method which caters for the above-mentioned points has thus been developed and can be found in EN 143/prA1:2006.

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[3] The Vienna Agreement provides the framework for technical cooperation between the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN).

It can also be assumed that other harmonized standards which refer to EN 143:2000 do not fully ensure that electrostatic filters comply with the essential health and safety requirements. Consequently, they will now also be amended following the publication of the amendment to EN 143:2000.

Gas and combined filters

It is not possible to cite a universally applicable indicative value for the useful life of gas filters since various external factors, e.g. the nature and concentration of air contamination, humidity, ambient temperature and intensity of the work (amount of air required by the user) influence the useful life. It is difficult for users to calculate the exact useful life using the information leaflet supplied by the manufacturer and taking into account the various influencing factors. Manufacturers offer a voluntary service whereby users describe the conditions of use (e.g. the nature and concentration of pollutants in the atmosphere, humidity and temperature) to the manufacturer, who then provides an estimation of the useful life. Nonetheless, it would be helpful if the information leaflet were to supply basic data to permit a rough estimate to be made.

The standards do not contain any requirements specifying that the manufacturer must provide information in the information leaflet to help the user decide when gas filters need to be replaced. Users are usually not able to notice that breakthrough has occurred in a gas filter. One possible indication would be odour but using odour as an indicator can result in the user being overexposed to the substance, if the breakthrough process is gradual and the user is exposed to gases for a certain period before noticing the odour and realising that a breakthrough has occurred. Moreover, there is a risk that the user might not detect the breakthrough on the basis of the odour, e.g. because the substance is odourless or because the user’s sense of smell does not pick it up. Although end-of-service-life indicators are technically possible, they are not the norm on the market. The question of whether such indicators could be used in the future should also be addressed in standardizers’ discussions.

Experiments designed to assess the reusability of gas filters already exposed to gases and/or vapours [18] showed that the filtering efficiency of type A gas filters (filters for organic gases and vapours) diminished significantly as a result of storage between periods of use. This is due to the fact that the concentration of the hazardous substance is distributed throughout the active carbon layer over a certain amount of time during post-use storage. This can result in breakthrough occurring earlier in re-used filters than in those which are not stored between periods of use. Conversely, however, it is also evident that the efficiency of inorganic gas filters which have been exposed to gases sometimes increases following storage. This does not mean, however, that there is no need for caution when re-using them. Other parameters, e.g. material properties, filter design and humidity, mean that the filter’s performance cannot be predicted.

Experiments conducted by the BG Institute for Occupational Safety and Health (BGIA) [16] have shown that gas and combined filters are flammable in certain conditions. When these filters burn out, toxic carbon monoxide (CO) is formed, which users cannot detect immediately. This can put users’ health or life at risk. This problem is not taken into consideration in the standards. It would be helpful if a test could be used in the future to determine the flammability of gas and combined filters. The instructions for use already draw attention to this issue by means of a warning notice.

Another aspect which is considered problematic is the emission of materials from gas/combined filters. Where double combined filters with impregnated filters are used, exposure to pollutants can cause carbon dust to be emitted from the respiration side of the filter. This can cause hazardous substances to get into the user's mouth, causing damage to health. The experts would like to see this effect taken into consideration in future standards.

Powered filtering devices

Electrical components in powered filtering devices can be prone to interference from electromagnetic waves. This can jeopardize the functional safety of the equipment, e.g. of electrical warning devices, when in use. As a result, the user might not be warned of a hazardous situation. However, the relevant standards do not contain a requirement concerning resistance to electromagnetic waves.

The standards require the materials used to be resistant to the cleaning and disinfecting agents and methods recommended by the manufacturer. Resistance to the influence of cleaning is tested by means of a visual inspection. In addition, the device has to be cleaned, disinfected and dried before each leak test.

According to the experts, the following (warning) information, which the standards currently do not require to be contained in the information leaflet supplied by the manufacturer, is also necessary:

- Need for pre-use check
- Type of use
- Restrictions on use
- Meanings of symbols/pictograms used

This information plays an important role in ensuring that the equipment is used in a safe manner and should be incorporated into the requirements in the standards.

3.1.2 Generic requirements for self-contained breathing protection

General requirements for self-contained breathing protection

Self-contained respiratory protective devices are required to withstand use and storage. However, these requirements are of a general nature, i.e. the requirement is merely that the devices must be sufficiently resistant to the rough treatment which can be expected during use. Furthermore, all materials used must display sufficient mechanical strength, durability and resistance to, for example, the influence of heat and/or sea water. Compliance with the requirements is determined, following conditioning (storage test), by means of a visual inspection and the practical performance test.

In order to ensure during use that respiratory protective devices are functioning safely, the standards require them to be fitted with components which warn users when they are not working safely. Mechanical warning devices are increasingly being replaced by electrical warning devices.

prEN 137:2002 for compressed air breathing apparatus with full face mask is a draft revision of the existing European standard EN 137:1993 for self-contained open-circuit compressed air breathing apparatus. The revision is intended to bring the standard into line with current developments in standardization work and with the state of the art, though it should be pointed out that the revision work has not yet been completed. With regard to prEN 137:2002, the issue of electromagnetic compatibility, i.e. functional safety in the presence of electromagnetic influences, of electronic components is seen as problematic although the question of the frequency range in which the components must be resistant to interference has not yet been adequately resolved. Criticism was also voiced in relation to the call by Working Group 3 "Self-contained closed-circuit breathing apparatus” of the DIN Precision Engineering and Optics Standards Committee for compressed air tanks to have a higher resistance to thermal loads. This issue is dealt with in the first paragraph of the section entitled “Self-contained breathing apparatus”.

The standards relating to insulating respiratory protection do not require transport simulations. In practice, the respiratory protective devices are frequently transported between various locations. The vibrations to which they are subjected during transport can be detrimental to safe functioning. An appropriate test is deemed necessary to determine the influence of vibration on the devices’ functionality.

Self-contained breathing apparatus

Self-contained breathing apparatus is tested for a temperature range between –30 °C and +60 °C. This range does not reflect real-life conditions during firefighting operations. Firefighters can be subjected to thermal loads far in excess of +250 °C. However, increasing the temperature range in the tests for these respiratory protective devices would only make partial sense since the problem lies in the compressed air tanks used. In accordance with the European Pressure Equipment Directive [28], the tanks, like the respiratory protective devices themselves, are only tested and approved for a temperature range of -30 °C und +60 °C. Thus, it would only make sense to test respiratory protective devices at higher temperatures if tested and certified compressed air tanks existed for the same temperature range. In practice, it has become evident that when a compressed air tank is subjected to brief exposure to flames and thermal radiation (outside of the temperature range) during operations, the wearer *is* protected but the tank cannot be reused. To verify that appropriate protection can be provided for the wearer, even after a thermal load of +250 °C or more, tests should be conducted in real-life conditions.

Built-in warning devices are not tested for resistance to temperatures between -30 °C and +60 °C or for flammability. It would be helpful if the standards were to require such testing in order to ensure safe functioning even when exposed to heat or cold. Having said that, warning devices do undergo an icing test, in accordance with, for instance, EN 137:1993 and EN 14435:2004 for self-contained open-circuit compressed air breathing apparatus with half mask designed to be used with positive pressure only. During the testing of the device, the relative humidity is > 90 % and water is applied every five minutes using a spray gun in an ambient temperature of (3 ± 1) C. This test is intended to ensure that the warning device functions safely in a temperature range between 0 °C and 10 °C.

Unlike EN 137:1993, prEN 137:2002 contains requirements for electrical warning devices. However, it is not yet clear when the prEN 137:2002 will be available as a standard. Electrical warning devices undergo a visual inspection following exposure to temperatures between –30 °C and +60 °C. It is pointed out, however, that the potential influence of a temperature of, for example, +100 °C on the functionality of the warning device is not known. This is a significant factor because firefighters can be exposed to temperatures of far more than +60 °C. In addition, the intensity of the disturbance radiation and the level of electromagnetic radiation, both of which can influence the functional safety of the warning device, are not specified. This should be taken into consideration in the standard. It is not known whether electrical warning devices are prone to ageing.

The standards for self-contained breathing apparatus specify that they must undergo a flame engulfment test but they do not take into account the protective clothing which can be worn in combination with self-contained breathing apparatus. The experts were not able to establish whether the various components (protective clothing, helmets, respiratory protective devices, etc.) influence each other. It is thus recommended that this point be discussed by standardizers.

3.1 Respiratory protection

The standards require the devices to be resistant to the cleaning and disinfecting agents and methods recommended by the manufacturer. Compliance with this requirement is determined by means of a visual inspection and during the practical performance test

Self-contained breathing apparatus undergoes storage testing. The device is stored at a room temperature of (23 ± 2) °C for (4 ± 1) h. A person then dons the device at room temperature (approx. 23 °C) and enters a cold chamber with a temperature of (-6 ± 2) °C. A practical performance test is then carried out there for a period of 30 minutes but at least until the warning device is activated. In addition to the practical performance test, the dimensions of the connections between the device and the facepiece are measured. They must not have changed in a way which would diminish the protective effect.

Non-self-contained breathing apparatus

Although it is possible that the air lines might trail over the floor when non-self-contained breathing apparatus is used, the influence of this abrasion is judged to be negligible because it is not known to have any negative impacts on the material and thus on the protective effect. Using the devices outside of the temperature range in which they are tested is also not thought to be problematic, i.e. there is no decline in the protective effect.

The materials used are required to be resistant to the cleaning and disinfecting agents and methods recommended by the manufacturer. Compliance with this requirement is determined by means of a visual inspection.

As with the standards relating to self-contained breathing apparatus, the standards for non-self-contained breathing apparratus (apart from EN 138:1994 for fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly) require warning devices to undergo an icing test. The aim of this test is to ensure that the warning device continues to function properly in a temperature range of 0 °C to 10 °C.

Non-self-contained breathing apparatus undergoes storage testing. The device is stored at a room temperature of (60 ± 3) °C and a relative humidity of at least 95 % for a period of 4 h to 16 h. It is then exposed to a temperature of (-30 ± 3) °C for a period of 4 h to 16 h. After storage, the device is brought back to the ambient temperature and must fulfil all of the performance requirements set out in the standard after storage. A test method described in EN 138:1994 includes an additional stipulation that the practical performance test be conducted at -6 °C. To this end, the device is pre-cooled at a temperature of (-6 ± 3) °C for 2 h to 3 h. A test person then dons the device in a cool chamber with a temperature of (-6 ± 3) °C in order to carry out a practical performance test there for 30 min. At the end of the test, each tested device is examined for malfunctions caused by low temperatures. In addition, the volume flow is measured before the test, after cooling at the end of the test in order to determine the influence of low temperatures. This test is deemed adequate to be able to assess whether non-self-contained breathing apparatus functions properly.

The standards do not contain any requirements concerning the details in the information leaflet supplied by the manufacturer with regard to:

- Need for pre-use check
- Type of use
- Restrictions on use
- Explanation of markings and/or pictograms

3.1.3 *Standard-specific requirements for respiratory protective devices*

EN 136:1998
Respiratory protective devices — Full face masks — Requirements, testing, marking

EN 140:1998
Respiratory protective devices — Half masks and quarter masks — Requirements, testing, marking; including Amendment AC:1999

Volatilization of softeners in the mask body can cause masks to become hard and brittle, a process which can be accelerated by external influences, e.g. UV radiation. The materials have not yet been observed to change in this manner in real-life conditions though that does not mean that it is not possible. The question of whether this matter can be taken into consideration in the standards, and how, should be discussed.

The DIN standards which existed prior to the drafting of harmonized European standards required the effects of cleaning and disinfection on masks to be tested. This testing was intended to determine the materials' resistance to the substances contained in cleaning and disinfecting agents. The EN standards no longer include this type of test method in this form. Instead, the materials are tested using the cleaning and disinfecting agents and methods recommended by the manufacturer. This can create a scenario whereby ten different cleaning and disinfecting agents have to be used for ten different masks, which can lead to a risk of confusion. The aim should be to enable users to select cleaning and disinfecting agents themselves. This could be achieved by testing the materials' resistance to substances typically contained in cleaning and disinfecting agents and not to the cleaning and disinfecting agents recommended by the manufacturer.

Chemical substances can influence the protective effect of masks. Permeation of chemicals through the mask is seen as a problem since fluids or glasses seeping through the mask can cause harm to the wearer. It has been established that phosgene (mustard gas) can permeate the silicone membrane of a mask. Exposure to chemical substances can also cause the ocular to become opaque. The standards do not address these types of negative influence caused by chemical substances. The experts feel that appropriate ways of taking this problem into consideration in the standards should be discussed.

Since leaks cause the protective effect of masks to decrease, a chamber test is carried out in the laboratory using a test aerosol (NaCl) to determine the level of inward leakage (fit test). The test involves the wearer performing various exercises, comparable with light physical activity. This results in an increase in the wearer's breathing frequency, meaning that more air is required. The increase in the amount of air the wearer needs can cause a vacuum in the mask, which in turn raises the risk of leaks. The test simulates leak formation during use but it does not reflect what actually happens in real-life conditions because the large number of possible combinations makes it impossible to simulate all of the influencing factors.

Experience has shown that the useful life of masks is between 6 and 12 years. Since ageing is known to reduce useful life, the standards require all components whose function can be impaired by ageing to be marked with the date of manufacture for identification purposes. Annex B of EN 136:1998 and Annex A of EN 140:1998 recommend which assemblies and components the manufacturer can mark for this purpose. The recommendations in the annexes are of a purely informative nature – they are not requirements. However, no requirement is made for the information leaflet supplied by the manufacturer to explain the meaning of such markings. This might result in users ignoring them because they do not know what they mean. Furthermore, simply indicating the date of manufacture does not enable the user to see how long the product can be used starting from the indicated date. Consequently, in addition to marking the components, there should be a requirement for the information leaflet to contain an explanation of the meaning of the marking. The manufacturer should also include recommendations in the leaflet on how often the masks should be replaced.

EN 138:1994

Respiratory protective devices — Fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly — Requirements, testing, marking

In order to prevent possible leaks between hose connectors, it was suggested that the standard could stipulate that fresh air hose breathing apparatus should have an air supply hose consisting of one piece.

EN 138:1994 does not require any warning devices to warn the user when the air intake becomes detached. Should it become detached, the risk is that it might no longer ensure a supply of breathable air and the user might inhale air from the contaminated atmosphere. The experts therefore recommend that the standard should require devices to warn users of this potential hazard.

EN 145:1997

Respiratory protective devices — Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type — Requirements, testing, marking

As a rule, self-contained, closed-circuit breathing apparatus is not breath-controlled so as to prevent a decrease in the oxygen content of the air feed. The user is supplied with a constant flow of respirable air. If the oxygen content drops, the warning device warns the user. In addition, increasing breathing resistance indicates to the user that the oxygen supply is running out.

EN 149:2001

Respiratory protective devices — Filtering half masks to protect against particles — Requirements, testing, marking

The dust-clogging test involves the particle-filtering half mask being subjected to sinusoidal breathing in an atmosphere containing dolomite dust. The breathing resistance and filter penetration are then measured. The test does not take into consideration the influence of the use of the half mask, i.e. there is no simulation of use. When the user is performing a task, his or her breathing frequency may increase, which, depending on how demanding the work is, could have negative effects on the exposure test conducted on the particle-filtering half mask. Due to the complexity of the testing and the poor reproducibility of the results, use is not simulated. Ways of including simulated use in the testing should be discussed.

Re-usable particle-filtering half masks undergo a dust-clogging test in order to determine their resistance to blockages. This test is optional in the case of particle-filtering half masks designed to be used once only since they are disposed of after use. The test is conducted on three particle-filtering half masks so as to be able to establish the influence of the temperature on performance. One particle-filtering half mask is tested straight from the factory and the other two are tested after temperature conditioning. The temperature conditioning entails the particle-filtering half masks being subjected to the following thermal cycle:

– 24 h in a dry atmosphere of (70 ± 3) °C

– 24 h at a temperature of (–30 ± 3) °C

Between the exposures and the testing they are brought back to room temperature for four hours in order to prevent a thermal shock. The dust-clogging test is conducted with the help of an artificial lung; the exhaled air must have a temperature of (37 ± 2) °C and a relative humidity of 95 %. These specifications are intended to simulate the influence of breathing since the increased level of moisture can have a negative influence on the filtering efficiency of the mask. These stringent requirements thus cater for the worst-case scenario.

The experts cited the following (warning) information which the standards do not require the information supplied by the manufacture to include:

– masks must only be worn by one person;
– a poorly fitting mask could cause a decline in the protective effect; and
– a general note explaining that leaks have a major influence on the level of protection.

The standard requires particle-filtering half masks intended to be used for more than one shift (re-usable masks) to be made of materials which are resistant to the cleaning and disinfecting agents recommended by the manufacturer. Compliance with this requirement is determined during both the leak test and the practical performance test.

EN 12941:1998

Respiratory protective devices — Powered filtering devices incorporating a helmet or a hood — Requirements, testing, marking; including A1:2003

The standard requires an auxiliary means to be provided for checking whether the minimum nominal volume flow is reached in order to ensure that the user receives sufficient breathable air. Class TH2 and TH3 devices must be equipped with a warning device which, during use, tells the user when the minimum nominal volume flow needs to be checked. There must also be an auxiliary means for checking that the warning devices are working properly. In accordance with EN 12941:1998, the warning device undergoes a visual inspection and a practical performance test in order to determine whether it is functioning properly. One critical issue, however, is fan failure in powered filtering devices which do not have warning devices (TH1 class devices) since this can quickly lead to a dangerous concentration of carbon dioxide in helmets and hoods.

EN 12942:1998

Respiratory protective devices — Power-assisted filtering devices incorporating full face masks, half masks or quarter masks — Requirements, testing, marking; including A1:2002

If the fan fails, the device will provide either no or only a low level of respiratory protection. The standard makes the following stipulation: "A warning must be given that a deactivated fan is to be considered as an unusual state" (Clause 9.1.4 “Information leaflet supplied by the manufacturer”). This stipulation does not make clear the hazard which can occur if the fan fails. The experts thus feel that a clearer warning should be given here.

3.1 Respiratory protection

Power assisted filtering devices incorporating full face masks must meet the inward leakage requirements both when the energy supply is switched on and when switched off. This requirement is intended to ensure that the protective effect is maintained after a power failure.

EN 12942:1998 specifies that an auxiliary means must be supplied for checking directly or indirectly, before each use, whether the minimum operating conditions indicated by the manufacturer have been achieved. The auxiliary means must be checked to ascertain whether it is activated when the operating conditions reach or exceed the minimum indicated by the manufacturer. The minimum operating conditions indicated by the manufacturer are checked in order to confirm the minimum service life cited by the manufacturer.

EN 14593-1:2005
Respiratory protective devices — Compressed air line breathing apparatus with demand valve — Part 1: Apparatus with a full face mask — Requirements, testing, marking

EN 14593-2:2005
Respiratory protective devices — Compressed air line breathing apparatus with demand valve — Part 2: Apparatus with a half mask at positive pressure — Requirements, testing, marking

Compressed air line breathing apparatus is fitted with a switch-over warning device if self-contained breathing apparatus is connected to it. If the apparatus malfunctions or is cut off from the compressed air line, it switches over to the self-contained breathing apparatus. In this case, a warning signal must be activated in order to inform the wearer that air from the self-contained breathing apparatus is being consumed. The purpose of the switch-over warning device is to enable the user to leave the hazard zone in good time. However, the user is not able to test the warning device before use. This should be made possible so that the user can ensure the warning device is in work order during use.

Electrical warning devices can be prone to electromagnetic interference and/or the effects of other influences. This can mean that the warning device is unable to function safely when exposed to electromagnetic waves during use. The standards should take this into consideration by including requirements of the type to be introduced in the revised version of EN 137:1993.

3.1.4 Conclusions

To summarize the opinion of the experts for respiratory protective devices, the standards do not always adequately cover the possibility of the protective effect of respiratory protective equipment decreasing due to use. Although the standards do attempt to align the tests and requirements with real-life conditions as far as possible, the real influencing factors and thus the useful life can only be determined to a certain extent. The reason given for this is that it is not possible to simulate real-life use. This is mainly due to innumerable factors which can influence the respiratory protective equipment and reduce its protective effect.

The standards include requirements relating to marking, packaging and information supplied by the manufacturer, which are intended to supply the user with information concerning time-related performance aspects. However, they only enable users of filtering respiratory protective devices to determine to a limited extent whether protection is still provided against contaminated atmospheres after the equipment has been used or stored. With regard to self-contained respiratory protective equipment, the user can judge whether it is functioning safely with the help of the warning devices and the information leaflet.

During the survey, support was expressed for the introduction of standardized instructions for use (sample instructions for use) for respiratory protective devices. One of the reasons given was that, when various manufacturers' products are used, the users would have a better overview of the content of the different information leaflets. This would enable them to obtain direct information on such points as proper and improper use, restrictions on use, cleaning and maintenance and warnings, and to compare different manufacturers' products.

In addition to standardized operating instructions, it is felt that it would be useful if the standards included a recommendation on how often respiratory protective devices (presuming they are re-usable) should undergo maintenance by a competent person, in order to ensure their protective effect.

3.2 Eye protection

Safety requirements and test methods for eye and face protective devices are specified in harmonized European standards drawn up by CEN/TC 85 “Eye protective devices”. Annex A2 contains a detailed list of these standards.
The functional requirements relating to eye protection are set out in the following standard:

EN 166:2001	Personal eye protection — Specifications

This European standard contains general specifications concerning, for example, basic requirements, marking and information for the user. The specifications in this standard do not apply to eye protective devices which are governed by a separate standard of their own. The standards for such devices include:

EN 175:1997	Personal protective equipment — Equipment for eye and face protection during welding and allied processes
EN 207:1998/A1:2002	Personal eye protection — Filters and anti-protectors against laser radiation (laser eye-protectors)
EN 379:2003	Personal eye protection — Automatic welding filters

3.2.1 Standard-specific requirements for eye protection

EN 166:2001
Personal eye protection – Specifications

EN 166:2001 stipulates that personal eye protection must be resistant to ageing. The eye protective devices must be resistant to high temperatures and UV radiation (oculars only). The testing is carried out as specified in EN 168:2001 “Personal eye protection – Non-optical test methods”, Clauses 5 and 6. In accordance with Clause 5, the sample is placed in an oven and exposed to a temperature of (55 ± 2) °C. There then follows a visual inspection, after the sample has adjusted to the room temperature, to ensure that no damage has occurred to the eye protective devices. Clause 6 describes the method for testing resistance to UV radiation, entailing the oculars being exposed to the light of a xenon high-pressure lamp. This test is intended to simulate the potential negative influence of UV radiation of the kind which occurs, for example, in industrial processes (welding). The aim is to determine both resistance to material embrittlement and the stability of the optical characteristics.

In addition, eye protective devices are tested for resistance to corrosion. The requirement is that the surfaces of all metal parts must be corrosion-free, the aim being to prevent a decline in the protective effect. Resistance to corrosion is tested in accordance with a method specified in EN 168:2001. Once impurities such as oil and grease have been removed from the metal parts, the sample is immersed for (15 ± 1) min in a boiling, watery sodium chloride solution and then, for the same period at room temperature, in a sodium chloride solution, both with a mass proportion of (10 ± 0.5) %. Once taken out of the solution, the samples are stored for (24 ± 1) h at a room temperature of (23 ± 5) °C, then rinsed in warm water and visually inspected.

All marking on eye protective devices must be clear and permanent in order to guarantee that the user has the necessary information at all times. Oculars and frames must bear the manufacturer’s identification mark, which enables the user to obtain from the manufacturer any further information necessary for safe use. In addition, the intended area of use must also be marked on the frame.

3.2 Eye protection

The information to be supplied by the manufacturer in the information leaflet for the user includes:

- instructions relating to storage, use and maintenance,
- special instructions for cleaning and disinfection,
- details regarding the area of use,
- use-by date or period, if relevant, for the entire eye protective device and/or its components and
- a notice to warn the user that scratched or damaged oculars should be replaced.

EN 175:1997
Personal protection – Equipment for eye and face protection during welding and allied processes

This standard sets out requirements concerning protection against radiation-related hazards, flammability and mechanical and electrical hazards, taking into account ergonomic aspects. The casing and filter of the protective devices for welders must provide identical protection against radiation; any ventilation must not impair the level of protection.

Welders' face shields must be resistant to damage caused by dropping. They undergo conditioning before the drop test. One face shield is stored for 120 min to 150 min at (-5 ± 2) °C and one at (80 ± 2) °C. They are then dropped three times onto a steel plate, having been conditioned each time. After testing, the shields must not be visibly deformed, have any cracks, be broken into two or more parts or sustain any other permanent damage which could impair their functioning. The filter and the cover glasses must also not display any permanent damage of a nature which would impair their functioning.

In addition, a corrosion test must be performed in accordance with the requirement set out in EN 166:1995. Furthermore, all of the PPE components must be able to withstand the cleaning and disinfection methods recommended by the manufacturer without any visible changes occurring.

The marking on the frame or casing must include the following information:

- manufacturer's identification mark and
- area of use (possibly more than one).

When the face shield is assembled, the marking must be easy to see.

For the minimum requirements concerning the information leaflet to be supplied by the manufacturer, the reader is asked to refer to the details given for EN 166:2001.

EN 207:1998
Personal eye protection – Filters and eye-protectors against laser radiation (laser eye-protectors); including A1:2002

The quality of filter materials and surfaces is tested in accordance with the methods described in EN 167:2001 for optical tests methods. Damage to the filter layer, e.g. due to scratches or holes, can impair the protective effect. Whether or not this is the case is assessed using a "light box" or an illuminated grid. In the latter method, the illuminated grid is used as a background, which is looked at with the eye from various distances through the ocular. In the other method, the ocular is illuminated by a fluorescent lamp in a matt black chamber and the luminance is changed using an adjustable, opaque black mask.

3.2 Eye protection

Since the essential protective characteristics of filters and eye protective devices must not change, they are first exposed to UV radiation from a 450 watt lamp for a period of (50 ± 0.2) h. The thermal resistance which they are also required to display is tested by exposing the PPE to a temperature of (55 ± 2) °C and a relative humidity of at least 95% during five hours of storage in a climatic exposure test cabinet. The filters and eye protective devices must meet the performance requirements set out in the standard (e.g. concerning spectral transmittance, resistance to laser radiation and quality of filter surface materials) both after the UV radiation and the thermal exposure.

The information to be supplied by the manufacturer must include the following:

- a notice explaining that laser eye-protectors and laser safety filters which have been damaged or whose colour has changed should no longer be used;
- a notice explaining a suitable cleaning method ; and
- a notice warning users that damaged eye-protectors or eye-protectors with contaminated lenses should be replaced.

EN 379:2003
Personal eye protection – Automatic welding filters

This standard attempts to prevent a decrease in the protective effect of automatic welding filters by, for instance, requiring that they be resistant to ultraviolet radiation. This resistance is tested in accordance with the method described in EN 166:2001.

In addition, automatic welding filters have to meet requirements concerning the minimum switching time, which are specified in EN 379:2003 for each of the protection levels. Performance is tested both at temperatures of (-5 ± 2) °C and (55 ± 2) °C and at temperatures of (10 ± 2) °C and (55 ± 2) °C. The measured switching time shall not be exceeded at either of these temperatures. This temperature test is intended to ensure the safe functioning of the filter. If the filter should not be used below 10 °C, the manufacturer must provide a warning and mark the filter accordingly since the level of performance required by this standard cannot be achieved at -5 °C.

In the case of electro-optical filters for arc-welding, the user can see whether the PPE is functional before using it. These filters are dynamic liquid-crystal filters, which, when ready for use and when there is no arc, are so transparent that the workpiece and environment are clearly visible. Once the arc has been ignited, the filter darkens within just a few tenths of a second in order to protect the welder’s eyes from the optical radiation. In the event of a failure, e.g. in the electronics, the filter goes dark. This protects the user from harmful effects because it is not possible to continue working.

The marking must comply with EN 166:2001. In addition, an information leaflet must be supplied with each filter. The leaflet must meet the requirements of clause 10 of EN 166 and contain the following additional information:

- information on how to recognize a failure;
- information on the periods after which components or the entire filter should be replaced; and
- a notice explaining that the filters’ sensors should be kept clean and clear.

3.2.2 Conclusions

3.2 Eye protection

The general feeling is that a possible decline in the performance aspects of eye and face protective devices is not problematic. A study conducted by the “Berufsgenossenschaft” institution for statutory accident insurance and prevention in the quarry industry [1] in the period 1998 to 2002 evaluated accidents involving eye injuries. It did not identify changes in performance aspects of the PPE as a cause of accidents.

There are currently no known research findings as to when and to what extent the PPE’s protective effect is impaired by ageing or use. In the case of simple eye-protectors made of plastic, it is conceivable that the material might turn brittle in the long term. However, industry practitioners do not consider this problematic because the low procurement costs (between 3 and 15 euros) mean it is safe to assume that damaged eye protectors actually are regularly replaced. By contrast, it can be assumed that laser eye-protectors, which are very expensive to buy (around 1,000 euros) are used for a longer period. However, these eye-protectors are used by people who have usually completed training corresponding to their job and have learnt how to handle and care for laser eye-protectors during that training.

The standards also require the manufacturer to indicate the use-by date or period (if appropriate) to the user as well as including recommendations on such points as maintenance, cleaning and storage. Based on this and other information provided in the markings and the content of the information supplied by the manufacturer, the user should be in a position to judge the protective effect of eye protective devices.

Furthermore, leading manufacturers currently voluntarily provide "helplines" on their websites. This interaction feature enables the manufacturer to get a better idea of what additional information the user requires and, where necessary, to "fill in the gaps" in future information leaflets.

All of the standards relating to eye and face protective devices require the information supplied by the manufacturer to point out that eye-protectors should no longer be used if the oculars are scratched or broken. It should be noted that the more specific wording of Section 3.3 of BG Rule 192 [8] stipulates that oculars should be replaced “if they are discoloured, scratched or particles have become permanently adhered to them as well as if there are signs of rips in the protective film. In addition, eye and face protective devices should be removed from use if adjustable components can no longer be locked into position." Standardizers should explore whether these requirements could be adopted for the information leaflet to be supplied by the manufacturer.

3.3 Head protection

Safety requirements and test methods for head protectors are specified in harmonized European standards drawn up by CEN/TC 158 "Head protection”. Annex A3 contains a detailed list of the standards used as the basis for this section.

3.3.1 Generic requirements for head protectors

The ageing behaviour of industrial safety helmets was a particular focus of past studies [17] by the BG Institute for Occupational Safety and Health (BGIA) in collaboration with the Federal Institute for Occupational Safety and Health (BAuA). Industrial safety helmets often remain in use for several years. They are almost exclusively made of plastics and are subject to environmentally induced material ageing. The studies were designed to establish whether helmets provide a long-term protective effect and for how long, and included scenarios in which the helmet had not been damaged in an accident or due to incorrect handling. The studies only examined the ageing behaviour of the helmet *shells* since the headbands and chin straps can be replaced several times during a helmet’s service life for reasons of hygiene.

The ageing processes differed according to the material of the helmet shell. The studies resulted in a recommendation for industrial safety helmets made of thermoplastics, stating that, as a rule, they should not remain in use for more than four years after the date of manufacture. Assuming a constant level of UV irradiation, the speed of the ageing processes largely depends on the quality of the plastic used and the type and amount of the UV stabilizer added. In the case of helmet shells made of thermosetting plastics, however, applications involving a combination of UV exposure and high ambient temperatures proved particularly critical. The resulting recommendation for the period of use for industrial safety helmets made of thermosetting plastics was a maximum of eight years. Both recommendations are based on the assumption that the helmets are worn in normal conditions of use and are not subject to extreme stress.

If the date of manufacture and the symbol for the material used are embossed in the helmet shell, wearers can determine when a helmet needs to be replaced if they know how long the useful life is. The applicable product standard specifies the manufacturer’s obligations with regard to marking the helmet shell with the material used as well as the requirements for the information leaflet supplied by the manufacturer. The latter must contain the information necessary for the user to be able to estimate the useful life of the PPE in the specific conditions in which they use it, based on the specific combination of materials used in the product.

3.3.2 Standard-specific requirements for head protectors

EN 397:1995
Industrial safety helmets; including A1:2000

Industrial safety helmets undergo conditioning prior to performance testing in order to take into account influences which could result in a decline in their protective effect. The conditioning covers factors such as the influence of high temperature (50 ± 2) °C and low temperature (-10 ± 2) °C as well as artificial ageing. Ageing is simulated using a xenon high-pressure lamp with a rated output of 440 watts and a sintered quartz case, with the sample being exposed to radiation of (400 ± 4) h.

3.3 Head protection

Annex B (informative) of the standard describes an artificial ageing method to be introduced at a later stage as a replacement for the method described in the preceding paragraph. In the meantime, it can be used as an alternative to said method. In the new method, the artificial ageing takes the form of the helmet being exposed to radiation from a xenon arc lamp. The energy radiated by the lamp is filtered so that the spectral energy distribution is as close as possible to that of natural daylight. The exposure interval shall be adjusted in such a way that the exposed samples receive a total energy of 1 GJ/m^2 over a wavelength range of 280 nm to 800 nm.

The permanent markings required on industrial safety helmets include the name or mark of the manufacturer (for any questions the user might have) plus the year and quarter of manufacture. Furthermore, a label bearing additional information in the language of the country of sale must be affixed to the helmet. This information must include the following statement: "The helmet is made to absorb the energy of a blow by partial destruction or damage to the shell and the harness, and even though such damage may not be readily apparent, any helmet subjected to severe impact should be replaced. Do not apply any paint, solvents, adhesives or self-adhesive labels, except in accordance with instructions from the helmet manufacturer.“

In addition, compliance with additional requirements, e.g. resistance to molten metal splash (MM), must be indicated on the helmet or by means of a permanent self-adhesive label.

The information leaflet which has to be enclosed with the helmet must include the following information in the language(s) of the country of sale:

- name and address of the manufacturer;
- instructions or recommendations on use, cleaning, disinfection, maintenance, repair and storage. The substances recommended by the manufacturer for cleaning, maintenance or disinfection must not, according to the information available at the time, have any detrimental effects on the helmet or the wearer if the latter uses the substances as instructed by the manufacturer. The substances recommended will depend on the material of the helmet shell;
- the meaning of the additional requirements plus any restrictions on the use of the helmet based on the hazards present; and
- the use-by date and period of the helmet and its components.

EN 443:1997
Helmets for firefighters

The requirements concerning the general properties of helmets for firefighters stipulate that the materials should be durable, i.e. ageing and the usual conditions in which the helmet is used (exposure to the sun, rain and/or cold; skin contact, sweat, etc.) should not produce any perceivable change in such properties. The standard does not specify a test method specifically designed to provide evidence of durability. The helmet must meet the requirements concerning impact absorption, penetration by sharp-edged objects, mechanical strength, burning behaviour, resistance to radiant heat, electrical insulation and stability of the supporting structure.

The requirements concerning cleaning, maintenance and care are identical to those for industrial safety helmets. Readers are requested to consult the comments made in the section covering industrial safety helmets.

Before each test, the helmet must be conditioned in accordance with defined criteria. The conditioning reflects the particular influences to which helmets for firefighters are exposed in real-life conditions, e.g. thermal shock, as well as taking into account factors which can result in a decline in the protective effect, e.g. UV ageing. Ageing is simulated using a xenon high-pressure lamp with a rated output of 440 watts and a sintered quartz case, with the sample being exposed to radiation of (400 ± 4) h. Alternatively, a method described in an informative annex can be used. This test takes the form of the helmet being exposed to radiation from a xenon arc lamp. The energy radiated by the lamp is filtered so that the spectral energy distribution is close to that of the Earth's natural daylight. The exposure interval is set in such a way that the samples are exposed to a total energy of 1 GJ/m^2 over a wavelength range of 280 nm to 800 nm.

All helmets which comply with the requirements of the standard must bear a cast or embossed marking including the name or mark of the manufacturer and the year of manufacture. Compliance with optional requirements, e.g. classification of the radiant heat, must also be indicated.

The information leaflet which has to be enclosed with the helmet must include the following information in the language of the country in which it is sold:

- name and address of the manufacturer or retailer and helmet type;
- details or recommendations concerning storage, use, cleaning, repair, maintenance and disinfection; and
- precise details regarding suitable packaging in which to transport the helmet.

prEN 443:2004
Helmets for firefighting in buildings and other structures

This draft standard contains a number of changes compared to EN 443:1997, resulting in additional testing of fitness for purpose and further-reaching requirements relating to the information to be supplied by the manufacturer, based on the latest findings concerning material properties and empirical values from hazard analyses.

Normative Annex A contains a list of the most significant hazards involved in firefighting in buildings and other structures (based on the Risk assessment guidelines for choosing PPE for firefighters). By looking up the hazard, e.g. "flames", and taking into account the conditions and obstacles, such as "flashback", it can be used to find the correct test method for a specific hazard and specific “protection zone”. For this purpose, the upper half of the head is divided into five zones. The helmets are classified as type A or type B depending on the zone protected by the helmet shell.

The samples must undergo a defined conditioning sequence. With regard to the conditioning by means of UV ageing, the standard now merely refers to 4.7 of EN 13087-1:2001 “Protective helmets – Test methods, Part 1: Conditions and conditioning”, which describes the method outlined above involving radiation from a xenon high-pressure lamp with a rated output of 450 W and the use of a sintered quartz case as well as permitting the alternative method using a xenon arc lamp.
The general requirements of the draft specify that type A and type B helmets must comply with the requirements set out in the standard. Any products recommended for cleaning, maintenance or disinfection must not have any detrimental effect on the helmet. The scope of this standard does include a note stating that guidelines on selection, use, care and maintenance are to be contained in an informative annex. However, the informative Annex C, “Minimising interference”, in the draft from August 2004 provided to this study's authors only includes information on selecting suitable PPE taking into account, in particular, ergonomic aspects. Despite what was announced, the draft

does not provide recommendations on care and maintenance. It remains to be seen whether the information announced will be added during the revision phase.

With regard to marking, the draft stipulates that each helmet which meets the standard's requirements must now also have a visible, legible and clear, cast or embossed marking, including the following information:

- helmet type A or B,
- ISO 472 abbreviation of the helmet material (if made of plastic), e.g. ABS, PC, HPDE, PS, etc., with additional details given in the information supplied by the manufacturer.

The draft now requires the information leaflet to be easy to understand and recommends, where suitable, the use of pictures, part numbers and descriptions. Appropriate warnings or FAQs should be available to users to help them use the helmet correctly. In addition to the information leaflet supplied by the manufacturer as described in EN 443:1997, the following extra details, formulated in a precise and comprehensive manner, must be enclosed with each helmet:

- in addition to the company name and the address of the manufacturer or retailer, the trademark* (*only if it is a suitable means of identification); and
- along with the details or recommendations concerning storage, use, etc., a note stating that a visual inspection should be carried out and an indication of the anticipated service life.

  No specific details are given of the aspects or criteria (scratches, changes in the surface) which users should take as their basis when visually inspecting the helmet to determine its fitness for purpose. One opinion was that this is not necessary in the case of a product standard. On the other hand, if the intention were to help the manufacturer to provide the user with comprehensive information, suitable criteria could be added to the informative Annex B, "Useable life and general properties".

  Annex B of prEN 443:2004, “Useable life and general properties”, expands on the recommendation that materials should be of “long-lasting quality” by adding that, as far as possible, the helmet shell should have the same strength properties across all of its parts and that shells must never be reinforced at one particular point. There is no description of a special test method for assessing compliance with this requirement. In this context, it should be pointed out that the overall range of test methods has been broadened by adding, for instance, a flame engulfment test and a test to determine the protection provided by the helmet shell against molten metals and hot bodies. At the same time, the required level of protection to be displayed in the radiant heat test and the penetration test has been increased. Thus, in the penetration test, the helmet must now be exposed to a falling impactor with a mass of 1,000 g instead of the previous 400 g. That is to say, the requirements to be met by the helmet are now stricter.
- In addition to marking showing the helmet material, the following statement is to be added: "The length of the useable life of this helmet will be affected by the type(s) of material used in its construction and the environments in which the helmet is used and stored.””. This will ensure that the manufacturer can give guidance tailored to the specific situation in which the user wears the helmet.

EN 812:1997
Industrial bump caps; including A1:2001

In addition to this standard's requirements concerning materials and design, the informative Annex A gives the following recommendations: "The materials used should be durable, i.e. the influence of ageing or the usual conditions of use (sun, rain, cold, dust, vibration, skin contact, effect of sweat or skin or hair care products) to which industrial bump caps are usually exposed should not have any discernible effect on their properties." The standard does not state what criteria have to be met in order to be able to assume that the material is durable.

Industrial bump caps undergo conditioning prior to performance testing in order to take into account influences which could result in a decline in their protective effect. The conditioning covers factors such as the influence of high temperature (50 ± 2) °C and low temperature (-10 ± 2) °C as well as artificial ageing. Ageing is simulated using a xenon high-pressure lamp, with the sample being exposed to radiation of (400 ± 4) h.

Annex B of the standard offers an alternative artificial ageing method, in which the artificial ageing takes the form of the bump cap being exposed to radiation from a xenon arc lamp. The energy radiated by the lamp is filtered so that the spectral energy distribution is similar to that of natural daylight.

The permanent markings required on each bump cap include the name or mark of the manufacturer plus the year and quarter of manufacture. There must also be a permanent label with additional information, including a note that any bump cap subjected to a strong impact should be replaced even if there is no directly recognizable damage. It must also be pointed out that paint, varnish, solvents and self-adhesive stickers may only be applied/adhered to the cap in accordance with the instructions given by the cap manufacturer. Compliance with additional requirements must also be marked in a permanent manner. (In accordance with the standard, material marking is not necessary. Since the other product standards in this area do require material marking, consideration should be given to harmonizing this requirement).

The information leaflet which has to be enclosed with the bump cap, and must be written in the language of the country of sale, must include the following information:

- name and address of the manufacturer;
- instructions or recommendations on storage, use, cleaning, maintenance, repair and disinfection. The substances recommended for cleaning, repairs or disinfection must not have any detrimental effects on the bump cap;
- the use-by date and period of the bump cap and its components; and
- details of suitable packaging in which to transport the bump cap.

3.3.3 Conclusions

Past studies on the ageing of helmet shells, based on the example of industrial safety helmets [16], have already shown that ageing behaviour varies according to the material used. The durability of the shell depends on atmospheric influences, e.g. solar radiation, air contamination or temperature. Manufacturer-related aspects are the type and quality of plastic used, the UV stabilizers added and production parameters. Other influencing factors are the mechanical stress during the useful life and the individual user's handling of the protective helmet (duration of use, place of use, care, storage).

3.3 Head protection

Thermal loads which cause changes in the material's behaviour which could result in a decline in the PPE's performance are simulated by means of various types of conditioning (heat, cold, UV ageing, water, etc.) when testing is carried out.

With regard to design, the annexes to the standards provide the manufacturer with material recommendations intended to ensure "durability" or "long-lastingness", i.e. their protective properties must not change, for example, due to ageing. The standards do not say what criteria the manufacturer can use to check whether such changes have occurred. This issue should perhaps be resolved.

Compared to EN 443:1997, draft standard prEN 443:2004 is designed to bring about a series of changes, resulting in additional testing of fitness for purpose and further-reaching requirements relating to the information to be supplied by the manufacturer, based on the latest findings concerning material properties and empirical values from hazard analyses. In addition to details or recommendations concerning storage, use, cleaning, repair, maintenance and disinfection, a reminder that a visual inspection should be carried out and details of the anticipated service life are now also required. The standard should require further information to be provided regarding the criteria which the user should apply when carrying out the visual inspection to determine a helmet's fitness for purpose. Furthermore, the following statement is to be added to the information leaflet: "The length of the useable life of this helmet will be affected by the type(s) of material used in its construction and the environments in which the helmet is used and stored. Recommendations on this topic should be sought from the manufacturer." This method of interaction, which, in the era of the Internet and e-mail, makes it quick and simple to answer users' questions, means that, in particular, the manufacturer gets the necessary feedback to be able to respond better to users' needs. It remains to be seen whether the draft of this standard will be implemented without any changes to these points. Where appropriate, consideration should be given to similar changes in the other standards relating to head protection.

3.4 Hearing protection

Safety requirements and test methods for hearing protectors are specified in harmonized European standards and draft standards drawn up by CEN/TC 159 "Hearing protectors". Annex A4 contains a detailed list of these standards.

The essential safety requirements for hearing protectors are set out in the following standards:

EN 352-1:2002	Hearing protectors — General requirements — Part 1: Ear-muffs
EN 352-2:2002	Hearing protectors — General requirements — Part 2: Ear-plugs
EN 352-3:2002	Hearing protectors — General requirements — Part 3: Ear-muffs attached to an industrial safety helmet

Ear-muffs for special usage and ear-plugs for special usage are conventional hearing protectors fitted with electronic devices. The essential safety requirements relating to hearing protectors for special usage are therefore the same as the requirements specified in standards EN 352-1 to -3:2002.

3.4.1 Generic requirements for hearing protectors

EN 352-1:2002, EN 352-2:2002, EN 352-3:2002
“General requirements for various ear-muffs and ear-plugs”

The softness of ear-plugs, particularly PVC ear-plugs, has been observed to change during storage as a result of softeners becoming volatilized. Ear-plugs which have become hard might not expand as quickly or completely in the user's ear canal. This could result in a reduction in sound attenuation. An ageing test (storage test) is therefore deemed necessary. A notice warning the user of this problem should also be included in the standards’ requirements relating to the information to be supplied by the manufacturer.

Storage-induced ageing is of minor significance for ear-muffs. Experience has shown that, when stored properly, the materials do not change in a way which would reduce the protective effect. It is, however, necessary to take into account environmental influences (e.g. UV radiation or heat) and other influences (e.g. oils or coolants) which could affect the ear-muffs during use. The external influences can have a detrimental effect on the cushions' properties and result in hardening/embrittlement. This change in the materials can cause the cushions to not sit completely on the user's head because they do not fully adapt to the wearer's head. Furthermore, the risk of tears can increase if the cushions become brittle. These tears pose a risk of leakage, which would lead to a decrease in sound attenuation and thus constitute a hazard to the wearer. It is thought that it would be beneficial to explore whether a test for resistance to environmental influences and other external influences could be incorporated into the standards. In this context, the fact that EN 352-1:2002 and EN 352-3:2002 do not contain a recommendation to replace hardened cushions, where possible, is also considered to be critical.

The information to be supplied by the manufacturer recommends the user to check cushions for signs of e.g. tears and holes. However, the experts feel that the recommendation in EN 352-1:2002 and EN 352-3:2002 for users to check cushions for holes is difficult to implement. The user *can* carry out a visual inspection but a simple visual inspection is not sufficient to detect holes. This recommendation and, in particular, assessment criteria should be discussed.

3.4 Hearing protection

The standards do not stipulate any restrictions on the materials (the chemical composition) or the substances used (harmful substances) used in ear-plugs. Use-induced ageing can cause substances to be released which can pose a risk to the wearer during use. The substances which could be considered would be, e.g. metals (lead, arsenic or tin), phthalates and organic tin compounds. Future standardization discussions should look at possible ways of using standards to restrict harmful materials and substances and introduce test methods with which to identify substances.

The experts feel it would be helpful if hearing protectors, particularly PVC ear-plugs, were all marked with a serial or batch number. This would make it easier to trace the products' history. The user would then be able to determine the date of manufacture and thus the age – an important factor in view of the risk which ageing-induced hardening of PVC ear-plugs poses.

Standards EN 352-1 to -3:2002 specify product and material requirements intended to prevent a decline in the protective effect due to use. They require hearing protectors, including the headband, to be able to withstand drops and, optionally, to withstand drops at low temperatures.

Standards EN 352-1 to -3:2002 require the materials used in hearing protectors to be resistant to the cleaning methods specified by the manufacturer. Re-usable ear-plugs undergo cleaning and disinfection testing, after which there must be no significant change in their size or adjustability (ear-muffs and banded plugs) and no change in their sound-attenuation properties. Cleaning and disinfection testing is not carried out for ear-muffs. The information to be supplied by the manufacturer is required to give users of ear-muffs and re-usable ear-plugs information on cleaning and disinfection methods which are known not to be harmful to the user.

Standards EN 352-1:2002 and EN 352-3:2002 specify a maximum pressure for ear-muffs' cushions and headbands. Once the headband of some of the samples has been subjected to bending (equivalent to being placed on and taken off the head 1,000 times), the pressure is tested again in accordance with the standards. Headbands can stretch due to use (as a result of the ear-muffs being put on and taken off), which can make the pressure caused by the cushions decrease, resulting in a reduction in sound attenuation. There is a risk that, in the long term, due to constant use and atmospheric influences (e.g. UV radiation), the headband might no longer provide the pressure necessary to ensure adequate sound attenuation. It was therefore suggested that the need for a continuous stress test for ear-muffs, using artificial ageing, should be discussed.

Temperature and/or atmospheric influences can have an effect on ear-plugs during transport or storage. Low ambient temperatures can cause ear-plugs to become hard. However, users can prevent a reduction in sound attenuation if they warm the ear-plugs, e.g. by holding them tightly in the palm of the hand, before inserting them into their ear canal. The standards do not require the information supplied by the manufacturer to include an explicit note to this effect. The standard states that there must be "Anleitungen zum Einsetzen und zur Anwendung, in denen auf die Erfordernis des richtigen Sitzes hingewiesen werden muss".

On the subject of cleaning and disinfection, EN 352-2:2002 stipulates that re-usable ear-plugs must not display any significant changes in size and adjustability or any changes in their sound-attenuation properties after having been cleaned and disinfected once. However, it is not clear why the test in accordance with EN 352-2:2002 is carried out after one single cleaning process. Since re-usable ear-plugs might be cleaned and disinfected more than once, future standardization discussions should examine whether the number of cleaning cycles needs to be increased.

In the case of custom-moulded ear-plugs, it can be said that neither ageing nor use generally cause the products to change in a way which might reduce their protective effect. It is, however, possible that the sound attenuation provided by the custom-moulded ear-plugs might decrease after a certain time. However, this is the result of changes in the user's ear, not the fault of the product. It is for this reason that BG Rule 194 [10] requires a leakage test to be conducted at least every two years. The standards do not include a recommendation of this nature.

Standards EN 352-1 to -3:2002 recommend that a note be included in the information supplied by the manufacturer that ear-muffs and re-usable ear-plugs should regularly be checked to ascertain whether maintenance is required. However, this recommendation is judged to be too imprecise. A recommendation that the products be checked before each use would be more conducive to identifying damage early on. In addition to such pre-use checks, it would be beneficial if the manufacturer were to recommend regular maintenance intervals as a guide for the user.

3.4.2 Standard-specific requirements for hearing protectors

EN 352-3:2003
Hearing protectors – General requirements – Part 3: Ear-muffs attached to an industrial safety helmet

EN 352-3:2003 sets out requirements concerning construction, design, performance, marking and user information for ear-muffs intended to be attached to industrial safety helmets constructed to the specifications of EN 397. The latter must comply with requirements which are not covered in EN 352-3:2003. These requirements relate to aspects such as the electrical insulation of the helmet and its resistance to artificial ageing. The electrical insulation provided by the helmet is intended to protect the user against short, unintended contact with live conductors operating on A/C. The question of whether ear-muffs in combined helmet and ear-muff products influence this property and whether a test is necessary should be discussed by the experts. As already mentioned, industrial safety helmets are required to be resistant to artificial ageing (see also Section 3.3) and their resistance is determined by means of a test using a xenon arc lamp. It is conceivable that UV radiation might have a negative influence on the material properties of, for instance, the fastening point on the helmet, which could cause the ear-muffs to come apart from the helmet, e.g. after being dropped or when being placed on or taken off the head. It was therefore suggested that possible requirements for combined helmets and ear-muffs and test methods suitable for assessing UV radiation (artificial ageing) should be discussed.

EN 352-4:2001, EN 352-5:2002, EN 352-6:2002, EN 352-7:2002
"Safety requirement and tests for various ear-muffs and ear-plugs with electronic sound-attenuation devices"

These special-purpose ear-muffs all have a minimum sound-attenuation level in passive mode in order to provide the user with sufficient protection in the event of electronic equipment failing and enable the user to leave the noise zone.

Ear-muffs with active noise compensation and level-dependent ear-plugs are required to be resistant to electromagnetic waves. However, the standards do not include methods with which to test that resistance. Electromagnetic waves could jeopardize the functional safety of the hearing protectors' electronic devices. This can cause the sound attenuation to decrease to the minimum level required by EN 352-1:2003. In the event of this electronic device failing, the user might no longer be able to hear all of the necessary work noises or signals. This could result, for example, in warnings going unnoticed, which could result in the user being harmed. Possible test methods with which to determine the influence of electromagnetic waves should therefore be discussed for standards EN 352-5:2002 and EN 352-7:2002.

It has been ascertained that the sound-attenuation settings on ear-muffs with electronic sound-attenuation devices can change as a result of being transported. The reduction in sound attenuation can be as much as 10 dB(A). It is also considered possible that ageing of the electronic devices or being dropped could cause a shift in the level, resulting in reduced sound attenuation. In the cases cited here, the sound attenuation level can shift to a range where the user will be harmed. It is therefore thought that it would make sense to test the electronic devices for their reactions to transport, ageing and drops.

3.4.3 Conclusions

The experts feel that standards EN 352-1 to -3:2002 “General requirements for various ear-muffs and ear-plugs” do not give sufficient consideration to changes in performance brought about by use or ageing. One example is ear-muffs, the cushions of which can become hard or brittle due to external influences (e.g. UV radiation, heat or oil). The standards do not specify tests with which to check resistance to external influences, nor do they include recommendations on replacing the products where such replacement is possible.

The marking, packaging and the information leaflet supplied by the manufacturer required by the standards for hearing protectors only provide the user with a limited basis upon which to judge the permanent protective effect of hearing protectors.

3.5 PPE against falls from a height and descender devices

Safety requirements and test methods for personal protective equipment against falls from a height and descender devices are specified in harmonized European standards drawn up by CEN/TC 160 "Protection against falls from height including work belts”. Annex A5 contains a detailed list of these standards.

3.5.1 PPE against falls from a height

None of the product requirements in the standards gives specific consideration to performance decline caused by use or ageing. The components undergo performance testing based on the intended use.

The requirement made in some standards that the metal parts of PPE against falls from a height should be resistant to corrosion and the testing for compliance with this requirement are intended to examine functionality, not performance or useful life. This is because static or dynamic failure caused by overloading or misuse of the metal parts is more likely than failure when the PPE is under load and being used as intended or failure due to ageing. Furthermore, the individual standards point out that, even if the corrosion resistance of the products which they describe has been proved, they are not automatically suitable for use in a maritime environment. For them to be used in a maritime environment, further requirements have to be met, e.g. special materials have to be used (e.g. stainless steel).

The standards do not take into account any special areas of application such as the above-mentioned use in a maritime environment or use in refractory construction or in oil tanks. The standards assume a "normal" European climate and area of use. These criteria are used so that testing leads to reproducible results which permit a uniform conclusion with regard to product conformity. Manufacturers offer special solutions for applications which require product characteristics beyond what is required by the standards.

The performance of textile lanyards, such as man-made fibre ropes and webbings, changes over time as a result of external influences such as UV radiation, an increased risk of soiling and/or heat. Standards EN 354:2002 for lanyards and EN 358:1999 for belts for work positioning and restraint and work positioning lanyards therefore specify that the breaking tenacity of the synthetic fibres shall be known to be at least 0,6 N/tex. This requirement for the material is intended to ensure the performance of the textile components. Experience has shown that 0.6 N/tex is a good level.

EN 354:2002 is currently being revised and will probably include a test method for checking textile lanyards for changes in performance due to use or ageing. In the test method proposed by the United Kingdom, the textile lanyards are exposed to UV rays and, in an abrasion test, sand. This is followed by a tension test to determine the lanyards' static strength. One of the reasons for this testing is that particles of dust can get into the inner structure of the rope during use and damage it from the inside without the user being able to see the damage from the outside.

Various experiments [29] to investigate the ageing of ropes have been carried out in Germany in the past with the aim of determining the influence on lanyards of external factors such as atmospheric conditions or UV radiation. One such experiment was a long-term test, in which lanyards were exposed to natural weather for a period of eight years in order to find out whether external effects influence their performance. The results showed that the rope stretch did not decrease over time, nor was there any link between the breaking forces of polyester ropes and the weathering time. In the case of polyamide ropes, the breaking force was found to depend on the age and atmospheric influences accelerated the ageing. A linear decrease in the breaking force was observed during the experiment period. The decrease was larger for laid ropes than for plaited kernmantel ropes. However, there was also no evidence of a clear link between the decrease in breaking force and the number of hours of sunshine. It can thus be concluded that other influences cause an ageing-related decline in performance. General recommendations for the period of use of PPE against falls from a height were given on the basis of the findings obtained. In normal conditions of use, it is assumed that belts can be used for six to eight years and lanyards (ropes/straps) for four to six years.

The standards do not stipulate that the useful life must be indicated. It would not be possible to give precise information because of the innumerable combinations of effects which can play a part in decreasing strength and thus protective effect.

With regards to the instructions for use supplied by the manufacturer, the standards require information to be given on, for example, what hazards can impair the functioning of the equipment and what protective measures should be taken. Hazards which influence the functioning of the equipment include extreme temperatures, sharp edges causing stress on lanyards, rope slackening, exposure to chemicals, electrical influences, cuts, rubbing, climatic effects and pendular movements during falls.

Misuse can result in the performance of PPE against falls from a height changing in ways which are not tested in the standards. The standards explicitly refer the reader to the instructions for use supplied by the manufacturer, which stipulate that the equipment may only be used for the intended purpose. However, it has become evident that, in real life, PPE against falls from a height is also often used in a way which is contrary to its intended purpose. Usually, these cases involve the PPE being used in a horizontal position. Drop tests over an edge have shown that the load on the lanyards (edge load) is significantly higher than in drop tests in which the strain is in a vertical direction, which are included in the standards. New tests and material requirements have therefore been defined and are to be included in the standards. It is anticipated that the revised version of EN 354:2002 will include a test method which takes into account use in a horizontal position and possible edge loads.

EN 365:2004 for personal protective equipment against falls from a height sets out generic requirements for the instructions for maintenance, periodic examination and repair, and markings and the information to be supplied by manufacturers of PPE against falls from a height. Product-specific requirements can be found in the relevant product standards. The manufacturer must supply written instructions for the use, maintenance and periodic examination of each piece of PPE. This information includes, e.g.:

- a note instructing users that they must check the equipment before use in order to ensure it is ready to use and that it works properly;
- details of any known limitations on the useful life of the equipment or each part of the product and/or details of how to determine when they are no longer safe to use;
- cleaning methods;
- storage methods;
- further maintenance measures which are essential for the equipment, e.g. lubrication;
- notice warning the user of the necessity for periodic examination; and

– recommendations on the frequency of periodic examinations.

To ensure these measures are implemented correctly, the standards stipulate that the equipment may only be used by persons who have been taught and know how to use it safely.

Some manufacturers use indicators for PPE components (connectors, safety harnesses, retractable-type fall arresters, etc.) to show the user whether the equipment has been involved in a fall. These fall indicators should only be considered as warning devices. They are permanently attached to the PPE against falls from a height and are intended to indicate to the user that the equipment has been in a fall. As outlined in the instructions for use, the equipment must be withdrawn from use if a fall from a height has caused strain on it. The fall can cause such strain on the equipment that it may fail in the event of a further fall from a height. It may only be used again if a competent person has given written approval. The use of fall indicators is not dealt with in the standards.

3.5.2 Descender devices

EN 341:1992
Personal protective equipment against falls from a height — Descender devices, including A1:1996 and AC:1993

prEN 341:2006
Personal protective equipment against falls from a height — Descender devices for rescue

EN 341:1992 is the standard currently applicable to descender devices. Given its age and the technical progress which has occurred in the meantime, EN 341:1992 is to be revised. Existing product and material requirements, test methods or specifications in test methods concerning use and ageing have been taken from the existing standard and developed and expanded in prEN 341:2006. The study thus also had to examine prEN 341:2006. According to the experts, some testing is already carried out in accordance with prEN 341:2006.

prEN 341:2006 draws the attention of manufacturers of wire-rope lines to the fact that some types of stainless steel have fatigue and corrosion properties which are difficult to judge. The following list cites some examples of requirements which take time-related performance aspects into consideration:

– if wire-rope lines are supplied with permanent terminations, the loops must be protected against wear and tear;

– the temperature generated by rubbing must not impair the functioning of the descender device;

– descender devices must not have any sharp or rough edges which could cut into, rub at or damage in any other way the rope or harness strap or which could injure the user; and

– class D descender devices must be designed, marked and packaged in a way which makes it clear that they may only be used once.

The maximum number of descending processes in the test for descending performance (performance testing) is specified on the basis of the device's classification. The number of descending processes indicates the useful life of the descender device, i.e. the device should be withdrawn from service once the number of descending processes specified by the standard has been reached. The marking of the class, maximum height of descent and minimum rated load on the descender device informs the user of the maximum number of descending processes and therefore the useful life.

Descender devices are tested for resistance to corrosion. No part of the device may display corrosion. It is also pointed out that fulfilment of this requirement does not mean that the device may be used in a maritime environment.

In accordance with EN 341:1992 and prEN 341:2006, the marking and information to be supplied by the manufacturer must meet the requirements of EN 365:2004. The latter sets out generic requirements concerning issues such as marking and the information to be supplied by the manufacturer. Product-specific requirements can be found in the relevant product standards. The information to be supplied by the manufacturer as specified in EN 365:2004 should enable the user to assess the protective effect of descender devices.

3.5.3 Conclusions

It is difficult to use testing of PPE against falls from a height to obtain findings on time-related performance aspects which can be applied to real-life practice. The conditions in which the equipment is used and thus the influences on it are so numerous that, although it is possible to imitate worst-case effects on the equipment, this would not reflect real-life use of PPE. An assessment of the service or useful life of PPE against falls from a height based on such worst-case effects would not correspond to actual use. It is for this reason that the standards specify other means of assessing whether the PPE should be removed from service, e.g. instructions for use, testing by a competent person, testing by the user before use, removal from use after a fall, etc. In addition, each piece of PPE must have a batch or serial number assigned by the manufacturer or another mark to enable the products' history to be traced. This requirement is intended to enable the user or competent person to request information about the product from the manufacturer, e.g. the date of manufacture. According to the experts, the information leaflet supplied by the manufacturer provides a suitable basis for the user to assess the protective effect of the PPE.

The standards relating to descender devices can also be said, in summary, to give sufficient consideration to time-related changes in performance. The user can determine the useful life of descender devices by looking at the marking on the device. As with PPE against falls from a height, the user can judge the protective effect of the PPE using the information supplied by the manufacturer.

3.6 Foot protection

Safety requirements and test methods for foot and leg protectors are specified in harmonized European standards drawn up by CEN/TC 161 "Foot and leg protectors”. Annex A6 contains a detailed list of these standards.

3.6.1 Generic requirements for foot protectors

Toecaps and metal penetration-resistant inserts are required to be resistant to corrosion. In the case of metal penetration-resistant inserts manufactured in accordance with standards EN ISO 20345:2004 for safety footwear, EN ISO 20346:2004 for protective footwear and EN ISO 20347:2004 for occupational footwear, corrosion resistance is an additional requirement. No more than five areas may display a specific amount of corrosion either before or after testing. Following exposure, e.g. to a salt solution, the toecaps and penetration-resistant inserts are examined. Corrosion can cause the material properties to change to such an extent that the footwear no longer performs as required due to external factors during wear, e.g. an impact or penetration, with the result that the wearer could be harmed.

In addition to the information which the manufacturer is required to enclose with the footwear, an instruction concerning the electrical properties and the insoles is enclosed with each pair of shoes. This instruction includes recommendations for use, warnings and other information, which are important for ensuring that the user correctly handles footwear with conductive, anti-static or electrical insulation properties. The instruction concerning electrical properties includes a warning that the electrical resistance can change significantly due to bending, soiling or moisture. Users are therefore recommended to check the electrical resistance at regular short intervals to ensure that the footwear still provides a protective function.

3.6.2 Standard-specific requirements for foot protectors

EN 12568:1998

Foot and leg protectors — Requirements and test methods for toecaps and metal penetration resistant inserts

This standard contains requirements relating to footwear components which themselves are not actually PPE. Toecaps made of materials other than metal undergo chemical and thermal ageing before testing for resistance to impacts. The influence of high ambient temperatures (4h in a convection oven at (60 ± 2) °C, followed by cooling down to (40 ± 2) °C) and low ambient temperatures (4h in a climatic chamber at (–20 ± 2) °C, followed by heating to (–1 ± 1) °C), acids (24h in sulphuric acid), lyes (24h in caustic soda) and fuel (24h in trimethylpentane) is tested. The thermal and chemical influences must not have any negative effect on resistance to impacts. This requirement is deemed to be met if, following testing, the clearance beneath the cap is not smaller than the limit stated in the standard and no cracks form on the toecap.

Due to the requirement for flexural strength, inserts undergo performance testing in which they are subjected to a total of 1×10^6 bends at a rate of (16 ± 1) cycles per second. This requirement is considered to have been met if the visual inspection determines that there are no visible breaks.

EN ISO 20345:2004, EN ISO 20346:2004, EN ISO 20347:2004

3.6 Foot protection

General requirements for safety footwear, protective footwear and occupational footwear

These standards specify basic and additional requirements for safety, protective and occupational footwear. The necessity of the additional requirements depends on the hazards present at the workplace. If the additional requirements *are* necessary, they must be complied with and the footwear must be marked accordingly.

One of the tests which the shoe upper undergoes is the performance test. In this test, the flexural strength must be such that after a certain number of bends, depending on the type of material (rubber or polymer), no tears occur.

Prior to the water vapour permeability test, the sample (shoe upper and lining) is subjected to a mechanical stress of 20,000 bending cycles. The bending is intended to simulate use, which could have a negative influence on water vapour permeability. Although a decrease in water vapour permeability does not jeopardize the protective effect of safety footwear, the microclimate inside the shoe can become unpleasant for the wearer.

The inner lining and the insole/insock undergo a wear resistance test, in which a moving abradant rubs against the sample. The test is considered to have been passed if no holes are visible after a certain number of cycles. A distinction is made between the wet and dry state of the inner lining and the insole/insock. As with water vapour permeability, abrasion does not jeopardize the protective effect of the footwear but ergonomic aspects are an important criterion.

Insoles also undergo wear resistance testing. The abrasion damage to non-leather insoles before 400 cycles must not be worse than that caused to the reference samples from the same family of materials. This is determined by means of a visual inspection.

Outsoles undergo performance testing, in which the criteria they are required to meet include resistance to wear, oil and bending. The wear resistance test is deemed to be met if the reduction in the outsoles' volume is not lower than a specific limit. In the test for flex resistance, the sample is bent or stretched as far as possible with a frequency of between 135 cycles/min and 150 cycles/min. After 30,000 cycles, the tear propagation must not be more than 4 mm. The bending and stretching simulate factors which can influence the footwear during use. Among other things, the test for oil resistance is intended to determine swelling resistance. Swelling causes certain properties of outsoles, such as tear strength or wear resistance, to change, which can result in a decline in the protective effect. If the outsole's volume decreases during this testing or if it becomes hard, the test is repeated with an additional 150,000 bending cycles. The test is deemed to have been passed if the tear propagation is not more than 6 mm. The second test, including the bending, is intended to ascertain whether the oil has resulted in a material change which alters the flex resistance and thus a possible decrease in the useful life and/or the protective effect.

Non-metal penetration-resistant inserts undergo chemical and thermal conditioning as specified in EN 12568:1998. After conditioning, the penetration resistance required by EN 12568:1998 must be fulfilled. The aim of the conditioning is to determine whether these factors can influence performance and thus the protective effect of penetration-resistant inserts. The test is deemed to have been passed if a force of a least 1,100 N is needed to penetrate the inserts.

Footwear must be permanently marked, e.g. by means of a punched or embossed mark, with information including the manufacturer's mark and type designation and the year of manufacture (at least the quarter in which the footwear was manufactured). This information enables the user to obtain detailed information about the safety footwear from the manufacturer.

The information to be enclosed by the manufacturer must include the following general points:

- instructions for use:
  - tests to be conducted by the wearer before use, if necessary,
  - restrictions on use (e.g. temperature range),
  - storage and maintenance instructions including the maximum intervals between maintenance inspections,
  - instructions on cleaning and/or sterilisation and
  - use-by date or period.

3.6.3 Conclusions

In summary, it can be said that the standards for foot protectors *do* contain requirements and test specifications which take into consideration the possibility of a decline in protective effect due to use. One example is the (bending) performance test for outsoles, in which factors which influence the footwear during use are simulated, i.e. the sample is bent or stretched. Before penetration-resistant inserts are tested for penetration resistance and before non-metal toecaps are tested for impact resistance, the samples undergo chemical or thermal ageing. The aim of this conditioning is to determine any negative effects on performance which could cause a decline in the protective effect.

The standards also require an instruction concerning the electrical properties to be enclosed with each pair of shoes. This instruction includes recommendations for use, warnings and other information, which are important for ensuring that the user handles the product correctly.

According to manufacturers, it is difficult to give a figure for the useful life, as they are required to do in the information leaflet, because ageing of foot protectors largely depends on the stress to which they are subjected and how they are cared for. The experts therefore recommend that the leaflet should include additional information on this point to enable the user to determine whether the footwear is fit for use. Evident wear and tear, e.g. a worn tread on the outsole or an exposed toecap, can be identified by the user.

3.7 Protective clothing and hand protection

Safety requirements and test methods for protective clothing and hand protection are specified in harmonized European standards drawn up by CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets". Annex A7 contains a detailed list of the standards used as the basis for this section.

The general safety requirements applicable to protective clothing and hand protection are specified in the following standards:

EN 340:2003	Protective clothing — General requirements
EN 420:2003	Protective gloves — General requirements and test methods

Additional requirements which can be applied to protective clothing and hand protection are specified in the following standards:

EN 510:1993	Specification for protective clothing for use where there is a risk of entanglement with moving parts
EN 1149-1:1995	Protective clothing — Electrostatic properties — Part 1: Surface resistivity (test methods and requirements)
EN 1149-2:1997	Protective clothing — Electrostatic properties — Part 2: Test methods for measurement of the electrical resistance through a material (vertical resistance)
EN 1149-3:2004	Protective clothing — Electrostatic properties — Part 3: Test methods for measurement of charge decay

The additional requirements are optional and their necessity depends on the hazards present at the workplace. The specific requirements are set out in the product standards.

The results of the expert survey showed that consideration of time-related performance aspects is a generic issue, rarely connected to individual standards. This is particularly true with regard to standards EN 340:2003 and EN 420:2003, which set out general requirements for protective clothing and gloves. More in-depth statements concerning requirements relating to time-related performance aspects in specific standards are included in the descriptions of the standards and draft standards below. In view of the large number of standards, this section has been divided up in accordance with the relevant working groups in CEN/TC 162.

3.7.1 Generic requirements for protective clothing and gloves

General requirements for protective clothing and gloves

It is generally true to say that the storage period indicated by the manufacturer can be important in terms of product safety. Long storage periods can cause the material to change to such an extent that the protective effect for the user decreases. There is currently no universally applicable standardized test method in Europe which takes into account storage-related ageing. Some well-known manufacturers use a method based on the American test method ASTM D 572-99, "Standard Test Method for Rubber – Deterioration by Heat and Oxygen", drawn up by the American Society for Testing and Materials (ASTM). The purpose of this method is to determine the relative ageing resistance of vulcanized rubber. A test sample in a booth is exposed to the effects of high temperatures and 100% oxygen during a certain amount of time. The disadvantage, however, is that the number of days of actual storage corresponding to one day in the booth must be known for this test. The manufacturer determines the effect of storage on the material in advance by conducting long-term storage tests. Following the testing, the storability of the material can be ascertained by comparing the sample's values with the data from the long-term storage tests. Whether such a method for determining the ageing resistance of vulcanized rubber can be made binding by way of standardization is a question which the experts need to discuss.

Many standards require conditioning in the form of a washing or dry-cleaning test before the performance testing. The samples are required to undergo five cleaning processes or the number of cleaning processes specified by the manufacturer. This is followed by a dimensional stability test, in which the degree of shrinkage or stretching is measured. As stipulated for testing in accordance with EN 340, it must not exceed 3% in length or width. According to the experts, there is no need to increase the number of cleaning cycles since the shrinking or stretching process has largely stopped after five wash cycles. Consequently, an increase in the number of cleaning cycles to more than five would have merely a minor impact on the material's shrinking and stretching behaviour. This only applies, however, to the shrinking and stretching behaviour of the materials. If, for example, the fluorescence of the background material of high-visibility warning clothing is being examined, the number of cleaning cycles *is* significant because cleaning can influence the fluorescent properties of the protective clothing. However, it is not conceivable for standards to require testing which reflects workplace conditions and is intended to determine the maximum possible number of wash cycles because innumerable additional factors such as UV radiation, soiling, the way in which the clothing is handled during use, etc. would also have to be taken into account.

3.7.2 Standard-specific requirements for protective clothing and gloves

3.7.2.1 General requirements for protective clothing

EN 340:2003
Protective clothing — General requirements

Clause 5 "Ageing" of EN 340:2003 gives consideration to the negative effects which colour change, cleaning and dimensional change have on performance levels and the legibility of the label. Sub-clause 5.3 "Dimensional change due to cleaning" specifies that dimensional changes caused by cleaning protective-clothing materials must not exceed ± 3% lengthwise or widthwise. The required limitation of dimensional change, i.e. the requirement that the garment size remain the same, largely serves ergonomic purposes. In addition, there is a risk of shrunk protective clothing tearing as a result of the user's work, which would mean that, for example, where protective clothing is intended to provide protection against chemicals, gases could penetrate the protective clothing and harm the user. If protective clothing stretches, the risk of, for example, entanglement in moving parts, increases. Compliance with the requirement is tested by means of five washing or dry-cleaning processes. If both washing and dry cleaning are permitted, the sample must be washed since washing is harsher on the material than dry cleaning.

Sub-clause 5.4 of EN 340:2003 specifies the method for washing and dry cleaning. As in Sub-clause 5.3, it stipulates that the sample should be washed if both washing and dry cleaning are allowed. In addition, if washing is permitted both in non-industrial and industrial conditions, the garments must undergo industrial washing in accordance with EN ISO 15797 "Textiles – Industrial washing and finishing procedures for testing of work wear". Industrial washing is extremely harsh on the protective clothing, potentially resulting in damage to the protective clothing or changes in the product's properties. The clothing is washed at between 75 °C and 85 °C and then, for instance, dried at approximately 155 °C in a finishing procedure. These high temperatures can cause, for example, glued seams to open or reflective strips on high-visibility vests to become unglued. According to the experts and some manufacturers, the question of whether industrial washing could always be included as a conditioning requirement in standards, where considered necessary, should be discussed.

Including industrial washing and finishing procedures as conditioning requirements would also be a way of addressing the fact that protective clothing is often leased. Companies which lease protective clothing often use industrial washing methods, which, as mentioned above, can result in damage, increasing the risk of a decline in the protective effect.

The labelling requirements in EN 340:2003 take time-related performance aspects into consideration by specifying that, for example, the following information must be included:

- care instructions:

  where necessary, washing and cleaning instructions as described in EN 23758 must be included;

  If there are specific requirements for marking the maximum recommended number of cleaning processes, the maximum number of processes shall be stated after „max“ next to the care labelling.
- the words "Do not re-use” in the case of disposable personal protective equipment.

The standard also requires the labelling to be resistant to the appropriate number of care cycles so that it still provides the user with all of the necessary information even after a certain number of care cycles.

The requirement concerning the content of the information to be supplied by the manufacturer is unclear. It specifies that instructions for use appropriate for the specific standard must be supplied. Although this phrase does make it clear that the manufacturer is responsible for the content of the information, there is no clear stipulation of what information has to be supplied to the user to enable him or her to assess the protective effect of protective clothing.

Some of the points to which the requirements refer are:

- tests to be carried out by the wearer before use,
- restrictions on use,
- instructions on storage and maintenance including details of the maximum intervals between maintenance inspections.

It should be pointed out, however, that the requirement set out in EN 340:2003 for the content of the instructions for use is not applicable to all products. For example, the requirement for maintenance to be carried out is not applicable to disposable clothing. It was suggested that a feasibility study be conducted to establish which details should be contained in all instructions for use and which are only relevant for product-specific standards. This would be a way of ensuring that users have all of the information they need to be able to assess the protective effect of the protective clothing.

EN 510:1993

3.7 Protective clothing and hand protection

Specification for protective clothing for use where there is a risk of entanglement with moving parts

EN 510:1993 mainly contains design requirements. The dimensional change requirements are set out in prEN 340:1992. The dimensional changes in the materials must not exceed 3% in length or width. This requirement is intended, among other things, to prevent stretched protective clothing increasing the risk of entanglement in moving parts.

There are also requirements concerning the effectiveness of fastenings. The garment must be cleaned five times in accordance with prEN 340:1992. Following this conditioning, the fastenings are examined for chemical or mechanical damage and traces of rust. This requirement is significant because the safety functions are only ensured if the garments described in this standard fit tightly and are done up properly.

EN 1149-1:1995
Protective clothing — Electrostatic properties — Part 1: Surface resistivity (test methods and requirements)

A sample from the electrostatic dissipative garment is conditioned in the following test atmosphere for at least 24 hours before the test:

– air temperature: (23 ± 1) °C

– relative humidity: (25 ± 5) %

The low relative humidity simulates an unfavourable scenario since the surface resistivity of many materials depends heavily on the relative humidity. Thus, the lower the relative humidity, the higher the surface resistivity. As surface resistivity increases so does the electrostatic charge. This in turn increases the risk of electric discharge in areas containing, for example, flammable mixtures. The conditioning is intended to ensure that the protective clothing continues to offer the wearer sufficient protection even in an unfavourable environment, that is to say that it dissipates electricity.

The information leaflet supplied by the manufacturer advises the user that the protection provided against electrostatic charge usually decreases in correlation with the number of cleaning cycles, duration of wear and in severe conditions. One potential cause of such a decrease in the protection provided against electrostatic charge is poor hem conductivity. The testing required by the standard is carried out on samples of material taken from the protective clothing. However, there are no clear specifications as to from which part of the clothing the samples should be taken. The experts therefore recommend that hem conductivity be tested. In addition, the entire suit should be tested in order, firstly, to determine any inhomogeneity, e.g. seams and pockets, and secondly, the structure of the suit’s layers.

The information leaflet also informs the user that the anti-static finish (in the case of clothing with a temporary finish) can only be effective for a limited amount of time. The manufacturer must therefore indicate how the conductive properties can be maintained. In the experts' opinion, it would be useful to add here that the remaining clothing (socks and footwear) should also be taken into account when examining conductivity. This is of significance due to the need to ensure that the electric charge is conducted to the floor if there is no direct earthing, e.g. via a terminal.

3.7.2.2 Protective clothing against heat and fire

3.7 Protective clothing and hand protection

Generic requirements for heat-protective clothing

When testing limited flame spread, the sample is conditioned by washing it five times and then exposed to a 4 cm high flame at right angles to the surface (method A) or on the edge (method B) for 10 seconds. Depending on the result, the tested materials are assigned indices 1-3. The experts feel it would be useful to differentiate more clearly between materials when testing limited flame spread. This would make it possible to apply higher performance requirements as the performance level increases. Users would thus be able to select the correct type of protective clothing for their work. They would also be able to ensure a higher protective effect by selecting protective clothing of a higher class.

Working Group 2 (WG 2) of CEN/TC 162 is working on a document [26] which sets out specifications concerning the washing method and number of washing cycles in order to take ageing into account in the pre-treatment process carried out before testing. The document will provide definitions of pre-treatment, conditioning, cleaning and ageing. In addition, common requirements have been set out for the cleaning methods and for the cleaning information to be supplied by the manufacturer. These definitions and requirements are to be incorporated into the existing EN standards when the latter are revised and have already been included in standards to be published in the near future, e.g. EN ISO 11611 and 11612.

In the standards concerning products which use metallized materials to achieve a protective effect, e.g. products for protection against radiant heat, there are no requirements for the information leaflet to advise the user of any restrictions on use. Possible restrictions are:

- influence of chemicals,
- influence of electricity and
- oxidation of the aluminium coating due to humidity.

This information should be given in the user information. There should also be a warning that metallized clothing must not be washed since the moisture accelerates the oxidation process.

Standard-specific requirements for heat-protective clothing

EN 469:2005
Protective clothing for firefighters – Performance requirements for protective clothing for firefighting

Prior to the testing described in Clause 6, which sets out the performance requirements, the protective clothing is conditioned. The conditioning involves the materials to be tested being washed and dried or dry-cleaned in accordance with the information on the care label and the information supplied by the manufacturer. This conditioning can identify changes in the materials which could lead to a decline in the protective effect.

Clause 6 of EN 469:2005 stipulates that the materials and seams used in protective clothing for firefighting must reach the limited flame spread index 3 described in EN 533:1997, "Protective clothing. Protection against heat and flame". With the exception of aluminized materials and leather, all materials must be tested for resistance to cleaning or soaking. The limited flame spread test is conducted before and after the materials have been tested for resistance, and the index assigned must be the lowest value determined. Indicating the lowest index determined allows for a potential decrease in the protective effect after cleaning and offers the user maximum protection.

The standard requires the material strength remaining after exposure to radiant heat to be tested. In each case, three samples from the outer material are conditioned by being exposed to radiant heat. A tensile load is then applied to the samples; the material's tensile strength must be at least 450 N. The influence of radiant heat on material strength can be determined by means of this test.

In the test for resistance to penetration by liquid chemicals, the test chemical must not have penetrated through to the innermost surface after the material has been exposed to the chemical for 10 seconds. In addition, the protective clothing must have a repellency rate of at least 80% so as to prevent the chemical from adhering to the outer surface of the protective clothing and continuing to have an effect there. Moreover, it is not always possible to determine beyond doubt in firefighting operations whether chemicals will be present and, if so, which ones. The required repellency rate therefore aims to prevent a decrease in the protective effect during a firefighting operation.

The mechanical components, e.g. fasteners, of protective clothing of the type covered by EN 469:2005 can be damaged more by heat than the heat-protection components. The standard requires hardware to be tested separately by applying a flame to the outer surface of the hardware items. The hardware must remain functioning after the test. However, one study [30] observed degradation of the mechanical components before any visible change in the material. Such degradation can result in a risk to the user since it is not immediately noticeable. This effect is not taken into account by the standard. In the experts' opinion, the question of whether and how degradation can be taken into consideration in standard should be discussed. There should at least be warnings to draw the user's attention to this issue.

The labelling must conform to EN 340 and also include the following information:

- if the outer material has to be re-impregnated, the label must clearly show the number of wash cycles after which re-impregnation is required.

The information supplied by the manufacturer must also conform to EN 340 as well as the following requirements:

- the manufacturer must point out that if chemical or flammable liquids accidentally splash onto protective clothing covered by this European standard, the wearer should immediately withdraw and remove the clothing; the clothing must then be cleaned or removed from service; and
- if the optional test described in 6.15 has been carried out, the manufacturer must indicate the test results in accordance with Annex C "Prediction of burn injury using an instrumented manikin".

EN 470-1:1995
Protective clothing for use in welding and allied processes – Part 1: General requirements; including Amendment A1:1998

EN 470-1:1995 contains a design requirement intended to counter any decrease in protective effect. If garments have pockets, they must be fitted with, e.g. flaps. Fastenings must be designed in such a way that they do not form openings or folds in places where splashed metal could become lodged. In addition, trousers must not have creases or turn-ups. As already mentioned, these requirements aim to prevent splashed metal becoming lodged and thus reducing the protective effect of the protective clothing to such an extent that the user might be put at risk. The standard does not take into account the fact that a forced posture can result in folds forming in the heat-protective suit, in which, for example, drops of liquid metal can lodge. Standardizers should discuss whether this can be covered by standardization.

The requirement relating to dimensional change does not correspond with the requirement specified in EN 340:2003. EN 470-1:1995 stipulates that changes of more than 3% in length or width after the outer material of the textile has been tested must be indicated on the protective clothing's label and in the instructions for use. Strictly speaking, this specification permits unlimited dimensional change. In EN 340:2003, however, the maximum dimensional change is given as 3%. The exception permitted by EN 470-1:1995 is intended for protective clothing which has good insulating properties but, for example, is prone to shrinkage. The experts should discuss whether an upper limit for dimensional change is necessary in EN 470-1:1995.

The protective clothing is pre-treated before being tested. To this end, the materials to be tested must be washed five times and then dried, unless otherwise indicated on the care label. The pre-treatment allows material changes to be identified which could lead to a decrease in the protective effect.

The information to be supplied by the manufacturer for protective clothing for welders must meet the requirements of EN 340 as well as containing details of the intended and of incorrect use. Details on the intended use include information on general protection and protection against ultraviolet radiation. Annex A of EN 470-1:1995 states, “As extensive trials have shown that all materials tested protect against ultraviolet radiation, tests for this characteristic have not been specified.” This means that materials whose protective effect is not 100% certain might be used. The experts should determine whether it would be expedient to include in the standard a requirement that all of the materials used be tested to determine the level of protection they provide against ultraviolet radiation.

The details on incorrect use include, for example, the fact that

– flame spread is no longer limited if the welders' protective clothing becomes contaminated with flammable substances,
– wetness, moisture and sweat reduce the insulation effect (against electricity) of welders' protective clothing and
– an increased oxygen content in the air reduces the flammability protection provided by the welders' protective clothing. Special care is necessary when welding in small spaces in case oxygen builds up in the air.

EN 531:1995
Protective clothing for industrial workers exposed to heat (excluding firefighters' and welders' clothing); including Amendment A1: 1998

The material to be tested must be pre-treated before the flame spread test is carried out. To this end, the material is washed five times and then dried, unless otherwise indicated on the care label. The pre-treatment allows material changes to be identified which could lead to a decrease in the protective effect.

Clothing assemblies made of metallized materials designed to provide protection against radiant heat are pre-treated in accordance with Annex A prior to performance testing. A method for mechanical pre-treatment of metallized materials is specified in Annex A. The effectiveness of metallized coatings in reflecting radiant heat can decrease dramatically as a result of wear. The method was developed in order to simulate the effect of repeated wear. The mechanical pre-treatment entails samples being twisted and squeezed simultaneously.

The labelling and user information do not refer to the details specified in EN 340. The information required by EN 531:1998 must include details on labelling and on the areas of use. It should also include suitable cleaning and/or washing methods plus a notice warning that “Dirty clothing may lead to a reduction in protection” as well as details of any special storage requirements. According to the experts, prEN ISO 11612:2001 for clothing to protect against heat and flame, which is still in progress, will include a reference to EN 340. The future EN ISO 11612:2001, intended to replace EN 531:1995, specifies more extensive requirements, which also take time-related performance aspects into consideration. The limited flame spread test is conducted before and after the materials to be tested are pre-treated. The pre-treatment involves the material being washed five times and then dried or cleaned in accordance with the information on the label. This requirement is intended to help determine whether cleaning can result in a decrease in the protective effect.

prEN ISO 11612:2001 also requires the outer material to be resistant to abrasion and the clothing to be assessed using a test dummy fitted with measuring devices. The test for resistance to abrasion simulates real use. The entire garment is tested on a test dummy if the user requests such testing based on his or her assessment of the risks.

3.7.2.3 Protective clothing against chemicals, infective agents and radioactive contamination

Generic requirements

The performance levels determined in the permeation test do not enable any conclusions to be drawn with regard to the actual breakthrough times. The duration of the protection provided at the workplace is influenced by additional factors, such as temperature and abrasion. It is not possible to simulate in the laboratory the potential influencing factors at the workplace due to the innumerable possible combinations. The permeation test is therefore a means of comparing different chemical protective suits and the breakthrough time is a material characteristic. However, the standards do not require a warning notice in the information leaflet to inform the user that the actual breakthrough time can differ from what is indicated by the performance level. It is suggested that a future requirement for such a warning in the user information be discussed.

Volatilization of softeners can cause plastic oculars in protective suits to become hard and brittle. This change can be accelerated by external influences, e.g. UV radiation and heat. However, according to the experts, there is no problem in normal use because the suit is not kept in storage for a long time. With certain suits, e.g. those used for disaster-relief operations, softener volatilization could have negative effects because such suits are not used every day and might be stored for a lengthy period. For this reason, the user should be given precise storage recommendations plus a recommendation to carry out a visual inspection before use in order to identify any damage early on.

The standards do not contain any recommended maintenance intervals for reusable chemical protective suits. Periodic maintenance could enable any decreases in the protective effect to be detected at an early stage, thus reducing the risk of the user wearing a suit which does not provide sufficient protection. However, the recommendation concerning the maintenance intervals should be product-dependent, i.e. if, for example, the maintenance is more expensive than the product, it would not be reasonable to expect the user to comply with such a recommendation. It is therefore necessary, first of all, to establish how a suitable maintenance recommendation, where required, can be given.

Standard-specific requirements

EN 943-1:2002

Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles – Part 1: Performance requirements for ventilated and non-ventilated gas-tight (type 1) and non-gas-tight (type 2) chemical protective suits

EN 943-1:2002 specifies minimum performance requirements for materials in chemical protective suits. Following pre-treatment, the materials undergo a practical performance test as outlined in Normative Annex B.2, which specifies test methods and performance levels for materials in chemical protective suits. The pre-treatment involves the chemical protective suit passing through five cleaning cycles in accordance with the manufacturer's instructions. The test method detailed in Normative Annex B.2 specifies that the materials must meet performance requirements such as abrasion resistance, flex cracking resistance and flex cracking resistance at -30 °C (optional). In light of the material properties required, there is no testing of the entire suit. Thus, materials which do not display the appropriate resistance in a test method in accordance with Annex B.2 must be designated in the instructions for use as "NOT APPLICABLE" for certain applications. The reason for this exception is that not all material requirements specified in Annex B.2 are necessary in every place of use and/or for every purpose and therefore no unnecessary requirements are made.

The performance requirement for seam strength is at least class 5. This means that the strength of the seams can be higher than that of the suit, which can range from class 1 to 6 depending on the requirement. The required minimum strength class for seams is intended to ensure the clothing's protective effect. On the one hand, seams can be a weak point in clothing and, on the other, they can be subject to more extreme strain than the material.

Chemical protective suits undergo hot/cold testing, reflecting the worst-case scenario. The suits are exposed to a temperature of (60 ± 3) °C with 95 % relative humidity for at least 4 h and then to a temperature of (-30 ± 3) °C again for at least 4 h. They are then returned to ambient conditions. In industry, it is possible that the suit might be exposed to high temperatures, e.g. due to strong sunshine, during transport to the place of use and then be used in low temperatures. The test is intended to determine whether a temperature change can have a negative influence on the protective effect of the chemical protective suit.

EN 943-1:2002 specifies that an auxiliary means must be available to test prior to each use whether the minimum volume flow provided for by the manufacturer is exceeded. This auxiliary means enables the user to determine before using the product whether he or she will be supplied with sufficient respirable air. In addition, the suit must be equipped with a warning device which alerts the user immediately if the minimum volume flow specified by the manufacturer is not reached. The warning device enables the user to leave the hazard area at an early stage. The standard also requires an auxiliary means for testing the warning device so that the user can make sure the latter works properly.

The testing body must carry out a visual inspection before the laboratory and practical performance testing, e.g. to check whether acoustic warning devices comply with the performance requirement. This can include dismantling the protective equipment in accordance with the maintenance instructions given by the manufacturer. The dismantling of the protective clothing in accordance with the maintenance instructions constitutes a maintenance test, which is intended, for example, to check whether the user can perform the maintenance as instructed by the manufacturer.

The chemical protective clothing must be labelled with the year of manufacture and, where appropriate, with its anticipated life. This information may be given on each packaging unit instead of a label on each suit. In the experts' opinion, giving this information on the suit label is preferable to giving it on the packaging, where possible. This would ensure that, even if the packaging had been disposed of, the user would still know the year of manufacture and/or the life and thus be able to determine whether the clothing is ready to be withdrawn from use.

Specific requirements relating to that information to be supplied by the manufacturer which take time-related performance aspects into consideration include:

- a list of the chemicals and chemical products (including the names and the approximate concentrations of the constituent parts), against which the protective clothing has been tested; plus the performance level achieved in the test for permeation or penetration. If this list only provides a selection from the information available, this fact must be pointed out clearly and details must be given of where additional information can be obtained, e.g. an additional brochure, by telephone or fax from the manufacturer, via the manufacturer's website, etc.;
- the anticipated life of the garment if subject to ageing; and
- the details necessary for trained persons concerning:
  - use and restrictions on use;
  - checks to be carried out by the wearer before use;
  - Use;
  - maintenance and cleaning; and
  - storage.

EN 943-2:2002

Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles – Part 2: Performance requirements for gas-tight (type 1) chemical protective suits for emergency teams

Following pre-treatment, materials for chemical protective suits for emergency teams undergo a practical performance test as specified in EN 943-1:2002. The materials must meet minimum performance requirements concerning various types of resistance, including abrasion resistance, flex cracking resistance and flex cracking resistance at -30 °C. A distinction is drawn between suits for single use and reusable suits; the requirements for the latter being higher in some cases. The minimum requirements are intended to provide the emergency teams with adequate protection during operations since there are occasions when they do not have sufficient knowledge about potential hazards at the scene of the operations.

The visors of chemical protective suits are tested for, among other things, mechanical strength and resistance to chemicals. According to the experts, it is possible that the visor might also be exposed to chemicals during use. If chemicals penetrate the visor, the user might be put at risk.

However, EN 943-1:2002 does not include any requirements concerning the visor's resistance to permeation by chemicals. The experts should discuss whether requirements or tests of the type described in EN 943-2:2002 are considered necessary.

Sub-clause 5.2 of EN 943-2:2002 sets out requirements concerning the resistance of the material used in protective clothing, protective footwear, protective gloves and visors to permeation by chemicals. It points out that the chemicals listed in the standard are meant to represent a selection of aggressive chemicals. This ensures that a chemical protective suit which meets the requirements of the standard offers protection against a wide range of chemicals. Nonetheless, it should be mentioned that this approach only supplies general instructions for the group which those chemicals represent and that resistance to chemicals other than those listed can only be determined by means of individual tests. There is no requirement for the information to be supplied by the manufacturer to contain a reference to this point. However, in the experts' opinion, the information to be supplied by the manufacturer should draw the user's attention to this point.

The label and the information to be supplied by the manufacturer must comply with the requirements of EN 943-1:2002.

EN 1073-1:1998

Protective clothing against radioactive contamination - Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination

EN 1073-2:2002

Protective clothing against radioactive contamination - Part 2: Requirements and test methods for non-ventilated protective clothing against particulate radioactive contamination

Materials for protective clothing against radioactive contamination are conditioned and then undergo a practical performance test. The pre-treatment involves the protective clothing passing through five cleaning and disinfection cycles in accordance with the manufacturer's instructions. In the testing, the materials must meet performance requirements such as abrasion resistance and flex cracking resistance.

The testing body must carry out a visual inspection before the laboratory and practical performance testing. The dismantling of the components may be done in accordance with the maintenance instructions given by the manufacturer. The visual inspection is thus also a maintenance test, which is intended, for example, to check whether the user can perform the maintenance as instructed by the manufacturer.

If the manufacturer does not specify any particular conditions, the entire protective garment undergoes hot/cold testing, reflecting the worst-case scenario. The suits are exposed to a temperature of (-30 ± 3) °C for 4 h and then to an atmosphere of (60 ± 3) °C with 95 % relative humidity again for 4 h. They are then brought back to the ambient temperature. The test is intended to determine whether a temperature change can have a negative influence on the protective effect of the protective suit.

The information on the labelling must comply with EN 340. Unlike EN 1073-1:2002, EN 1073-2:2002 requires the year of manufacture to be marked on the protective clothing. The intention is to enable the user to determine the age of the protective clothing and to give the user freedom of choice when it comes to selecting protective clothing. The question of whether such information needs to be marked on clothing covered by EN 1073-1:2002 should be settled.

3.7 Protective clothing and hand protection

Clause 7 “Information supplied by the manufacturer” refers the reader to EN 340. It also requires additional details, e.g.:

- instructions concerning the donning, use, fit, removal and storage of protective clothing;
- use and restrictions on use;
- if necessary, checks to be carried out by the wearer before use; and
- maintenance, cleaning and decontamination.

3.7.2.4 Protective clothing against bad weather, wind and cold

EN 342:2004
Protective clothing – Ensembles and garments for protection against cold

In order to select the optimum type of clothing for protection against the cold, one needs to know the climatic parameters of the place where it is to be used, the air temperature, the mean radiation temperature, air velocity, relative humidity and what activities the worker performs – to name but a few a few aspects. This wide range of factors can make it difficult to make the optimum choice. The information leaflet to be supplied by the manufacturer therefore contains basic information (e.g. in the form of the tables shown in Annex B of EN 342:2004) for possible uses. The table values are based on scenarios, in which, for example, the air temperature is equal to the mean radiation temperature, the relative humidity is 50%, the air velocity is between 0.3 m/s and 0.5 m/s and the walking speed is approximately 1 m/s. These values are intended as a guide and can differ from actual conditions in practice. It is not possible to simulate the various conditions at the workplace due to the innumerable possible combinations. The user can determine the minimum basic thermal insulation of the clothing with the help of the tables and taking into account the activity to be performed (wearer working in a standing position, wearer performing low-strain or medium-strain activities whilst moving), the expected air temperature and the duration of use. Based on the minimum basic thermal insulation determined, the user can make the right choice and thus also have sufficient protection against the cold.

Clothing for protection against the cold does not undergo pre-treatment (cleaning). According to the experts, cold protection suits used in industry are usually not cleaned. In addition, the standard specifies that the information to be supplied by the manufacturer must include a note that the thermal insulation can decrease after any type of cleaning. Practical performance tests, e.g. for resistance to abrasion, are not required by the standard since minor damage has a negligible effect on the thermal insulation value of the clothing.

The label and care label must meet the requirements of EN 340. Additional details in the information to be supplied by the manufacturer which take time-related performance aspects into consideration include:

- basic information for possible uses, e.g. the values given in tables B.1 and B.2 of EN 342:2004 in relation to I_{cle} or I_{cler} of the garment, plus, if more precise information is available, the source;
- any necessary warnings concerning incorrect use (e.g. restricted duration of wear); and
- a note explaining that the thermal insulation can decrease after any type of cleaning.

3.7 Protective clothing and hand protection

EN 343:2003
Protective clothing – Protection against rain

The requirements relating to dimensional change are set out in Clause 4.6 "Dimensional change of the protective clothing". The dimensional change in the material must not exceed ± 3 % in length or width following five washing or dry-cleaning cycles.

Before being tested for waterproofness, materials for protective clothing against the rain are pre-treated and then undergo a practical performance test. The conditioning involves the clothing passing through five washing or dry-cleaning cycles in accordance with the manufacturer's instructions. The material samples are then tested for water resistance following abrasion, resistance to repeated bending and fuel and oil resistance. The lowest individual Pa value at the point at which the first drop of water penetrates the clothing is recorded as the result. The laboratory tests examine how the protective clothing against the rain performs when exposed to individual factors during use.

The standard does not take into account the effect of UV radiation on the protective effect of protective clothing against the rain. Exposure to UV radiation can cause damage to outer-coated materials in the shoulder area which are directly exposed to sun rays. If coated materials become brittle and tears form as a result, the amount of protection against rain could be limited. In the case of protective clothing against the rain with an inner water-repellent layer, there is hardly any risk of degradation through UV radiation since the water-repellent layer is protected by an outer layer of material. The possibilities for specifying a test for resistance to UV radiation should be discussed.

The label on the protective clothing against the rain and the information leaflet must comply with EN 340. In addition, the content of the information supplied by the manufacturer has to meet the following specific requirements, intended to take time-related performance aspects into consideration:

- any necessary warnings concerning incorrect use and
- basic information for possible uses, plus, if more precise information is available, the source;

must be provided.

The basic information for possible uses can be supplied in tabular form (see Annex A of EN 343:2003). The table values are based on a medium level of strain, a standard-sized man, 50% relative humidity and a wind velocity of 0.5 m/s. The wearer can thus deduce the recommended maximum period of wear for a complete suit based on the ambient temperature and the class to which the protective clothing has been assigned. These values are merely intended as guidance and enable the wearer to choose suitable clothing for the work at hand.

EN 14058:2004
Protective clothing – Garments for protection against cool environments

EN 14058:2004 specifies requirements concerning thermal resistance and thermal insulation (optional). The difference between the two requirements is that the thermal resistance is determined taking into account only material constants whereas the thermal insulation of a garment is measured in accordance with EN ISO 15831:2004 using a manikin. The advantage of the latter method is that it can be used to obtain data on the duration for which the protective clothing can be worn. This is not possible with the thermal resistance test. Having said that, the thermal insulation test is more expensive and involves more effort. Though it provides the user with a better basis upon which to choose the right protective clothing, it is optional due to the expense and effort involved, combined with the fact that protective clothing which complies with this EN standard is usually Category I PPE. According to the experts, a specification for the thermal insulation of all protective clothing covered by this EN standard would result in unnecessary testing effort.

The label on the protective clothing and the information leaflet must comply with EN 340. In addition, the content of the information supplied by the manufacturer has to meet the following requirements, intended to take time-related performance aspects into consideration:

- any necessary warnings concerning incorrect use;
- basic information for possible uses, plus, if more precise information is available, the source; if the test specified in 5.5 (Thermal insulation) has been carried out, the values given in tables B.1 and B.2 of EN 14058:2004 in relation to I_{cle} or I_{cler} of the garment; and
- a warning that the thermal insulation can decrease after any type of cleaning.

The basic information on possible uses are based on the principle set out in EN 342:2004 and are only applied if the protective clothing has been tested for thermal insulation.

3.7.2.5 High-visibility warning clothing and accessories

EN 471: 2003
High-visibility warning clothing for professional use – Test methods and requirements

Daytime visibility is achieved by a fluorescent background colour on the warning clothing. One of the influences on daylight visibility is the luminance factor of the colour used. UV radiation can have a negative impact on this property by destroying the pigments. This causes the warning clothing to become less luminous over time. The standard takes this external influence into account by requiring the background material to be exposed to xenon radiation. Following testing, the colour of the material must be within the range specified by the values given in the standard for background material and material with combined properties. However, it is not possible to use this test to determine the useful life since the point at which the clothing has to be withdrawn from use depends on how it is used. For example, the main influence on look-outs on railway tracks is the weather whereas the high-visibility warning clothing of road construction workers can also be exposed to physical factors.

In addition to the xenon radiation test, the background material and the non-fluorescent material are tested for colour fastness. The sample is exposed to the effects of abrasion, sweat, washing, dry-cleaning, hypochlorite bleaching and ironing. These tests are intended to simulate use and can only include part of the influences on the clothing.

In the dark, visibility is achieved by light shining onto the retro-reflective material. An indicator of clear visibility in the dark is the retro-reflection factor. The retro-reflective material is tested for photometric and physical properties, with the latter test simulating use. To begin with, the samples undergo photometric testing without having been conditioned. This is followed by tests to determine the physical properties, in which the samples are subjected to abrasion, continuous bending, folding at low temperatures, temperature changes, washing, dry cleaning and rain. Afterwards, the photometric properties are tested again. These tests aim to ascertain whether the photometric properties can deteriorate due to use. The results of the physical property testing, however, do not give any indication of the clothing's life. This is because the innumerable factors which can influence the warning clothing when in use cannot be predicted.

Over time, the warning clothing becomes less luminous, e.g. due to exposure to UV radiation or cleaning. According to the experts, users are currently not able to assess precisely whether the clothing's fluorescent property is no longer sufficient and whether the clothing must therefore be withdrawn from use. Research work conducted by the Saxon Textile Research Institute (STFI) and the Hohensteiner Institutes on the verification of protective clothing's colour fastness, as defined in EN 471:2003, show that it is possible to verify clothing's colour fastness – even after a considerable amount of time has lapsed – using indicators. However, since the method is very expensive and time-consuming, the question of whether it is reasonable should be settled.

3.7.2.6 Protective gloves

Generic requirements for protective gloves

Degradation can cause a decline in protective gloves' fitness for purpose. For instance, it is possible that, even if there is no permeation, the mechanical properties of chemical protective gloves may change following exposure to a hazardous substance. Equally, a change in temperature could have a negative impact on protective gloves against cold. Degradation is usually noticed by the user since, for example, the glove swells up, forms holes or becomes misshapen or stiff. However, degradation is not taken into consideration in the standards. The experts point out that the standards must take degradation of protective gloves into account because, for example, their protective effect can be significantly compromised by external effects. In addition, degradation of protective gloves can be triggered by unfavourable storage conditions. One example is the finding that oxidation during storage of leather gloves caused chromium III to turn into harmful chromium VI. To prevent unfavourable storage conditions, the manufacturer should give precise storage information and a warning in the information leaflet.

According to the experts, the information to be supplied by the manufacturer does not give an adequate definition of the areas in which protective gloves are to be used. The correlation between the area of use and the foreseeable use should be improved, paying more attention to the experience of, for instance, OSH experts.

EN 420:2003
Protective gloves — General requirements and test methods

EN 420:2003 stipulates that the performance levels to which the protective glove has been assigned must not be negatively influenced by the recommended number of cleaning cycles. The relevant tests set out in the specific standards must be performed on the protective gloves before and after the maximum recommended number of cleaning cycles, conducted in accordance with the manufacturer's care instructions. This requirement aims to ensure that the protective effect of re-usable protective gloves does not decline following cleaning or care carried out by the user.

Where testing of the electrostatic properties of protective gloves is necessary, it is to be carried out in accordance with the methods specified in EN 1149-1, EN 1149-2 or EN 1149-3. The standard does note though that the test methods specified in EN 1149-1 to -3 are designed for clothing and that their suitability for gloves has not yet been proved. Inter-laboratory tests identified considerable differences in the various test laboratories' results. In other words, the tests do not deliver reproducible results. The test results are thus to be presented in the information to be supplied by the manufacturer, along with information on the test atmosphere, tested area of the glove, test method and test voltage in order to enable the user to select a suitable product for the risks present at the place of use.

The packaging and each protective glove must be marked with the use-by date if ageing significantly compromises the protective effect, i.e. if the performance levels drop by one or several performance levels in the space of one year. The responsibility for meeting this requirement lies with the manufacturer.

The following special requirements are stipulated for the content of the information supplied by the manufacturer with regard to time-related performance aspects, e.g.:

- a list of the substances in the glove which are known to have the capacity to cause allergies;
- care instructions, including:
  - storage information and
  - care symbols as specified in EN 23758 or equivalent explanations and the permissible number of cleaning cycles.

Furthermore, a warning should be given explaining that where gloves with conductive properties are used, the other garments, including the footwear, must also be conductive. As already mentioned in the details given in Section 3.7.2.1 regarding EN 1149-1:1995, this is the only way to ensure earthing and thus to dissipate the electrical charge through skin contact and contact with the ground.

Standard-specific requirements

According to the experts, the permeation test specified for chemical protective gloves in EN 374-3:2003 does not adequately reflect the requirements applicable in practice. Their opinions vary, however, on how testing conditions could be adapted to real-life practice. Some believe that one of the major differences between the standard and use in real life is the higher inner-glove temperature caused by body heat. EN 374-3:2003 stipulates a test temperature of (23 ± 1) °C compared to the permeation test temperature of (33 ± 1) °C considered appropriate by the experts. Experiments have shown clearly that, if the temperature is raised to (33 ± 1) °C, the breakthrough times are 30 to 50% lower than in the permeation test as specified in EN 374-3:2003. A further factor influencing the gloves' life is the mechanical stretching caused by hand movements (e.g. forming a fist), though this influence is far smaller than that of body temperature. It was commented that, based on the test institutes' experience, including the stretching in the test method would make the permeation test unnecessarily complicated and result in inadequate reproducibility. On the other hand, some experts are of the opinion that increasing the test temperature would also not reflect real-life practice. Depending on the workplace, the gloves are exposed both to the influence of body temperature and of the ambient temperature, i.e. they can be exposed to temperatures higher or lower than (33 ± 1) °C, which, in turn, can result in other breakthrough times. They therefore recommend that the test continue to be performed as it is now with the inclusion of a safety factor instead of an increased test temperature. Since there is a difference of opinion here, a possible solution is currently being discussed.

The reusability of chemical protective gloves is not addressed in standards EN 374-1 to -3:2003. Nor is there any requirement for details on this point to be included in the information supplied by the manufacturer. The experts consider reuse a very critical point. Strictly speaking, protective gloves of the type covered by these EN standards are intended for single use. However, in real-life practice, they are often used several times for short periods. But the breakthrough time given in the information leaflet, e.g. > 480 min, could lead the user to incorrectly assume that the breakthrough time is only the time during which there is contact with the chemical. However, the beginning of the breakthrough time is the point at which there is contact with the chemical for the first time even if there are interruptions in the period of wear. When the glove is used for a short time, the chemical can remain on the glove and continue to affect it. Brief contact is therefore equivalent to continuous contact. The standards do not require any warnings in the information supplied by the manufacturer to draw attention to this fact. The experts therefore recommend that a reusability test be developed and a warning requirement included in the standards.

In light of the issue described in the preceding paragraph, the Expert Committee on Personal Protective Equipment initiated the drafting of a prevention guideline entitled “Degradation of protective gloves”, which aims to help ensure that degradation is taken into account in the standards for chemical protective gloves. The objective of the guideline is to enable information on the degradation of protective gloves used with chemicals to be provided on the basis of one common method. This would give users standardized information on repeat use of chemical protective gloves and enable them to compare various products. The document describes the factors which cause degradation, ways of identifying relevant degradation and cleaning methods.

In the tests specified in EN 374-1 to -3:2003, no samples are taken from the material between the fingers. However, since the protective effect of the glove can be weakest at these points (due to the production process), the experts feel that samples should also be taken from the material between the fingers in order to rule out potential weak points.

The standards currently do not require any indicators to warn the user that the glove has been permeated by a hazardous substance or that the service life is coming to an end. It could prove difficult to develop a universal indicator because chemical protective gloves are usually used as protection against splashes and are rarely in complete contact with the hazardous substance.

EN 374-1:2003
Protective gloves against chemicals and microorganisms — Part 1: Terminology and performance requirements

EN 374-2:2003
Protective gloves against chemicals and microorganisms — Part 2: Determination of resistance to penetration

EN 374-3:2003
Protective gloves against chemicals and microorganisms — Part 3: Determination of resistance to permeation by chemicals

Standard EN 374-1:2003 covers the problem of leaky or permeable protective gloves caused by variations in production. It does so, however, not by specifying test methods but by specifying a requirement for the details to be contained in the information supplied by the manufacturer. The manufacturer must indicate the Acceptable Quality Level (AQL) to be used for testing penetration during production (Annex A of EN 374-2:2003). Annex A of EN 374-2:2003 is an informative annex concerned with quality assurance during production. The AQL indicates how many chemical protective gloves within one lot or batch can have leaks. The leaks are caused by the production process, during which fluctuations can occur in the thickness of the protective layer and the polymer blend. The AQL is not explained in the information leaflet. The experts feel that the meaning of the AQL should be explained to the user. This would enable the user to select a product with the lowest AQL and thus the lowest probability of leakage.

Chemical protective gloves for use as protection against chemicals and/or microorganisms undergo a practical performance test. They are required to be resistant to the mechanical influence of abrasion and this resistance is determined using the method described in EN 388 for protective gloves against mechanical risks. There is, however, no additional penetration and/or permeation testing. The reason given for this is that the test for abrasion resistance is a destructive test, i.e. the test is continued until the test sample has been worn down to such an extent that a hole is created. However, mechanical pre-treatment before the penetration and permeation test was considered a positive idea. This is because mechanical impact can cause changes in the material which can result in a higher level of permeability and therefore a reduction in the protective effect. It was suggested that the standardization bodies should address the question of how such pre-treatment could be performed.

During wear, body heat and sweat can lead to a moist and warm atmosphere inside the glove causing the upper dermal layers to soften. If chemicals penetrate and/or permeate the glove, they can be absorbed more quickly due to the softened skin. Consequently, permeable gloves result in a higher risk to the user than if the chemical comes into direct contact with intact skin. This problem cannot be covered by tests as it is not possible to simulate it in a way that reflects real-life practice. Nonetheless, a warning should be given in the information supplied by the manufacturer to draw the user's attention to the issue.

With regard to labelling and the information to be supplied by the manufacturer, EN 374-1:2003 refers the reader to EN 420. In addition, the information supplied by the manufacturer must contain the following:

- a list of the chemicals tested and the corresponding protection index for the permeation test,
- a warning that the protection index does not indicate the actual duration of protection at the workplace since other factors, such as temperature, abrasion, etc., play a role in determining fitness for purpose and
- the performance level and the Acceptable Quality Level (AQL) for the penetration test during production (Annex A of EN 374-2).

In the permeation test, the gloves' reaction to individual substances is tested. The standard does not cover mixtures of substances although most substances at the workplace *are* mixtures. It is not possible to enforce testing of protective gloves' resistance to mixtures of substances by incorporating such a requirement in the standard. There are innumerable possible combinations and they cannot all be tested. The user therefore has the possibility to ask the manufacturer which protective gloves are suitable for the conditions and hazardous substances at his or her workplace. However, this is not required by the standards, i.e. the standards do not require any details in the information to be supplied by the manufacturer or on the packaging to make the user aware of this possibility. According to the experts, users often select the wrong protective gloves. It was therefore thought that it would be useful if the standardization experts were to address the question of whether and how suitable information could be conveyed on the basis of requirements concerning the content of the information leaflet, details on the packaging or other measures.

EN 388:2003

3.7 Protective clothing and hand protection

Protective gloves against mechanical risks

Protective gloves required to comply with this standard must meet all of the applicable requirements in EN 420. In addition, protective gloves against mechanical risks undergo a practical performance test in the form of an abrasion test. This involves an abradant being rubbed against the gloves with an additional movement; the abrasion resistance is then indicated by the number of cycles it takes for the glove to break. Since this test does not simulate real-life use, it does not permit any conclusions about the gloves' useful life, i.e. when they will need to be withdrawn from use. As already mentioned, the factors which can influence the protective gloves when in use cannot be imitated in the tests due to the innumerable possible combinations, e.g. duration and intensity of exposure.

The labelling and the content of the information supplied by the manufacturer are required to comply with the relevant sections in EN 420.

EN 511:2006
Protective gloves against cold

Protective gloves against cold have to comply with all applicable requirements in EN 420. In addition, the minimum level of mechanical strength, including resistance to abrasion as specified in EN 388, must also be complied with. As already mentioned, the mechanical strength is tested by means of a practical performance test.

According to the experts, the requirements concerning resistance to repeated bending and to cold are not logical. In the test for resistance to repeated bending, a test temperature of (-20 ± 2) °C is used and the glove is bent 10,000 times. No tears must be visible after this test. The test for resistance to cold is performed at a temperature of (-50 ± 2) °C; here too, no tears must be visible along the fold after the test. The test for resistance to cold must be conducted for gloves designed to provide protection at temperatures below -30 °C. It was commented that there was no relationship between the temperature requirements for resistance to repeated bending and those for resistance to cold. At very low temperatures, there is a risk that the material may become brittle and that the protective effect may therefore decline. Resistance to embrittlement can be assessed on the basis of the resistance to repeated bending. It is therefore suggested that the test for resistance to cold be based on the temperature ranges in which the glove is to be used according to the information given by the manufacturer. The test for resistance to repeated bending should then be carried out for the same temperature range.

EN 511:2006 stipulates that the marking of and instructions for use for protective gloves against the cold must comply with the requirements of EN 420. Additional information and warnings are also given, e.g.:

- the manufacturer must provide information, or indicate where information can be obtained, on the maximum permissible exposure, e.g. temperature, duration; and
- if, in the test for water tightness, the glove does not attain performance level 1, a warning must be given to the effect that the glove may lose its insulation properties in wet conditions.

EN 12477:2001
Protective gloves for welders; including Amendment A1:2005

3.7 Protective clothing and hand protection

Protective gloves for welders must comply with the general requirements set out in EN 420:2003 as well as certain special requirements. For instance, they must provide the level of resistance to abrasion and to impact cuts called for in EN 388. The abrasion resistance test is considered a practical performance test, and involves the gloves being assigned to design category A or B depending on the number of cycles achieved. However, for the reasons explained in the section on EN 388:2003, this does not permit any conclusions about when the gloves will need to be withdrawn from use.

Before undergoing the special tests specified in EN 12477:2001, the samples must be conditioned in accordance with the test standards being applied. If care instructions are available, the tests must be conducted before and after the samples have been subjected to the maximum number of cleaning cycles. The lowest performance level thus determined must be indicated on the label and in the instructions for use so as to take into account the possibility of the protective effect decreasing following cleaning, the aim being to provide the user with maximum protection.

The labelling must be as specified in EN 420:2003. In addition, the letters A or B (depending on the design category) and the pictograms for thermal and mechanical hazards must also be included.

The instructions for use must also correspond to EN 420:2003. In addition, the manufacturer must supply information on the recommended use of the glove. Further details and warnings must also be given in the information supplied by the manufacturer, e.g.:

- if gloves are to be used for arc welding: These gloves do not offer protection against electric shock caused by defective equipment or by touching live parts. Gloves which are wet, dirty or soaked with sweat have a reduced electrical resistance, which increases the risk of electric shock.

3.7.8 Conclusions – protective suits and gloves

In summary, it can be said that the standards do not always give adequate consideration to decreases in a product's protective effect as a result of use. It must be borne in mind, however, that it is not possible to simulate real-life use. This is primarily due to innumerable factors which influence protective clothing and gloves and which could cause the protective effect to decrease. In the case of protective gloves, the complaint is made that degradation, which can have a considerable influence on the protective effect, is not adequately reflected in the test methods. One example of a case in which consideration is given to decreases in the protective effect due to use is that the standards for areas in which cleaning can influence the protective effect (be it due to shrinkage or stretching or a decrease in fluorescent properties in the case of high-visibility warning clothing) require a cleaning test. Furthermore, some standards require strength tests to be carried out both before and after the sample has been subjected to the maximum number of cleaning cycles specified by the manufacturer. The lowest performance level thus determined is indicated in the information supplied by the manufacturer in order to guarantee maximum protection for the user even after the potentially negative impact of cleaning.

The standards contain labelling, packaging and information requirements designed to take into account time-related performance aspects. EN 420:2003 stipulates that the packaging and each protective glove must be marked with the use-by date if the protective effect is compromised significantly by ageing. However, the user is only able to determine to a limited extent whether the products provide an adequate protective effect following use or storage.

3.8 Protection against cuts and stabs

Safety requirements and test methods for protective clothing against stabs and cuts are specified in harmonized European standards and draft standards drawn up by CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets” of WG 5 "Resistance to mechanical impact of protective clothing". Annex A7 contains a detailed list of the standards used as the basis for this section.

3.8.1 Generic requirements for protective equipment against cuts and stabs

The standards drawn up by WG 5 of CEN/TC 162 do not take into consideration time-related changes in the performance of the protective surfaces of personal protective equipment against cuts and stabs. The reason given is that the protective surfaces are made of materials which are resistant to corrosion and weather, e.g. stainless steel or a titanium or aluminium alloy. These materials can largely be considered resistant to ageing.

The influence of storage is also not covered in the standards. This is because, rather than storing large amounts of protective clothing against cuts and stabs, users order it as needed. Due to mechanical stress, the life (useful life) can be expected, e.g. in the case of gloves, to be around one to three years. This figure is based on empirical values. In the experts' opinion, this period is so short that the influence of ageing can be disregarded.

Due to the requirements for the information leaflet to be supplied by the manufacturer, the user is told to conduct tests for wear and tear, decreases in quality and evident defects before beginning work. Typical damage is:

– broken rings in the chainmail,
– bends or nicks in the rings,
– corroded rings or fastening devices,
– worn rings,
– damaged or missing plates and
– damage to the apron straps, braces and fastening devices (hooks, straps, press studs, etc.).

At the workplace, protective gloves are often beaten against a work surface in order to clean them, e.g. to remove bits of meat. When they are handled in this way, it is usually the metal rings on the fingertips which break or become misshapen. This improper use is not covered in the standards. When the gloves are used as intended, the metal rings are subject to wear and tear caused by abrasion and/or other mechanical influences. There are no test methods for determining resistance to wear and tear. It is not possible to imitate in tests the stress to which these gloves are subject in real-life use (be it due to proper or improper use) in order to determine their useful life. Innumerable factors and combinations of factors influence the real useful life, making it impossible to produce a result which could be applied to real-life use at the workplace.

One way of determining wear and tear, e.g. of metal rings, in protective clothing against stabs and cuts could be regular maintenance by the manufacturer. In the experts' opinion, a recommendation to this effect in the standards would be desirable. Although users can conduct a visual inspection to determine whether there is any evident damage to the equipment, they are not able to conduct more extensive tests to establish the actual protective effect. More extensive tests are offered by the manufacturer, who can ascertain the wear and tear of the metal rings on the basis of measurements. The measurements enable the manufacturer to compare the actual and required figures and therefore to assess whether the equipment can continue to be approved for use.

3.8.2 Standard-specific requirements for protective equipment against cuts and stabs

EN 1082-1:1998

Protective clothing — Gloves and arm guards protecting against cuts and stabs by hand knives — Part 1: Chain mail gloves and arm guards

EN 1082-2:2000

Protective clothing — Gloves and arm guards protecting against cuts and stabs by hand knives — Part 2: Gloves and arm guards made of material other than chain mail

EN 14328:2005

Protective clothing — Gloves and arm guards protecting against cuts by powered knives — Requirements and test methods

The materials used to make the protective surface of a piece of PPE against cuts and stabs are pre-tested by the manufacturer to determine, for example, the tensile strength of the wire. In addition, the manufacturer supplies and certifies information on the composition of the materials used to produce the PPE against cuts and stabs. The certificate contains the composition of the metal materials (e.g. nickel) as well as information on tests conducted on the materials to determine the toxicity, allergenicity, carcinogenicity, etc. This requirement is intended to prevent harmful components of PPE against cuts and stabs having any effect on the user. The entire product must then meet the requirements of the relevant standards.

Standards EN 1082-1:1998, EN 1082-2:2000 and EN 14328:2005 specify the required resistance of plastic arm guards to cleaning temperatures. This requirement, including the test method, is intended to prevent damage to the protective clothing (arm guards) caused by cleaning. According to the experts, however, plastic arm guards are no longer used as a rule. The reason is that they are unpleasant to wear. Skin irritations can be caused due to heavy sweating under the plastic arm guard and there are also problems along the joint between the glove and the guard since it could break as a result of use. These problems have been resolved by replacing the plastic with metal. Another advantage of using metal instead of plastic is that the plastic's ageing can be ruled out as an influence.

EN ISO 13998:2003

Protective clothing — Aprons, trousers and vests protecting against cuts and stabs by hand knives (ISO 13998:2003)

The requirement made in EN ISO 13998:2003 that it must be possible to remove the fabric supports from the protective part of the garment is intended to enable the user to clean the straps and protective part separately. If they are washed separately, only cleaning methods suitable for the specific materials must be used in order to achieve the best result (e.g. steel vests should be cleaned in a dishwasher and straps in the washing machine). The standard does not require an explicit note on this point in the information leaflet supplied by the manufacturer. The standard states that the manufacturer must provide instructions concerning the cleaning and disinfection of the garment and, in particular, must specify/forbid processes which could damage the garment.

Unlike chainmail or metal plates, supports made of plastic are subject to ageing. UV radiation and other influences, e.g. temperature, can cause the softeners in the plastic to volatilize, which, in turn, can cause the plastic to become brittle and thus prone to breakage. This characteristic is not taken into account in the standards since it has become clear that the mechanical load exerts such an influence on the supports in real use that ageing doesn't actually occur. Furthermore, plastic supports are not intended to provide protection against cuts or stabs, their purpose is merely to attach the protective surfaces to the user.

EN 1082-2:2000
Protective clothing — Gloves and arm guards protecting against cuts and stabs by hand knives — Part 2: Gloves and arm guards made of material other than chain mail

EN ISO 13998:2003
Protective clothing — Aprons, trousers and vests protecting against cuts and stabs by hand knives (ISO 13998:2003)

EN 14328:2005
Protective clothing — Gloves and arm guards protecting against cuts by powered knives — Requirements and test methods

In accordance with EN 1082-2:2000 and EN ISO 13998:2003, the samples are washed and dried five times before the tests; EN 14328:2005 stipulates that, before testing, the samples must be washed at the highest temperature specified by the manufacturer. This pre-treatment is intended to determine whether the cleaning has any negative influence on the product. However, experience has shown, that it is not possible to establish any influence on the metal material because the temperatures are far lower than a temperature which could cause changes in the material. If the metal materials are heated to approximately 200 °C to 300 °C and then cooled down again, the material could become brittle and lose the desired properties. However, these temperatures do not occur when the protective clothing is used as intended.

3.8.3 Conclusions

In summary, it can be said that there is no reason to incorporate into the standards more extensive requirements concerning changes in the performance of PPE against cuts and stabs due to use or ageing. Workplace experience has shown that the standards' requirements are in line with requirements in real-life practice. Furthermore, the information in the instructions for use offers the user an adequate basis for assessing changes in the performance of PPE against cuts and stabs due to use or ageing. They also contain recommendations concerning equipment tests to identify any wear and tear and decline in quality. The equipment tests could also be backed up by regular maintenance by the manufacturer to determine the actual protective effect provided by the protective clothing against stabs and cuts.

3.9 Personal protective equipment designed to prevent drowning

Safety requirements and test methods for personal protective equipment designed to prevent drowning are specified in harmonized European standards drawn up by CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets” of WG 6 “Life jackets”. Annex A7 contains a detailed list of these standards.

In view of the age of the currently valid European standards and technical progress in the field of PPE designed to prevent drowning, it was deemed necessary to revise standards EN 393:1993, EN 394:1993, EN 395:1993, EN 396:1993 and EN 399:1993. The working group responsible for European and international standardization in this area used this opportunity to transform the standards into EN-ISO standards. A package of 10 standards – the prEN ISO 12402-1 to -10 series of standards – was thus created, taking into account technical progress and incorporating an approach designed for the international market. This package is to replace the current EN standards by the end of 2006 at the latest.

The EN-ISO standards incorporate, evolve and expand the product and material requirements, test methods and user-information specifications related to use and age contained in the existing series of standards. Standards prEN ISO 12402-2 to -5:2006 and prEN ISO 12402-6:2004 refer readers to the test standards prEN ISO 12402-7:2004 for materials and components and prEN ISO 12402-9:2006 for test methods. The tests specified in prEN ISO 12402-9:2006 form a test sequence. The EN series of standards did not make this requirement. Consequently, the requirements specified for the products in the new series of standards are higher because the test sample has to pass all of the tests.

3.9.1 Generic requirements for PPE designed to prevent drowning

Since the current EN standards are to be replaced in the near future, our analysis concentrated on the prEN-ISO package.

Certain factors can influence the performance of life jackets. Particularly problematic are garments made of microfibres and anti-exposure suits made of foil, which are well and truly airtight and therefore have an unpredictable inherent buoyancy. The uncontrolled buoyancy caused by the clothing can make it extremely difficult to turn over the rescuee. The air sealed in the clothing can prevent the life jacket from rotating. However, this problem cannot be resolved by means of standardization. There are innumerable possible combinations of life jackets and protective clothing, which cannot all be taken into consideration. It is for this reason that the instructions for use supplied by the manufacturer contain a warning concerning compatibility with safety harnesses and other garments and pieces of equipment.

It must be pointed out, however, that not all personal flotation devices are suitable for combining with protective clothing and equipment. That is why life jackets with a performance level of 275 are used for certain applications. As specified in prEN ISO 12402-2:2006 for performance level 275 life jackets, these jackets are designed for scenarios where extreme influences, e.g. sealed-in air causing uncontrolled buoyancy or users carrying tools upon their person, prevent personal flotation devices being used safely.

The evidence shows that there is no decline in the protective effect if the product is stored properly. Nonetheless, automatic inflating lifejackets are generally assumed to have a life of 10 years provided that they are regularly maintained and tested. After 10 years, they are removed from service irrespective of whether they have been used. The date of manufacture can be obtained from the manufacturer by citing the batch number, which has to be affixed to the life jacket in a permanent manner.

Changes in the materials' performance can influence the protective effect of personal flotation devices. The standards take this problem into account by specifying requirements relating to the material used and by stipulating that the entire product must undergo the relevant tests. The materials are thus pre-certified and the manufacturer has to provide evidence of this in the form of a certificate. In accordance with prEN ISO 12402-7:2004, the materials used are tested for aspects such as decreased performance caused by use and ageing.

In the case of automatic inflating lifejackets, the restraining component in the inflation mechanism, consisting of a tablet or a ring, requires particular attention with respect to ageing. Weather influences can cause the restraining component to disintegrate, which would stop the inflation mechanism functioning properly. Whilst the current EN standards only consider this issue on the basis of a normal level of moisture, prEN ISO 12402-7:2004 deals with the problem by exposing the restraining component to a higher level of moisture. In addition to the test requirements, the manufacturer must provide details of how to replace parts. Usually, the manufacturer recommends that the restraining component be replaced once a year. In addition, each inflation system is equipped with a ripcord for manual activation and a mouthpiece for inflating the life jacket. The inflation system is fitted with an indicator to show whether it is operational. This indicator displays a red dot if the mechanism is not ready for use and a green dot if it is. The quantity of CO_2 in the CO_2 bottle is also displayed to the user – a requirement which was not made in past standards.

The details given in the information leaflet and on the label enable the user to assess the protective effect of personal flotation devices. There is also a recommendation concerning the intervals at which maintenance should be conducted by a competent person: generally speaking, every 1-3 years for devices used commercially. Personal flotation devices which have been tested by competent persons are given a label to show that the testing has been carried out. However, the user is only able to a limited extent to check whether the life jacket or personal buoyancy aid is in full working order. Users can conduct visual inspections to determine whether there is any damage to the inherently buoyant material. They can also carry out buoyancy tests for inherently buoyant life jackets and inflatable life jackets. In the case of automatic inflating personal flotation devices, the indicator can be used to establish whether the inflation system is functioning properly.

3.9.2 Standard-specific requirements for PPE designed to prevent drowning

prEN ISO 12402-7:2004
Personal flotation devices – Part 7: Materials and components - Safety requirements and test methods (ISO/DIS 12402-7:2004)

In addition to the product tests specified in prEN ISO 12402-9:2006, personal flotation devices undergo material tests in accordance with prEN ISO 12402-7:2004. The latter standard takes into account the influences of ageing and use through, for instance, the following requirements and tests:

- components and textile fabrics must not be damaged by storage at temperatures ranging from -30 °C to +65 °C or by salt water in the test specified in ISO 9227 during a period of 96 h; and

- after a 160 hour test as specified in ISO 3768, metal components must not display any significant traces of corrosion. This must be verified by means of a functional test after the corrosion test.

The test to determine the corrosion resistance of all metal parts is intended, among other things, to ensure that the inflation mechanism of automatic inflating life jackets and the fastening on the harness strap (used to rescue the drowning person) are in working order.

prEN ISO 12402-8:2006
Personal flotation devices – Part 8: Accessories; safety requirements and test methods (ISO/DIS 12402-8:2006)

Risks posed by chemicals, stabs or welding work can make additional protection necessary for personal flotation devices. Protective covers are used for this purpose. prEN ISO 12402-8:2006 stipulates that protective covers must increase the life and performance of the personal flotation device. The material used to make the protective cover must be robust and resistant to wear and tear to a degree suitable for the conditions of use.

prEN ISO 12402-9:2006
Personal flotation devices – Part 9: Test methods (ISO/DIS 12402-9:2006)

prEN ISO 12402-9:2006 takes into consideration the possibility of a decrease in the protective effect due to use or ageing. The test methods specified in the standard form a test sequence, which means that the requirements to be met by the sample are higher. A test is deemed to have been passed when all specimens of the entire flotation device have passed all of the tests specified in the standard. Tests designed to take into account ageing and/or use include:

- Drum test (for testing minimum resistance to wear and tear) and
- oil and water resistance test.

3.9.3 Conclusions

The prEN ISO 12402-1 to -10 series specifies product and material requirements which take into consideration the possibility of a decline in the protective effect due to ageing or use. One of the requirements is a minimum level of resistance to wear and tear, which is verified by means of a drum test and a temperature-change test as specified in prEN ISO 12402-9:2006. The label and the information supplied by the manufacturer enable the user to determine the protective effect of personal flotation devices. It is therefore felt that the influences of use and ageing are given sufficient consideration in the prEN-ISO series.

In view of the age of the standards, technical progress and the special hazards emanating from the place of use, the experts would welcome a revision of the standards for buoyancy compensators, EN 1809:1997 and EN 12628:1999, in line with the prEN ISO 12402-1 to -10 series of standards. The higher product requirements made in the prEN-ISO series can only go to increase safety for the user.

4. *Final remarks*

This section gives an overall assessment of how time-related and use-related performance aspects are taken into consideration in standards. It also includes some additional statements concerning possible future developments.

The study found that the quality of PPE on the European market was mostly considered satisfactory. The purpose of the EN standards is to eliminate obstacles to the free movement of goods on the European market and also to offer users maximum protection against hazards to life and limb. The product requirements should therefore not only consider the performance of PPE when new but also any possible changes in performance caused by storage or use. However, it is generally very difficult, irrespective of the type of PPE involved, for standards to take such changes into account in a way which reflects real-life practice purely by means of product requirements. The innumerable possible combinations of influencing factors, e.g. the nature and duration of use, external influences (including UV radiation and climatic conditions) and the intensity of the influences on PPE, make it impossible to predict with certainty the stress to which the product will be subject. Nor does it make sense for testing required by the standards to subject the PPE to worst-case conditions since they would not reflect usual conditions in practice. In such an approach, the PPE would have to meet requirements which rarely, if at all, occur in use and which would therefore be unjustifiable in terms of production and testing costs.

The existing PPE requirements in standards mostly reflect real-life practice, i.e. the specifications and limits take into account the anticipated “normal" use of PPE. More extensive requirements are often made in the form of specifications concerning the content of the information to be supplied by the manufacturer, particularly by stipulating that the areas of and restrictions on use of the PPE must be indicated.

For certain types of PPE, assigning the PPE items to different classes would be one way of indicating how they are to be used and thus the factors which might potentially influence them. In many cases, the standards already contain this sort of classification in the form of performance levels and/or protection classes. Combined with information concerning special areas of use, these classifications can help prevent PPE being used incorrectly or for too long. However, even where such classification is in place, it is not always possible to determine the actual duration of the PPE’s useful life because the actual risks and the intensity of use cannot be identified by the standards.

In many cases, the laboratory tests specified by the standards are based on theory. One of the reasons for this is to ensure the necessary reproducibility and repeatability whilst keeping the effort required at an acceptable level. However, this can mean that it is not possible to completely assess the PPE's performance in real life on the basis of the tests conducted. The permeation and penetration testing for chemical protective gloves and suits provides a good example of this. The permeation test is used to compare various manufacturers' products and the breakthrough time is a characteristic of the material. "Post-standard" studies are considered to be one possibility for determining the effectiveness and suitability of specifications and test methods and for preventing occupational accidents and illnesses effectively. Such studies could be used to minimize the gap between test results and real-life practice.

In this connection, it was repeatedly pointed out that the expert knowledge concerning accident incidence and accident causes should be incorporated more into standardization work. This would enable requirements to be defined and information (e.g. in the form of a warning in the information leaflet supplied by the manufacturer) to be given which could be even more helpful in preventing accidents or reducing the number of accidents caused by, for example, improper use.

Further possibilities for countering decreases in the protective effect due to ageing or use are seen in technical developments, e.g. RFID and nanotechnology. In the PPE field, RFID systems could be used, for example, for maintenance and repair services. It is also conceivable that RFID could be used to ensure that tools are used at the right workplace and maintained in line with workplace regulations. Nanotechnology also offers a wide range of possible uses. One could be impregnation of textile surfaces (e.g. in protective clothing) to give them a finish with improved water and oil repellency. However, the knowledge currently available is not sufficient to be able to implement these technologies.

Annex A: List of standards and draft standards for PPE

(as at 16 January 2006)

A1: Respiratory protective devices (CEN/TC 79)

For the purpose of clarity, the standards and draft standards are listed separately by sub-committee (SC).

a) harmonized European standards

SC 1	**Terminology, definitions, classification and selection**	
Standard	**Title**	**replaces**
EN 132:1998	Respiratory protective devices – Definitions of terms and pictograms	EN 132:1990
EN 133:2001	Respiratory protective devices – Classification	EN 133:1990
EN 134:1998	Respiratory protective devices – Nomenclature of components	EN 134:1990
EN 135:1998	Respiratory protective devices – List of equivalent terms	EN 135:1990

SC 2	**Physiological requirements**
No standards	

SC 3	**Facepieces**	
Standard	**Title**	**replaces**
EN 136:1998	Respiratory protective devices – Full face masks – Requirements, testing, marking	EN 136-10:1992 EN 136:1989
EN 136:1998/ AC:1999	Amendment to EN 136:1998	
EN 140:1998	Respiratory protective devices – Half masks and quarter masks – Requirements, testing, marking	EN 140:1989
EN 140:1998/ AC:1999	Amendment to EN 140:1998	
EN 142:2002	Respiratory protective devices – Mouthpiece assemblies – Requirements, testing, marking	EN 142:1989
EN 148-1:1999	Respiratory protective devices – Threads for facepieces – Part 1: Standard thread connection	EN 148-1:1987
EN 148-2:1999	Respiratory protective devices – Threads for facepieces – Part 2: Centre thread connection	EN 148-2:1987
EN 148-3:1999	Respiratory protective devices – Threads for facepieces – Part 3: Tread connection M 45 x 3	EN 148-3:1992
EN 149:2001	Respiratory protective devices – Filtering half masks to protect against particles – Requirements, testing, marking	EN 149:1991

EN 405:2001	Respiratory protective devices – Valved filtering half masks to protect against gases or gases and particles – Requirements, testing, marking	EN 405:1992
EN 1827:1999	Respiratory protective devices – Half masks without inhalation valves and with separable filters to protect against gases or gases and particles or particles only – Requirements, testing, marking	

SC 4	**Filters and absorption devices**	
Standard	**Title**	**replaces**
EN 143:2000	Respiratory protective devices – Particle filters – Requirements, testing, marking	EN 143:1990
EN 403:2004	Respiratory protective devices for self-rescue – Filtering devices with hood for escape from fire – Requirements, testing, marking	EN 403:1993
EN 404:2005	Respiratory protective devices for self-rescue – Filter self-rescuer from carbon monoxide with mouthpiece assembly	EN 404:1993
EN 12083:1998	Respiratory protective devices – Filters with breathing hoses, (Non-mask mounted filters) – Particle filters, gas filters, and combined filters – Requirements, testing, marking	
EN 12083:1998/ AC:2000	Amendment to EN 12083:1998	
EN 14387:2004	Respiratory protective devices – Gas filter(s) and combined filter(s) – Requirements, testing, marking	EN 141:2000 EN 371:1992 EN 372:1992

SC 5	**Fresh air hose and compressed air line breathing apparatus**	
Standard	**Title**	**replaces**
EN 138:1994	Respiratory protective devices – Fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly – Requirements, testing, marking	
EN 269:1994	Respiratory protective devices – Powered fresh air hose breathing apparatus incorporating a hood – Requirements, testing, marking	
EN 14593-1:2005	Respiratory protective devices – Compressed air line breathing apparatus with demand valve – Part 1: Apparatus with a full face mask – Requirements, testing, marking	EN 139:1994
EN 14593-2:2005	Respiratory protective devices – Compressed air line breathing apparatus with demand valve – Part 2: Apparatus with a half mask at positive pressure – Requirements, testing, marking	EN 139:1994
EN 14594:2005	Respiratory protective devices – Continuous flow compressed air line breathing apparatus – Requirements, testing, marking	EN 139 :1994 EN 270 :1994 EN 271 :1995 EN 1835 :1999 EN 12419 :1999

SC 6	**Self-contained breathing apparatus**	
Standard	**Title**	**replaces**
EN 137:1993	Respiratory protective devices – self-contained open-circuit compressed air breathing apparatus – requirements, testing, marking	EN 137:1986
EN 137:1993/ AC:1993	Amendment to EN 137:1993	
EN 144-1:2000	Respiratory protective devices – Gas cylinder valves – Part 1: Thread connections for insert connector	EN 144-1:1991
EN 144-1:2000/ A1:2003	Respiratory protective devices – Gas cylinder valves – Part 1: Thread connections for insert connector; Amendment	
EN 144-1:2000/ A2:2005	Respiratory protective devices – Gas cylinder valves – Part 1: Thread connections for insert connector; Amendment	
EN 144-2:1998	Respiratory protective devices – Gas cylinder valves – Part 2: Outlet connections	
EN 144-3:2003	Respiratory protective devices – Gas cylinder valves – Part 3: Outlet connections for diving gases Nitrox and oxygen	
EN 145:1997	Respiratory protective devices – Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type – Requirements, testing, marking	EN 145:1988 EN 145-2:1992
EN 145:1997/ A1:2000	Respiratory protective devices – Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type – Requirements, testing, marking; Amendment	
EN 400:1993	Respiratory protective devices for self- rescue – self-contained closed-circuit breathing apparatus – compressed oxygen escape apparatus – requirements, testing, marking	
EN 401:1993	Respiratory protective devices for self- rescue – self-contained closed-circuit breathing apparatus – chemical oxygen (KO2) escape apparatus – requirements, testing, marking	
EN 402:2003	Respiratory protective devices – Lung governed demand self-contained open-circuit compressed air breathing apparatus with full face mask or mouthpiece assembly for escape – Requirements, testing, marking	EN 402:1993
EN 1061:1996	Respiratory protective devices for self-rescue - Self-contained closed-circuit breathing apparatus - Chemical oxygen (NaClO3) escape apparatus - Requirements, testing, marking	
EN 1146:1997	Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking	

EN 1146:1997/ A1:1998	Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking; Amendment	
EN 1146:1997/ A2:1999	Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking; Amendment	
EN 1146:1997/ A3:2001	Respiratory protective devices for self-rescue - Self-contained open-circuit compressed air breathing apparatus incorporating a hood (compressed air escape apparatus with hood) - Requirements, testing, marking; Amendment	
EN 13794:2002	Respiratory protective devices – Self-contained closed-circuit breathing apparatus for escape – Requirements, testing, marking	
EN 14435:2004	Respiratory protective devices – Self-contained open-circuit compressed air breathing apparatus with half mask designed to be used with positive pressure only – Requirements, testing, marking	

SC 7	**Diving apparatus**	
Standard	**Title**	**replaces**
EN 250:2000	Respiratory equipment – Open-circuit self-contained compressed air diving apparatus – Requirements, testing, marking	EN 250:1993
EN 13949:2003	Respiratory equipment – Open-circuit self-contained diving apparatus for use with compressed Nitrox and oxygen – Requirements, testing, marking	
EN 14143:2003	Respiratory equipment – Self-contained re-breathing diving apparatus	

SC 8	**Powered respirators**	
Standard	**Title**	**replaces**
EN 12941:1998	Respiratory protective devices – Powered filtering devices incorporating a helmet or a hood – Requirements, testing, marking	EN 146:1991
EN 12941:1998/ A1:2003	Respiratory protective devices – Powered filtering devices incorporating a helmet or a hood – Requirements, testing, marking; Amendment	
EN 12942:1998	Respiratory protective devices – Power assisted filtering devices incorporating full face masks, half masks or quarter masks – Requirements, testing, marking	EN 147:1991
EN 12942:1998/ A1:2002	Respiratory protective devices – Power assisted filtering devices incorporating full face masks, half masks or quarter masks – Requirements, testing, marking; Amendment	

SC 9	Interpretation of CEN/TC 79 standards	
Standard	**Title**	**replaces**
EN 13274-1:2001	Respiratory protective devices – Methods of test – Part 1: Determination of inward leakage and total inward leakage	
EN 13274-2:2001	Respiratory protective devices – Methods of test – Part 2: Practical performance tests	
EN 13274-3:2001	Respiratory protective devices – Methods of test – Part 3: Determination of breathing resistance	
EN 13274-4:2001	Respiratory protective devices – Methods of test – Part 4: Flame tests	
EN 13274-5:2001	Respiratory protective devices – Methods of test – Part 5: Climatic conditions	
EN 13274-6:2001	Respiratory protective devices – Methods of test – Part 6: Determination of carbon dioxide content of the inhalation air	
EN 13274-7:2002	Respiratory protective devices – Methods of test – Part 7: Determination of particle filter penetration	
EN 13274-8:2002	Respiratory protective devices – Methods of test – Part 8: Determination of dolomite dust clogging	

b) draft European standards

SC 4	Filters and absorption devices
Standard	**Title**
EN 143:2000/ prA1:2006	Respiratory protective devices - Particle filters - Requirements, testing, marking

SC 6	Self-contained breathing apparatus
Standard	**Title**
prEN 137:2002	Respiratory protective devices - Self- contained open-circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking

SC 7	Diving apparatus
Standard	**Title**
EN 250:2000/ prA1:2005	Respiratory equipment - Open-circuit self-contained compressed air diving apparatus - Requirements, testing, marking
prEN 15333-1:2005	Respiratory equipment - Open-circuit umbilical supplied compressed gas diving apparatus - Demand apparatus

A2: Eye protective equipment (CEN/TC 85)

a) harmonized European standards

Standard	Title	replaces
EN 165:1995	Personal eye-protection – Vocabulary	EN 165:1986
EN 166:2001	Personal eye-protection – Specifications	EN 166:1995
EN 167:2001	Personal eye-protection – Optical test methods	EN 167:1995
EN 168:2001	Personal eye-protection – Non-optical test methods	EN 168:1995
EN 169:2002	Personal eye-protection – Filters for welding and related techniques – Transmittance requirements and recommended use	EN 169:1992
EN 170:2002	Personal eye-protection – Ultraviolet filters – Transmittance requirements and recommended use	EN 170:1992
EN 171:2002	Personal eye-protection – Infrared filters – Transmittance requirements and recommended use	EN 171:1992
EN 172:1994	Personal eye protection – Sunglare filters for industrial use	
EN 172:1994/ A1:2000	Personal eye-protection – Sunglare filters for industrial use; Amendment	
EN 172:1994/ A2:2001	Personal eye protection – Sunglare filters for industrial use; Amendment	
EN 175:1997	Personal protection – Equipment for eye and face protection during welding and allied processes	
EN 207:1998	Personal eye-protection – Filters and eye-protectors against laser radiation (laser eye-protectors)	EN 207:1993
EN 207:1998/ A1:2002	Personal eye-protection – Filters and eye-protectors against laser radiation (laser eye-protectors); Amendment	
EN 208:1998	Personal eye-protection – Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)	EN 208:1993
EN 208:1998/ A1:2002	Personal eye-protection – Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors); Amendment	
EN 379:2003	Personal eye-protection – Automatic welding filters	EN 379:1994
EN 1731:1997	Mesh type eye and face protectors for industrial and non-industrial use against mechanical hazards and/or heat	
EN 1731:1997/ A1:1997	Mesh type eye and face protectors for industrial and non-industrial use against mechanical hazards and/or heat; Amendment	
EN 14458:2004	Personal eye-equipment - Faceshields and visors for use with firefighters and high performance industrial safety helmets used by firefighters, ambulance and emergency services	

b) draft European standards

Standard	Title
prEN 1731:2005	Personal eye protection - Mesh eye and face protectors

A3: Head protection (CEN/TC 158)

a) harmonized European standards

Standard	Title	replaces
EN 397:1995	Industrial safety helmets	
EN 397:1995/ A1:2000	Industrial safety helmets; Amendment	
EN 443:1997	Helmets for firefighters	
EN 812:1997	Industrial bump caps	
EN 812:1997/ A1:2001	Industrial bump caps; Amendment	
EN 960:1994	Headforms for use in the testing of protective helmets	
EN 960:1994/ A1:1998	Headforms for use in the testing of protective helmets; Amendment	
EN 13087-1:2000	Protective helmets – Test methods – Part 1: Conditions and conditioning	
EN 13087-1:2000/ A1:2001	Protective helmets – Test methods – Part 1: Conditions and conditioning; Amendment	
EN 13087-2:2000	Protective helmets – Test methods – Part 2: Shock absorption	
EN 13087-2:2000/ A1:2001	Protective helmets – Test methods – Part 2: Shock absorption; Amendment	
EN 13087-3:2000	Protective helmets – Test methods – Part 3: Resistance to penetration	
EN 13087-3:2000/ A1:2001	Protective helmets – Test methods – Part 3: Resistance to penetration; Amendment	
EN 13087-4:2000	Protective helmets – Test methods – Part 4: Retention system effectiveness	
EN 13087-5:2000	Protective helmets – Test methods – Part 5: Retention system strength	
EN 13087-6:2000	Protective helmets – Test methods – Part 6: Field of vision	
EN 13087-6:2000/ A1:2001	Protective helmets – Test methods – Part 6: Field of vision; Amendment	
EN 13087-7:2000	Protective helmets – Test methods – Part 6: Field of vision	
EN 13087-7:2000/ A1:2001	Protective helmets – Test methods – Part 7: Flame resistance; Amendment	
EN 13087-8:2000	Protective helmets – Test methods – Part 8: Electrical properties	
EN 13087-8:2000/ A1:2005	Protective helmets – Test methods – Part 8: Electrical properties; Amendment	
EN 13087-10:2000	Protective helmets - Test methods - Part 10: Resistance to radiant heat	

b) draft European standards

Standard	Title
prEN 443:2004	Helmets for fire fighting in buildings and other structures
prEN 960:2005	Headforms for use in the testing of protective helmets

A4: Hearing protectors (CEN/TC 159)

a) harmonized European standards

Standard	Title	replaces
EN 352-1:2002	Hearing protectors – General requirements – Part 1: Ear-Muffs	EN 352-1:1993
EN 352-2:2002	Hearing protectors – General requirements – Part 2: Ear-plugs	EN 352-2:1993
EN 352-3:2002	Hearing protectors – General requirements – Part 3: Ear-muffs attached to an industrial safety helmet	EN 352-3:1996
EN 352-4:2001	Hearing protectors – Safety requirements and testing – Part 4: Level-dependent ear-muffs	
EN 352-5:2002	Hearing protectors – Safety requirements and testing – Part 5: Active noise reduction ear-muffs	
EN 352-6:2002	Hearing protectors – Safety requirements and testing – Part 6: Ear-muffs with electrical audio input	
EN 352-7:2002	Hearing protectors – Safety requirements and testing – Part 7: Level-dependent ear-plugs	
EN 458:2004	Hearing protectors – Recommendations for selection, use, care and maintenance – Guidance document	EN 458:1993
EN ISO 4869-2:1995	Acoustics - Hearing protectors - Part 2: Estimation of effective A-weighted sound pressure levels when hearing protectors are worn (ISO 4869-2:1994)	
EN ISO 4869-4:2000*	Acoustics - Hearing protectors - Part 4: Measurement of effective sound pressure levels for level-dependent sound-restoration ear-muffs (ISO/TR 4869-4:1998)	
EN 13819-1:2002	Hearing protectors – Testing – Part 1: Physical test methods	
EN 13819-2:2002	Hearing protectors – Testing – Part 2: Acoustic test methods	
EN 24869-1:1992	Acoustics; hearing protectors; subjective method for the measurement of sound attenuation (ISO 4869-1:1990)	
EN 24869-3:1993	Acoustics; hearing protectors; part 3: simplified method for the measurement of insertion loss of ear-muff type protectors for quality inspection purposes (ISO/TR 4869-3:1989)	

b) draft European standards

Standard	Title
EN 352-1:2002/ prA1:2004	Hearing protectors - General requirements - Part 1: Ear-Muffs
EN 352-2:2002/	Hearing protectors - General requirements - Part 2: Ear-plugs

* In the EC type examination, level-dependent ear-muffs are not tested in accordance with EN ISO 4869-4:2000, but with EN 352-4:2001.

prA1:2004	
EN 352-3:2002/ prA1:2004	Hearing protectors - General requirements - Part 3: Ear-muffs attached to an industrial safety helmet

A5: Protection against falls from a height including working belts (CEN/TC 160)

a) harmonized European standards

Standard	Title	replaces
EN 341:1992	Personal protective equipment against falls from a height – Descender devices	
EN 341:1992/ A1:1996	Personal protective equipment against falls from a height – Descender devices; Amendment	
EN 341:1992/ AC:1993	Corrigendum to EN 341:1992	
EN 353-1:2002	Personal protective equipment against falls from a height – Part 1: Guided type fall arresters including a rigid anchor line	EN 353-1:1992
EN 353-2:2002	Personal protective equipment against falls from a height – Part 2: Guided type fall arresters including a flexible anchor line	EN 353-2:1992
EN 354:2002	Personal protective equipment against falls from a height – Lanyards	EN 354:1992
EN 355:2002	Personal protective equipment against falls from a height – Energy absorbers	EN 355:1992
EN 358:1999	Personal protective equipment for work positioning and prevention of falls from a height – Belts for work positioning and restraint and work positioning lanyards	EN 358:1992
EN 360:2002	Personal protective equipment against falls from a height – Retractable type fall arresters	EN 360:1992
EN 361:2002	Personal protective equipment against falls from a height – Full body harnesses	EN 361:1992
EN 362:2004	Personal protective equipment against falls from a height – Connectors	EN 362:1992
EN 363:2002	Personal protective equipment against falls from a height – Fall arrest systems	EN 363:1992
EN 364:1992	Personal protective equipment against falls from a height – Test methods	
EN 364:1992/ AC:1993	Corrigendum to EN 364:1992	
EN 365:2004	Personal protective equipment against falls from a height – General requirements for instructions for use, maintenance, periodic examination, repair, marking and packaging	EN 365:1992
EN 795:1996	Protection against falls from a height – Anchor devices – Requirements and testing	
EN 795:1996/ A1:2000	Protection against falls from a height – Anchor devices – Requirements and testing; Amendment	
EN 813:1997	Personal protective equipment for prevention of falls from a height – Sit harnesses	

EN 1868:1997	Personal protective equipment against falls from a height – List of equivalent terms	
EN 1891:1998	Personal protective equipment for the prevention of falls from a height – Low stretch kernmantel ropes	

b) draft European standards

Standard	**Title**
prEN 341:2006	Personal fall protection - Descender devices for rescue
EN 353-1:2002/ prA1	Personal protective equipment against falls from a height - Part 1: Guided type fall arresters including a rigid anchor line
prEN 354:2005	Personal protective equipment against falls from a height - Lanyards
prEN 363:2006	Personal fall protection equipment - Personal fall protection systems
prEN 813:2005	Personal fall protection equipment - Sit harnesses
prEN 1496:2005	Personal fall protection equipment - Rescue lifting devices
prEN 1497:2005	Personal fall protection equipment - Rescue harnesses
prEN 1498:2005	Personal fall protection equipment - Rescue loops
prEN 12841:2005	Personal protective equipment for prevention of falls from a height - Rope access systems - Rope adjustment devices for work positioning

A6: Foot and leg protectors (CEN/TC 161)

a) harmonized European standards

Standard	Title	replaces
EN 12568:1998	Foot and leg protectors - Requirements and test methods for toecaps and metal penetration resistant inserts	
EN 13287:2004	Personal protective equipment - Footwear - Test method for slip resistance	
EN ISO 20344:2004	Personal protective equipment - Test methods for footwear (ISO 20344:2004)	EN 344:1992 EN 344-2:1996
EN ISO 20345:2004	Personal protective equipment - Safety footwear - (ISO 20345:2004)	EN 345:1992 EN 345-2:1996
EN ISO 20346:2004	Personal protective equipment - Protective footwear (ISO 20346:2004)	EN 346:1992 EN 346-2:1996
EN ISO 20347:2004	Personal protective equipment - Occupational footwear - (ISO 20347:2004)	EN 347:1992 EN 347-2:1996

b) draft European standards

Standard	Title
prEN 13832-1:2005	Footwear protecting against chemicals and micro-organisms - Part 1: Terminology and test methods
prEN 13832-2:2005	Footwear protecting against chemicals and micro-organisms - Part 2: Footwear protecting against the spraying of chemicals
prEN 13832-3:2005	Footwear protecting against chemicals and micro-organisms - Part 3: Footwear highly protective against chemicals
prEN 15090:2005	Footwear for firefighters
EN ISO 20344:2004/ prA1:2004	Personal protective equipment - Test methods for footwear; Amendment 1 (ISO 20344:2004)
EN ISO 20345:2004/ prA1:2004	Personal protective equipment - Safety footwear (ISO 20345:2004)
EN ISO 20346:2004/ prA1:2004	Personal protective equipment - Protective footwear (ISO 20346:2004)
EN ISO 20347:2004/ prA1:2004	Personal protective equipment - Occupational footwear - (ISO 20347:2004)

A7: Protective clothing including hand and arm protection and lifejackets (CEN/TC 162)

For the purpose of clarity, the standards and draft standards are listed by working group (WG).

a) harmonized European standards

WG 1	**General requirements for protective clothing**	
Standard	**Title**	**replaces**
EN 340:2003	Protective clothing – General requirements	EN 340:1993
EN 510:1993	Specification for protective clothing for use where there is a risk of entanglement with moving parts	
EN 1149-1:1995	Protective clothing - Electrostatic properties - Part 1: Surface resistivity (Test methods and requirements)	
EN 1149-2:1997	Protective clothing – Electrostatic properties – Part 2: Test method for measurement of the electrical resistance through a material (vertical resistance)	
EN 1149-3:2004	Protective clothing – Electrostatic properties – Part 3: Test methods for measurement of charge decay	

WG 2	**Resistance to heat and fire of protective clothing**	
Standard	**Title**	**replaces**
EN 348:1992	Protective clothing; test method; determination of behaviour of materials on impact of small splashes of molten metal	
EN 348:1992/ AC:1993	Corrigendum to EN 348:1992	
EN 367:1992	Protective clothing - Protection against heat and fire - Method of determining heat transmission on exposure to flame	
EN 367:1992/ AC:1992	Corrigendum to EN 367:1992	
EN 373:1993	Protective clothing – assessment of resistance of materials to molten metal splash	
EN 469:2005	Protective clothing for firefighters - Performance requirements for protective clothing for firefighting	
EN 470-1:1995	Protective clothing for use in welding and allied processes - Part 1: General requirements	
EN 470-1:1995/ A1:1998	Protective clothing for use in welding and allied processes - Part 1: General requirements; Amendment	
EN 531:1995	Protective clothing for industrial workers exposed to heat (excluding firefighters' and welders' clothing)	
EN 531:1995/ A1:1998	Protective clothing for workers exposed to heat; Amendment	
EN 533:1997	Protective clothing - Protection against heat and flame -	

	Limited flame spread materials and material assemblies	
EN 702:1994	Protective clothing - Protection against heat and flame - Test method: Determination of the contact heat transmission through protective clothing or its materials	
EN 1486:1996	Protective clothing for fire-fighters - Test methods and requirements for reflective clothing for specialised fire-fighting	
EN ISO 6942:2002	Protective clothing - Protection against heat and fire - Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat (ISO 6942:2002)	EN 366:1993
EN 13911:2004	Protective clothing for firefighters - Requirements and test methods for fire hoods for firefighters	
EN ISO 15025:2002	Protective clothing - Protection against heat and flame - Method of test for limited flame spread (ISO 15025:2000)	EN 532:1994

WG 3	**Protective clothing against chemicals, infective agents and radioactive contamination**	
Standard	**Title**	**replaces**
EN 463:1994	Protective clothing - Protection against liquid chemicals - Test method: Determination of resistance to penetration by a jet of liquid (Jet Test)	
EN 464:1994	Protective clothing - Protection against liquid and gaseous chemicals, including aerosols and solid particles - Test method: Determination of leak-tightness of gas-tight suits (Internal pressure test)	
EN 468:1994	Protective clothing - Protection against liquid chemicals - Test method: Determination of resistance to penetration by spray (Spray Test)	
EN 943-1:2002	Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles - Part 1: Performance requirements for ventilated and non-ventilated "gas-tight" (Type 1) and "non-gas-tight" (Type 2) chemical protective suits	
EN 943-1:2002/ AC:2005	Corrigendum to EN 943-1:2002	
EN 943-2:2002	Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles - Part 2: Performance requirements for "gas-tight" (Type 1) chemical protective suits for emergency teams (ET)	
EN 1073-1:1998	Protective clothing against radioactive contamination - Part 1: Requirements and test methods for ventilated protective clothing against particulate radioactive contamination	
EN 1073-2:2002	Protective clothing against radioactive contamination - Part 2: Requirements and test methods for non-ventilated protective clothing against particulate radioactive contamination I	

EN ISO 6529:2001	Protective clothing - Protection against chemicals - Determination of resistance of protective clothing materials to permeation by liquids and gases (ISO 6529:2001)	EN 369:1993
EN ISO 6530:2005	Protective clothing - Protection against liquid chemicals - Test method for resistance of materials to penetration by liquids (ISO 6530:2005)	EN 368:1992
EN 13034:2005	Protective clothing against liquid chemicals - Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6] equipment)	
EN ISO 13982-1:2004	Protective clothing for use against solid particulates - Part 1: Performance requirements for chemical protective clothing providing protection to the full body against airborne solid particulates (type 5 clothing) (ISO 13982-1:2004)	
EN ISO 13982-2:2004	Protective clothing for use against solid particulates - Part 2: Test method of determination of inward leakage of aerosols of fine particles into suits (ISO 13982-2:2004)	
EN 14126:2003	Protective clothing - Performance requirements and tests methods for protective clothing against infective agents	
EN 14325:2004	Protective clothing against chemicals - Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages	
EN 14605:2005	Protective clothing against liquid chemicals - Performance requirements for clothing with liquid-tight (Type 3) or spray-tight (Type 4) connections, including items providing protection to parts of the body only (Types PB [3] and PB [4])	EN 465:1995 EN 466:1995 EN 467:1995

WG 4	**Protective clothing against foul weather, wind and cold**	
Standard	**Title**	**replaces**
EN 342:2004	Protective clothing - Ensembles and garments for protection against cold	
EN 343:2003	Protective clothing - Protection against rain	
EN 14058:2004	Protective clothing - Garments for protection against cool environments	
EN 14360:2004	Protective clothing against rain - Test method for ready made garments - Impact from above with high energy droplets	
EN ISO 15027-1:2002	Immersion suits - Part 1: Constant wear suits, requirements including safety (ISO 15027-1:2002)	
EN ISO 15027-2:2002	Immersion suits - Part 2: Abandonment suits, requirements including safety (ISO 15027-2:2002)	
EN ISO 15027-3:2002	Immersion suits - Part 3: Test methods (ISO 15027-3:2002)	

EN ISO 15831:2004	Clothing - Physiological effects - Measurement of thermal insulation by means of a thermal manikin (ISO 15831:2004)	

WG 5	**Resistance to mechanical impact of protective clothing**	
Standard	**Title**	**replaces**
EN 530:1994	Abrasion resistance of protective clothing material - Test methods	
EN 530:1994/ AC:1995	Corrigendum to EN 530:1994	
EN 863:1995	Protective clothing - Mechanical properties - Test method: Puncture resistance	
EN 1082-1:1996	Protective clothing - Gloves and arm guards protecting against cuts and stabs by hand knives - Part 1: Chain mail gloves and arm guards	
EN 1082-2:2000	Protective clothing - Gloves and arm guards protecting against cuts and stabs by hand knives - Part 2: Gloves and arm guards made of material other than chain mail	
EN 1082-3:2000	Protective clothing - Gloves and arm guards protecting against cuts and stabs by hand knives - Part 3: Impact cut test for fabric, leather and other materials	
EN ISO 13995:2000	Protective clothing - Mechanical properties - Test method for the determination of the resistance to puncture and dynamic tearing of materials (ISO 13995:2000)	
EN ISO 13997:1999	Protective clothing - Mechanical properties - Determination of resistance to cutting by sharp objects (ISO 13997:1999)	
EN ISO 13997: 1999/ AC:2000	Corrigendum to EN ISO 13997:1999	
EN ISO 13998:2003	Protective clothing - Aprons, trousers and vests protecting against cuts and stabs by hand knives (ISO 13998:2003)	EN 412:1993
EN 14328:2005	Protective clothing - Gloves and armguards protecting against cuts by powered knives - Requirements and test methods	
EN 14404:2004	Personal protective equipment - Knee protectors for work in the kneeling position	
EN ISO 14877:2002	Protective clothing for abrasive blasting operations using granular abrasives (ISO 14877:2002)	EN ISO 14877:1997
WG 6	**Lifejackets**	
Standard	**Title**	**replaces**

EN 393:1993	Lifejackets and personal buoyancy aids - Buoyancy aids – 50 N	
EN 393:1993/ A1:1998	Lifejackets and personal buoyancy aids - Buoyancy aids – 50 N; Amendment	
EN 393:1993/ AC:1995	Corrigendum to EN 393:1993	
EN 394:1993	Lifejackets and personal buoyancy aids - Additional items	
EN 395:1993	Lifejackets and personal buoyancy aids - Lifejackets – 100 N	
EN 395:1993/ A1:1998	Lifejackets and personal buoyancy aids - Lifejackets – 100 N; Amendment	
EN 395:1993/ AC:1995	Corrigendum to EN 395:1993	
EN 396:1993	Lifejackets and personal buoyancy aids - Lifejackets – 150 N	
EN 396:1993/ A1:1998	Lifejackets and personal buoyancy aids - Lifejackets – 150 N; Amendment	
EN 396:1993/ AC:1995	Corrigendum to EN 396:1993	
EN 399:1993	Lifejackets and personal buoyancy aids; lifejackets; 275 N	
EN 399:1993/ A1:1998	Lifejackets and personal buoyancy aids; lifejackets; 275 N; Amendment	
EN 399:1993/ AC:1995	Corrigendum to EN 399:1993	

WG 7	**Visibility clothing and accessories**	
Standard	**Title**	**replaces**
EN 471:2003	High-visibility warning clothing for professional use - Test methods and requirements	EN 471:1994

WG 8	**Protective gloves**	
Standard	**Title**	**replaces**
EN 374-1:2003	Protective gloves against chemicals and micro-organisms - Part 1: Terminology and performance requirements	EN 374-1:1994
EN 374-2:2003	Protective gloves against chemicals and micro-organisms - Part 2: Determination of resistance to penetration	EN 374-2:1994
EN 374-3:2003	Protective gloves against chemicals and micro-organisms - Part 3: Determination of resistance to permeation by chemicals	EN 374-3:1994
EN 388:2003	Protective gloves against mechanical risks	EN 388:1994

EN 407:2004	Protective gloves against thermal risks (heat and/or fire)	EN 407:1994
EN 420:2003	Protective gloves - General requirements and test methods	EN 420:1994
EN 421:1994	Protective gloves against ionizing radiation and radioactive contamination	
EN 511:2006	Protective gloves against cold	
EN 659:2003	Protective gloves for firefighters	EN 659:1996
EN ISO 10819:1996	Mechanical vibration and shock - Hand-arm vibration - Method for the measurement and evaluation of the vibration transmissibility of gloves at the palm of the hand (ISO 10819:1996)	
EN 12477:2001	Protective gloves for welders	
EN 12477:2001/ A1:2005	Protective gloves for welders; Amendment	

WG 12 Diving suits		
Standard	**Title**	**replaces**
EN 1809:1997	Diving accessories - Buoyancy compensators - Functional and safety requirements, test methods	
EN 12628:1999	Diving accessories - Combined buoyancy and rescue devices - Functional and safety requirements, test methods	
EN 12628:1999/ AC:2000	Corrigendum to EN 12628:1998	
EN 14225-1:2005	Diving suits - Part 1: Wet suits - Requirements and test methods	
EN 14225-2:2005	Diving suits - Part 2: Dry suits - Requirements and test methods	
EN 14225-3:2005	Diving suits - Part 3: Actively heated or cooled suits (systems) - Requirements and test methods	
EN 14225-4:2005	Diving suits - Part 4: One atmosphere suits (ADS) - Human factors requirements and test methods	

b) draft European standards

WG 1	General requirements for protective clothing
Standard	**Title**
prEN 1149-1:2005	Protective clothing - Electrostatic properties - Part 1: Test method for measurement of surface resistivity
prEN 1149-5:2005	Protective clothing - Electrostatic properties - Part 5: Performance requirements

WG 2	Resistance to heat and fire of protective clothing
Standard	**Title**
prEN 1486: 2004	Protective clothing for fire-fighters - Test methods and requirements for reflective clothing for specialized fire-fighting
prEN ISO 9150: 2005	Protective clothing - Determination of protective behaviour of materials when exposed to intense heat representative of welding and allied processes (ISO/DIS 9150:2005)
prEN ISO 9185: 2005	Protective clothing - Assessment of resistance of materials to molten metal splash (ISO/DIS 9185:2005)
prEN ISO 11611: 2003	Protective clothing for use in welding and allied processes (ISO/DIS 11611:2003)
prEN ISO 11612: 2001	Protective clothing - Clothing to protect against heat and flame (ISO/DIS 11612:2001)
prEN ISO 13506: 2004	Protective clothing against heat and flame - Test method for complete garments - Prediction of burn injury using an instrumented manikin (ISO/DIS 13506:2004)
prEN ISO 14116: 2002	Protective clothing - Protection against heat and flame - Limited flame spread materials, material assemblies and clothing (ISO/DIS 14116:2002)
prEN ISO 15384: 2000	Protective clothing - Clothing to protect against heat and flame (ISO/DIS 15384:2000)

WG 3 Protective clothing against chemicals, infective agents and radioactive contamination	
Standard	**Title**
prEN 14786:2005	Protective clothing - Determination of resistance to penetration by sprayed liquid chemicals, emulsions and dispersions - Atomizer test
prEN ISO 17491-3:2006	Protective clothing - Test methods for clothing providing protection against chemicals - Part 3: Determination of resistance to penetration by a jet of liquid (jet test) (ISO/DIS 17491-3:2006)
prEN ISO 17491-4:2006	Protective clothing - Test methods for clothing providing protection against chemicals - Part 4: Determination of resistance to penetration by a spray of liquid (spray test) (ISO/DIS 17491-4:2006)

WG 4	Protective clothing against foul weather, wind and cold
Standard	**Title**
EN 343:2003/prA1:2005	Protective clothing - Protection against rain

WG 6	Lifejackets
Standard	**Title**
prEN ISO 12402-2:2006	Personal flotation devices - Part 2: Lifejackets, performance level 275 - Safety requirements (ISO/FDIS 12402-2:2006)
prEN ISO 12402-3:2006	Personal flotation devices - Part 3: Lifejackets, performance level 150 - Safety requirements (ISO/FDIS 12402-3:2006)
prEN ISO 12402-4:2006	Personal flotation devices - Part 4: Lifejackets, performance level 100 - Safety requirements (ISO/FDIS 12402-4:2006)
prEN ISO 12402-5:2006	Personal flotation devices - Part 5: Buoyancy aids (level 50) - Safety requirements (ISO/FDIS 12402-5:2006)
prEN ISO 12402-6:2004	Personal flotation devices - Part 6: Special purpose lifejackets and buoyancy aids; Safety requirements and additional test methods (ISO/DIS 12402-6:2004)
prEN ISO 12402-7:2004	Personal flotation devices - Part 7: Materials and components; Safety requirements and test methods (ISO/DIS 12402-7:2004)
prEN ISO 12402-8:2006	Personal flotation devices - Part 8: Accessories - Safety requirements and test methods (ISO/DIS 12402-8:2006)
prEN ISO 12402-9:2006	Personal flotation devices - Part 9: Test methods (ISO/FDIS 12402-9:2006)
prEN ISO 12402-10:2006	Personal flotation devices - Part 10: Selection and application of personal flotation devices and other relevant devices (ISO/DIS 12402-10:2006)

WG 7	Visibility clothing and accessories
Standard	**Title**
EN 471:2003/prA1:2005	High-visibility warning clothing for professional use - Test methods and requirements

WG 8	Protective gloves
Standard	**Title**
EN 659:2003/prA1:2005	Protective gloves for firefighters

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[9] BGR 193: Benutzung von Kopfschutz (Use of head protectors); 01/2006

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