
**Guidance for the selection, use and
maintenance of safety, protective
and occupational footwear**

*Lignes directrices pour la sélection, l'utilisation et l'entretien des
chaussures de protection d'usage professionnel*

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Foreword

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

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

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

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is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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ISO/TR 18690 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 3, *Foot protection*.

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Guidance for the selection, use and maintenance of safety, protective and occupational footwear

1 Scope

This Technical Report provides guidance for selection, use and maintenance of safety, protective and occupational footwear for professional use. It is designed for footwear manufacturers, suppliers, employers and self-employed people, safety engineers and users. This Technical Report also provides guidance for preparing national guidance in this area.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20345:2004, *Personal protective equipment — Safety footwear*

ISO 20346:2004, *Personal protective equipment — Protective footwear*

ISO 20347:2004, *Personal protective equipment — Occupational footwear*

3 Terms and definitions

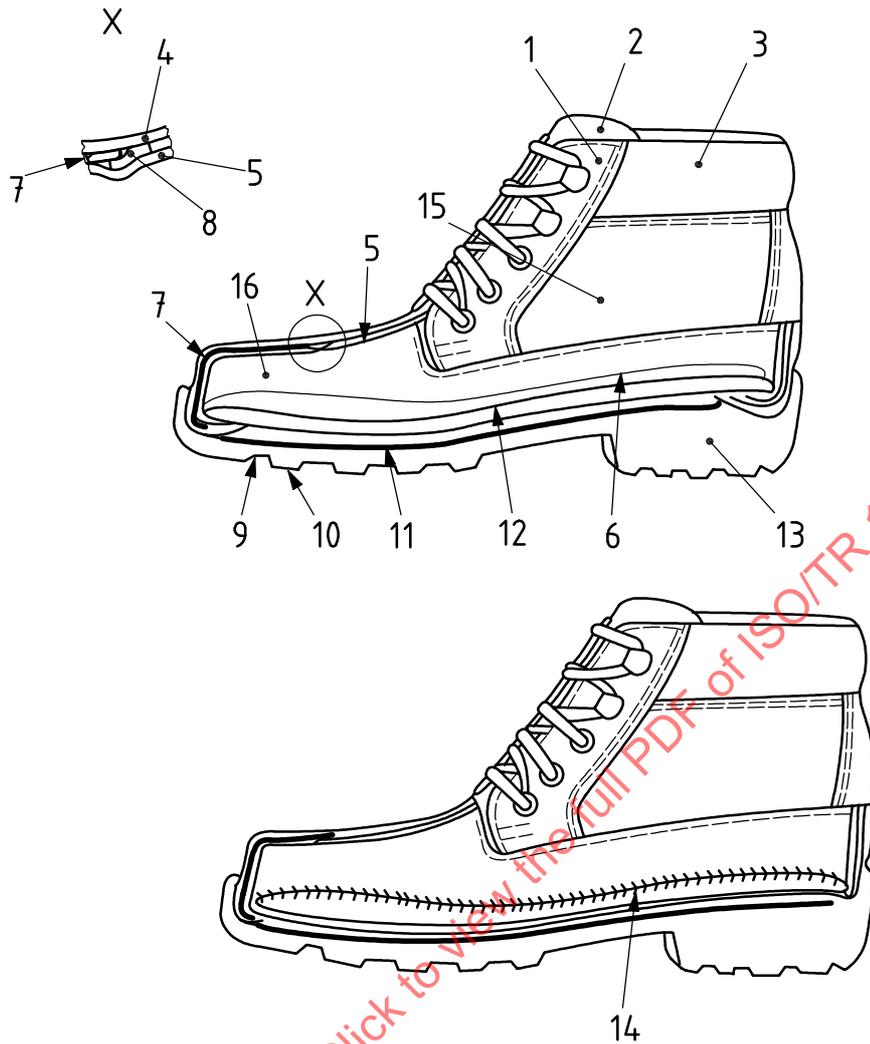
For the purposes of this document, the terms and definitions given in ISO 20345, ISO 20346 and ISO 20347 apply.

4 Design, construction and classification

Construction of safety, protective and occupational footwear is exemplified in Figure 1. Design and classification have been defined in ISO 20345, ISO 20346 and ISO 20347. Classification is presented in Table 1. Designs of footwear are illustrated in Figure 2. Protective elements should be incorporated in the footwear in such a way that they cannot be removed without damaging it.

Table 1 — Classification of footwear

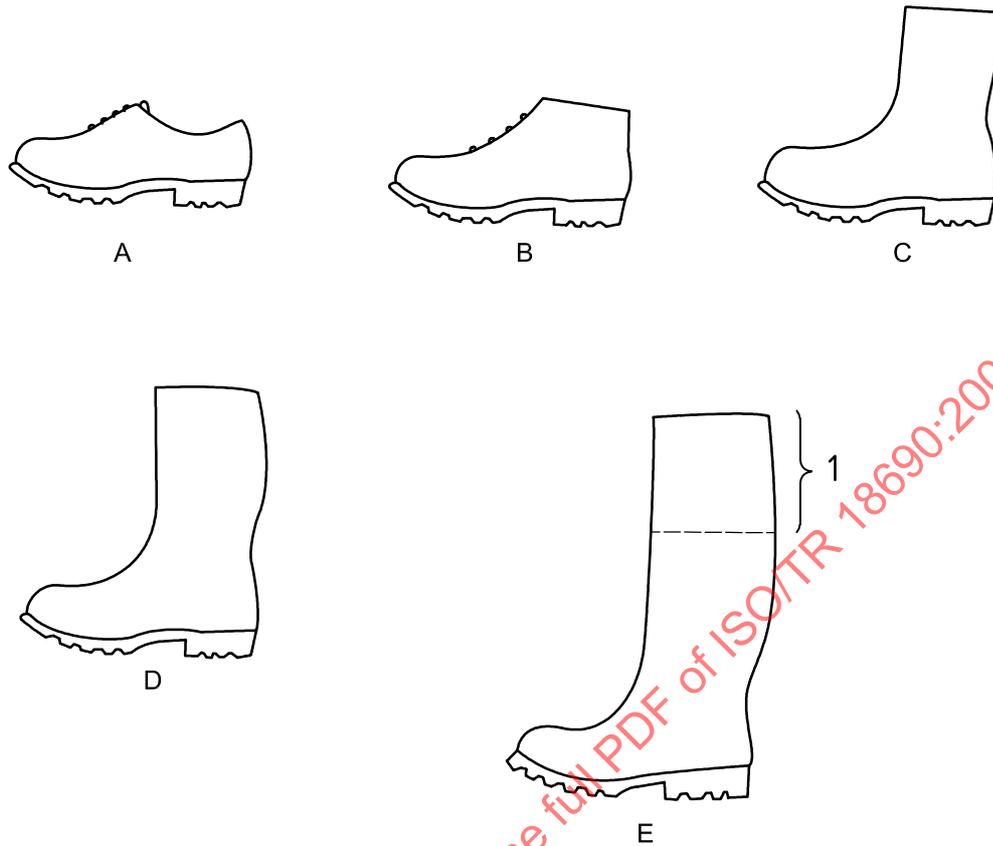
| Code designation | Classification |
|------------------|--|
| I | Footwear made from leather and other materials, excluding all-rubber or all-polymeric footwear |
| II | All-rubber (i.e. entirely vulcanized) or all-polymeric (i.e. entirely moulded) footwear |



Key

- | | |
|---------------|---------------------------------|
| 1 facing | 9 outsole |
| 2 tongue | 10 cleat |
| 3 collar | 11 penetration-resistant insert |
| 4 upper | 12 insole |
| 5 vamp lining | 13 heel |
| 6 insock | 14 Strobel stitching |
| 7 toe puff | 15 quarter |
| 8 foam strip | 16 vamp |

Figure 1 — Example of construction of safety, protective and occupational footwear

**Key**

Type A low shoe
 Type B ankle boot
 Type C half-knee boot

Type D knee-height boot
 Type E high boot
 1 variable extension which can be adapted to the wearer

Figure 2 — Designs of footwear

5 Marking of categories

5.1 Safety footwear for professional use

5.1.1 Basic requirements

Safety footwear is fitted with safety toecaps and complies with the basic requirements given in Table 2 of ISO 20345:2004. It can incorporate one or more additional protective features to protect the wearer from injuries that could arise through accidents in the working sectors for which the footwear is designed. Safety toecaps meet the requirements of impact resistance at an energy level of 200 J and the requirements of compression resistance at a compression load of 15 kN.

Marking symbol for basic requirements is SB.

5.1.2 Additional requirements

Additional protective features are presented in Table 2.

Table 2 — Additional symbols for safety, protective and occupational footwear

| Requirement | Symbol in footwear |
|--|--------------------|
| Penetration resistance | P |
| Electrical resistance | No symbol |
| Conductive footwear | C |
| Antistatic footwear | A |
| Resistance to inimical environments | No symbol |
| Insulation against heat | HI |
| Insulation against cold | CI |
| Energy absorption of seat region | E |
| Resistance to water (footwear of Classification I) | WR |
| Metatarsal protection | M |
| Ankle protection | AN |
| Water penetration and water absorption of upper (footwear of Classification I) | WRU |
| Cut resistance | CR |
| Cleated outsole | No symbol |
| Resistant to hot contact of outsole | HRO |
| Resistance to fuel oil of outsole (occupational footwear) | FO |

5.1.3 Marking of categories of safety footwear

Tables 3 and 4 categorize safety footwear with the most widely used combinations of basic and additional requirements.

Table 3 — Classification I (footwear made from leather)

| Category | Additional requirements |
|----------|---|
| SB | |
| S1 | Closed seat region Antistatic footwear Energy absorption of seat region |
| S2 | As S1 plus Water penetration and water absorption |
| S3 | As S2 plus Penetration resistance Cleated outsole |

Table 4 — Classification II (all-rubber or all-polymeric footwear)

| Category | Additional requirements |
|----------|---|
| SB | |
| S4 | Antistatic footwear Energy absorption of seat region |
| S5 | As S4 plus Penetration resistance Cleated outsole |

5.2 Protective footwear for professional use

5.2.1 Basic requirements

Protective footwear is fitted with protective toecaps and complies with the basic requirements given in Table 2 of ISO 20346:2004. It can incorporate additional protective features to protect the wearer from injuries that could arise through accidents in the working sectors for which the footwear is designed. Protective footwear meets the requirements of impact resistance at an energy level of 100 J and the requirements of compression resistance at a compression load of 10 kN.

Marking symbol for basic requirements is PB.

5.2.2 Additional requirements

Additional protective features are presented in Table 2.

5.2.3 Marking of categories of protective footwear

Tables 5 and 6 categorize protective footwear with the most widely used combinations of basic and additional requirements.

Table 5 — Classification I (footwear made from leather)

| Category | Additional requirements |
|----------|---|
| PB | |
| P1 | Closed seat region Antistatic footwear Energy absorption of seat region |
| P2 | As P1 plus Water penetration and water absorption |
| P3 | As P2 plus Penetration resistance Cleated outsole |

Table 6 — Classification II (all-rubber or all-polymeric footwear)

| Category | Additional requirements |
|----------|---|
| PB | |
| P4 | Antistatic footwear Energy absorption of seat region |
| P5 | As P4 plus Penetration resistance Cleated outsole |

5.3 Occupational footwear for professional use

5.3.1 Basic requirements

Occupational footwear complies with the basic requirements given in Table 2 of ISO 20347:2004 and it should incorporate one or more protective features to protect the wearer from injuries that could arise through accidents in the working sectors for which the footwear is designed. The additional protective requirements are presented in Table 2.

NOTE Occupational footwear is not fitted with safety or protective toecaps.

5.3.2 Marking of categories of occupational footwear

Tables 7 and 8 categorize protective footwear with the most widely used combinations of basic and additional requirements.

Table 7 — Classification I (footwear made from leather)

| Category | Additional requirements |
|----------|---|
| OB | Plus one or more of the following from Table 2: P, C, A, I, HI, CI, E, WR, AN |
| O1 | Closed seat region Antistatic footwear Energy absorption of seat region |
| O2 | As O1 plus Water penetration and water absorption |
| O3 | As O2 plus Penetration resistance Cleated outsole |

Table 8 — Classification II (all-rubber or all-polymeric footwear)

| Category | Additional requirements |
|----------|---|
| OB | Plus one or more of the following from Table 2: P, C, A, I, HI, CI, E, AN |
| O4 | Antistatic footwear Energy absorption of seat region |
| O5 | As O4 plus Penetration resistance Cleated outsole |

5.4 Other markings

All safety, protective and occupational footwear should be marked with:

- a) size;
- b) manufacturer's identification mark;
- c) manufacturer's type designation;
- d) year of manufacture and at least quarter;
- e) number of the International Standard, e.g. ISO 20345:2004;
- f) symbol(s) from Table 2 appropriate to the protection provided or, where applicable, the appropriate category.

The markings for e) and f) should be adjacent to one another.

6 Selection of professional footwear

6.1 Risk assessment

6.1.1 General

Employers and self-employed people should assess the risks from their work activities. If risks cannot be eliminated by other methods, personal protective equipment should be used. It is important to select a correct type of professional footwear in respect of the risk. A need of protection in the work place determines the type of footwear to be chosen.

Prior to the selection and use of professional footwear or leg protector the employer should assess the working conditions, which especially include type and extent of the hazards, duration of the hazard and personal requisites of the wearer.

6.1.2 Aid for risk assessment

The use of every footwear and leg protection should depend on the type of expected hazard (see Table 9). Although the types of hazard are known it cannot be predicted when they actually occur.

Prior to selection and use the employer should perform an assessment of the footwear and leg protection he/she has in mind to determine whether they:

- a) are type-examined (labelled with the appropriate symbol and other markings);

- b) offer protection against the hazards to be averted without inherently presenting a greater hazard;
- c) are suitable for the relevant workplace conditions;
- d) fulfil the ergonomic requirements and the health requisite of the wearer;
- e) can be adapted to the individual wearer.

The employer should ensure that every wearer is provided with his/her personal footwear or leg protection for his/her personal use.

Table 9 — Examples of risk assessment

| Risk factor of the working environment (expected hazard) | Occurrence of the risk | | | | Degree of risk and exposure time (h/day) | Protective feature of the footwear |
|--|------------------------|------|--------------------|-------|---|--|
| | None | Rare | Every now and then | Often | | |
| Mechanical hazards — falling objects — compression | | | | | | — toecap — metatarsal protection — ankle protection |
| — sharp objects | | | | | | — penetration resistance |
| — cut sharp objects chain saw | | | | | | — cut resistance — resistance to chain saw cutting |
| — vibration or shock (long-term walking and standing) | | | | | | — energy absorption of seat region |
| — slipperiness | | | | | | — cleated outsole — slip resistance (coefficient of friction) |
| Electrical hazards — electrical work (electric shock, electric arc) | | | | | | — electrical insulation |
| — induced electricity (handling fuels or flammable chemicals) | | | | | | — antistatic footwear |
| — handling explosives | | | | | | — conductive footwear |
| Heat — environment — hot surfaces | | | | | | — heat insulation — heat resistance of outsole |
| — flame heat | | | | | | — flame resistance — insulation against heat — resistance to hot contact — resistance to radiant heat |

Table 9 (Continued)

| Risk factor of the working environment (expected hazard) | Occurrence of the risk | | | | Degree of risk and exposure time (h/day) | Protective feature of the footwear |
|---|------------------------|------|--------------------|-------|---|--|
| | None | Rare | Every now and then | Often | | |
| Cold — environment — cold surfaces | | | | | | — cold insulation |
| Moist or wet conditions — drops — splashes | | | | | | — water penetration and water absorption of upper — water resistance |
| Chemical or microbiological hazards | | | | | | description of chemicals used: — trade name — chemical formula — report of safe usage |
| — oil | | | | | | — resistance to fuel oil |
| — chemicals | | | | | | — resistance to chemicals — impermeability — leakproofness |
| — microorganisms — bacteria, viruses | | | | | | — impermeability — resistance to sterilization — leakproofness |

6.2 Ergonomic features

6.2.1 General

While selecting professional footwear, an optimal protection in respect of ergonomic features should be taken into account. The risk assessment should include this estimation. Over-protection should be avoided. Ergonomic features of the footwear are e.g. mass, rigidity of soling, water-vapour permeability, water resistance, energy absorption of seat region, slip resistance.

6.2.2 Wearing comfort

Wearing comfort depends to a considerable extent on the individual adaptation of the shoe to the foot and for this reason the shoe that fits should be chosen. Among others, the following influencing factors should be taken into consideration.

- the used lasts can differ from manufacturer to manufacturer but also within a collection of a manufacturer;
- if pressure is exerted on the foot by the toecaps, this can frequently be easily remedied by changing to a different shoe model;
- the padded collar with integrated ankle protection helps to avoid pressure points in the leg and ankle areas;
- padding of the tongue helps to avoid pressure points on the upper part of the foot;
- antimicrobial provision helps to avoid athlete's foot developing due to foot perspiration;

- f) air-conditioning membrane is especially important for shoes with high uppers. It optimizes the water-vapour diffusion and thereby reduces the formation of perspiration in the shoe;
- g) consistent foot hygiene, which includes a daily change of socks and, if possible, a daily change of shoes if the wearer suffers from increased foot perspiration;
- h) classification I footwear adapts to the user's feet. Nobody should wear Classification I or II footwear already used by other people.

NOTE See Annex B of prEN 15090 regarding firefighters' footwear.

7 Use of professional footwear

7.1 Mechanical hazards

7.1.1 Protection against impact and compression of the toes

Safety or protective footwear (Classification I or II) should be used. Protective features are given in Table 10.

Table 10 — Protection against impact and compression

| Protection and marking | Examples of intended use |
|--------------------------------------|--|
| Toecaps (SB, S1 to S5, PB, P1 to P5) | In general when there is a risk of falling objects on the feet. Only if the risk is small is it advisable to use PB, P1 to P5 Examples: Falling objects, construction industry, metal industry, agricultural work |
| Metatarsal protection (M) | To protect a more extended foot area than the toecap alone. Example: Mining, working with stones |
| Ankle protection (AN) | Mining, working with stones |

The symbols from Table 2 can be added to this marking, provided that the properties incorporated in the footwear are not included in the categories.

7.1.2 Protection against cut, penetration and sharp objects

Footwear of Classification I or II can be used. Protective features are given in Table 11.

Table 11 — Protection against cut, penetration and sharp objects

| Protection | Safety footwear | Protective footwear | Occupational footwear | Examples of intended use |
|----------------------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------------|
| Toecaps | Yes (SB, S1 to S5) | Yes (PB, P1to P5) | No | Construction industry, sharp objects |
| Penetration resistance (P) | Yes (SB+P, S1+P, S3, S5) | Yes (PB+P, P1+P, P3, P5) | Yes (OB+P, O1+P, O3, O5) | Construction industry, nails |
| Cut resistance (CR) | Yes | Yes | No | Sharp objects |

7.1.3 Protection against shock or vibration

Safety, protective or occupational footwear (Classification I or II) can be used depending on other needs of protection. Energy absorption of seat region (E) provides a limited protection against shocks (like falls from ladders) and vibration.

Examples of intended use include long-term walking and standing, and vibration.

7.1.4 Slip resistance

Slip resistance is an essential safety feature for all footwear (Classification I or II). The standard for determining slip resistance is EN 13287. Professional footwear should be slip-resistant especially when walking on surfaces contaminated by e.g. oil, detergent or water. Cleated outsoles can decrease falling outdoors on rough surfaces. Footwear for outdoor use in cold environment (snow, ice) should be slip-resistant on icy surfaces. Falling on icy surfaces can be prevented by using anti-slip devices, e.g. crampons or spikes. Although slip-resistant footwear cannot completely prevent slipping, it can reduce the risk of falling.

7.2 Chemical and microbiological hazards

It is recommended to use chemical resistant footwear when working with chemicals or materials that can cause microbiological hazards. Chemical-resistant footwear does not provide a protection against all chemicals. Instructions of the manufacturer should be followed. Footwear should be selected in accordance with the chemical group against which the footwear, has been tested. Footwear for microbiological hazards should be liquid- and gas-tight.

Outsoles of safety and protective footwear are resistant to fuel oil (FO) in accordance with the basic requirements. For occupational footwear, FO is an optional requirement.

Safety, protective or occupational footwear can be chemical resistant.

When working with flammable chemicals, it is recommended to wear antistatic footwear.

NOTE This clause should be adapted to the EN 13832 series of standards when approved.

7.3 Electrical hazards

7.3.1 Conductive footwear

Conductive footwear (symbol C in Table 2) should be used if it is necessary to minimize electrostatic build-up by dissipating electrostatic charges in the shortest possible time in order to minimize the risk of igniting flammable vapours (or dusts) when working in a potentially explosive atmosphere.

A risk of electric shock should be completely eliminated.

Safety, protective or occupational footwear (Classification I or II) can be conductive.

Removable inserts or insoles can decrease electrical conductivity. The wearer should always check the conductivity before entering a working area.

If the soling material becomes contaminated, electrical resistance can increase and minimize the conductivity of the footwear. The resistance of the flooring should not eliminate the protection provided by the footwear.

7.3.2 Antistatic footwear

Antistatic footwear (symbol A in Table 2) should be used if it is necessary to minimize electrostatic build-up by dissipating electrostatic charges thus avoiding the risk of spark ignition, and if a risk of electric shock has not been completely eliminated. This footwear can also be used to increase the user's comfort and to avoid nuisance to other people or harming equipment.

NOTE 1 Antistatic footwear cannot guarantee adequate protection against electric shock because it is not completely insulating.

Safety, protective or occupational footwear (Classification I or II) can be antistatic.

Removable inserts or insoles can decrease electrical conductivity. The wearer should always check the conductivity before entering a working area.

If the soling material becomes contaminated, the electrical resistance can increase and minimize the conductivity of the footwear. The resistance of flooring should not eliminate the protection provided by the footwear.

Examples of intended use include handling fuels or flammable chemicals.

NOTE 2 ESD (electrostatic discharge) footwear can be antistatic footwear, but it is tested according to different standards (e.g. EN 61340-4-3). The electrical resistance in this case is the summation of the resistance of all parts of the conductive chain from fingertip to floor. Footwear being worn for the primary purpose of protecting products such as sensitive electronic devices would not be considered as personal protective equipment and would not fall within the scope of the European PPE Directive.

7.3.3 Insulating footwear for electrical work

Insulating footwear eliminates electric shock up to a certain voltage. Charts are available that show the probability of fibrillation of the heart with respect to magnitude of the electric current and the time for which it is present. As electric current is directly related to voltage, footwear with a very high electrical resistance is required to protect the wearer when there is the possibility of a large potential difference (voltage) between e.g. the wearer's hand and the ground that he/she is standing on.

Safety, protective or occupational footwear (Classification I or II) can be insulating.

NOTE Insulating footwear cannot solely guarantee complete protection against electric shock.

Examples of intended use include electrical installations and electrochemical work.

This footwear is specified in EN 50321:1999, which has two classes:

- class 00, to be used in installations where the nominal voltage is not higher than 500 V a.c. or 750 V d.c.;
- class 0, to be used in installations where the nominal voltage is not higher than 1 000 V a.c. or 1 500 V d.c.

The marking, added to the symbols from ISO 20345 should be:

- double triangle;
- when colours are used, it should be light brown for "00" and red for "0";
- class.

7.4 Risks of inimical environment (hot and cold)

Safety, protective or occupational footwear (Classification I or II) can incorporate heat or cold insulation. Protective features are given in Table 12.

It is also recommended to improve cold insulation with insulating insoles and socks. Footwear incorporating insulation against cold cannot provide adequate protection in ultimate cold conditions. While working in very cold environments, e.g. in freezing rooms, additional protection is necessary.

Table 12 — Protection against hot and cold conditions

| Protection | Examples of intended use |
|--------------------------------------|---|
| Heat insulation of sole complex (HI) | Foundries, road works |
| Heat resistance of outsole (HRO) | Foundries, welding |
| Cold insulation of sole complex (CI) | Outdoor work in cold weather, food industry |

7.5 Dry and warm conditions

In dry and warm conditions, it is recommended to wear footwear of categories SB, S1, PB, P1, OB, O1 or clogs. The water vapour permeability of the upper should be as high as possible.

Examples of intended use include work in office and electronic goods manufacture.

7.6 Wet conditions

In wet conditions, it is recommended to wear all-rubber or all-polymerized footwear or alternatively leather footwear that fulfils the requirement of water penetration and water absorption of upper (WRU or categories S2, P2, O2 or S3, P3, O3) and possibly water resistance (WR) as an additional requirement.

Examples of intended use include outdoor work, building, agricultural work and work in food industry.

7.7 Job-related footwear

7.7.1 Safety footwear with resistance to chain-saw cutting

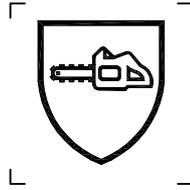
This footwear incorporates protection against cutting by hand-held chain saws, according to ISO 17249. It is recommended always to wear this footwear when handling a chain saw (forestry work, construction industry, etc.). The footwear is marked with an additional pictogram representing a chain saw and a level of protection (Figure 3).

Four levels of protection correspond to the test chain speeds in Table 13.

It is important to know that the level of protection marked next to the pictogram refers to the speed used in the test under the test conditions. It does not mean that the user will be protected at that speed under in-use conditions.

Table 13 — Test chain speeds

| Level of protection | Test chain speed m/s |
|---------------------|-------------------------|
| 1 | 20 |
| 2 | 24 |
| 3 | 28 |
| 4 | 32 |



X = level of protection

Figure 3 — Pictogram [ISO 7000-2416] indicating safety footwear with resistance to chain-saw cutting

7.7.2 Safety footwear with resistance to fire-fighting hazards

Footwear for firefighters should meet the requirements of safety footwear and be resistant against flame and heat and should have water protection. The footwear is marked, according to prEN 15090 with an additional pictogram (Figure 4).

On the lower right corner it should be marked as follows.

- **F** For flame, heat and water protection.
- **FP** When there is also an anti-perforation insert.
- **FA** When the footwear is antistatic.
- **FPA** When the footwear is antistatic and has an antiperforation insert.



Figure 4 — Pictogram [ISO 7000-2418] indicating safety footwear for fire-fighters

7.7.3 Footwear for work with hand-held spray devices (liquid-dispensing jets)

Liquid-dispensing jets such as hand-held spray devices (lances) with pressures of more than 25 MPa [250 bar ¹⁾] are used for cleaning and de-rusting containers, rooms and surfaces.

In practice, such devices are operating with pressures between 80 MPa (800 bar) and 250 MPa (2 500 bar). This involves an increased hazard of foot injuries if the high-pressure jet is inadvertently guided over a foot.

If it is necessary to use hand-held spray devices, the length of the lance should be, if possible, more than 75 mm to exclude contact with a foot. If shorter lances have to be used for reasons caused by the technical nature of the work (confined spaces, narrow scaffolding), it is necessary to wear safety footwear with additional protection in the upper foot area.

1) 1 bar = 10⁵N/m² = 0,1 MPa.

It can also be possible to achieve the same protection with an appropriate overshoe worn over a normal safety shoe.

7.8 Special types of footwear

7.8.1 Footwear for loose insoles

Shoes for loose insoles are for people who have to wear orthopaedic insoles and can, therefore, not manage with normal safety or protective footwear but whose condition is not sufficiently severe as to warrant the use of orthopaedic footwear. Several shoe manufacturers already offer shoes where the insole is not shaped and which have a raised rear cap to compensate for the thickness of the loose insole.

Electrical conductivity can possibly be impaired when loose shoe insoles are worn. For this reason, the combination of the shoe and the loose insole should be tested for its electrical properties.

7.8.2 Orthopaedic footwear

In the case of orthopaedic footwear, a differentiation should be made whether they are

- new shoes made by an orthopaedic master shoemaker; or
- industrially made shoes which were orthopaedically modified (finished).

If orthopaedic footwear is worn in areas which require the use of safety footwear, the orthopaedic footwear should also be made as safety footwear, i.e. they should comply with ISO 20345.

Since orthopaedic safety footwear is made as individual, single-piece units and therefore no type is available for the original, the procedure is defined by which the requirement for a type examination is fulfilled.

A similar procedure is to be followed for orthopaedic protective and occupational footwear.

8 Maintenance of professional footwear

8.1 Tests

Prior to use the wearer should inspect the foot and leg guards for visible defects. It should not be permitted to continue wearing worn-out or damaged footwear and leg protection. The employer should be informed of defects.

The following list and drawings may be provided to the wearer to assess the performance of his/her footwear. Footwear should be replaced when any signs of wear identified in 8.1 a) to g) are found. Some of these criteria can vary according to the type of footwear and materials used:

- a) beginning of pronounced and deep cracking affecting half of the upper material thickness [Figure 5 a)];
- b) severe abrasion of the upper material, especially if the toe puff is revealed [Figure 5 b)];
- c) the upper shows areas with deformations, burns, fusions or bubbles, or split seams in the leg [Figure 5 c)];
- d) the outsole shows cracks greater than 10 mm long and 3 mm deep [Figure 5 d)];
- e) upper/sole separation of more than 10 mm to 15 mm long and 5 mm wide (deep);
- f) cleat height in the flexing area lower than 1,5 mm [Figure 5 e)];