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Safety of machinery – Temperatures of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces

The European Standard EN 563:1994 has the status of a Swedish Standard. This document contains the official English version of EN 563:1994.

Maskinsäkerhet – Temperaturer på beröringsytor – Ergonomiska data för bestämning av temperaturgränser för heta ytor

Europastandarden EN 563:1994 gäller som svensk standard. Detta dokument innehåller den officiella engelska språkversionen av EN 563:1994.

EUROPEAN STANDARD

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English version

Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces

Sécurité des machines — Températures des surfaces tangibles — Données ergonomiques pour la fixation de températures limites des surfaces chaudes

Sicherheit von Maschinen — Temperaturen berührbarer Oberflächen — Ergonomische Daten zur Festlegung von Temperaturgrenzwerten für heisse Oberflächen

This European Standard was approved by CEN on 1994-06-14. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 122, Ergonomics, the secretariat of which is held by DIN.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

This is a type B1-standard in a series of standards for machinery safety. This means that it should be used when determining the requirements in type C-standards in a series. In addition, this standard should be used to contribute to the establishment of design and construction specifications when appropriate C-standards do not exist. Although specifically written for the safety of machinery, this type B1-standard can be used for other appropriate fields of application.

Annexes designated 'normative' are part of the body of the standard. Annexes designated 'informative' are given only for information. In this standard, annex B is normative and annexes A, C, D, E and F are informative.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1994, and conflicting national standards shall be withdrawn at the latest by December 1994.

In accordance with the CEN/CENELEC Internal Regulations, following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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0 Introduction

Accessible surfaces of machinery, which are hot when operated, represent sources of risk of burning. Touching such hot surfaces may take place intentionally, e.g. to operate a handle of the machine, or may take place unintentionally, when a person is near the machine. General directions for the design of safe machinery, taking into consideration measures against hazards, including thermal hazards, are specified in EN 292.

To assess the risk of burn due to a hot surface it is necessary to know those factors and influences which lead to a burn when a hot surface is touched by the skin. The most important factors are:

- the temperature of the surface;
- the material of which the surface consists;
- the period of contact between the skin and the surface.

Other factors may also occur but are of minor importance. In this standard data are specified to assess the risk of burn, when a hot surface is touched by the skin. These data may also be used if it is necessary to set temperature limit values for hot surfaces in other standards or regulations.

The data specified in this standard are based on scientific research and represent, as far as is known, the behaviour of the human skin when in contact with a hot surface.

1 Scope

This standard establishes ergonomics data and their use in establishing temperature limit values for hot surfaces and in the assessment of the risks of burning.

This standard is applicable within the field of application of the EN 292 to hot surfaces of machinery that are or can be touched during normal use.

This standard provides data concerning circumstances under which contact between bare skin and hot surface does or may lead to burns. These data allow the assessment of risks of burning.

This standard also provides data to be used to establish temperature limit values for hot surfaces to protect against skin burns. These data can be used in the development of standards for specific machinery where as a result of a risk assessment temperature limits are required.

The data of this standard are applicable to surfaces of objects with relatively high thermal capacity compared with that of the skin of the human body.

This standard is not applicable if a large area of the skin (approximately 10 % or more of the skin of the whole body) can be in contact with the hot surface. This standard is also not applicable to skin contact of more than 10 % of the head or contact which could result in burns of vital areas of the face.

NOTE 1. In some cases the results of contact with a hot surface may be more serious for the individual, for example:

- a) burns resulting in the restriction of airways;
- b) a large burn (more than 10 % of the body surface) may impair the circulation by fluid loss;
- c) heating of a large proportion of the head or whole body may lead to unacceptable heat strain even in the absence of burning.

This standard is applicable to the healthy skin of adults.

This standard does not provide data for protection against pain.

NOTE 2. If the burn thresholds specified in this standard are not exceeded, there is normally no risk of burning, when the skin comes in contact with the hot surface, but pain may occur nevertheless. If there is also a need for protection against pain, surface temperature values should be taken from suitable other sources (see annex A).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 292 : Part 1 : 1991 *Safety of machinery – Basic concepts, general principles for design – Part 1 : Basic terminology, methodology*

EN 292 : Part 2 : 1991 *Safety of machinery – Basic concepts, general principles for design – Part 2 : Technical principles and specifications*

prEN 614 : Part 1 *Safety of machinery – Ergonomic design principles – Part 1 : Terminology and general principles*

prEN 1050¹⁾ *Safety of machinery – Risk assessment*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 surface temperature (T_s)

The temperature of a surface measured in degrees Celsius.

3.2 contact period (t)

The time during which contact with the surface takes place.

3.3 thermal inertia

The product of the density, thermal conductivity and specific thermal capacity of material.

¹⁾ Draft standard prepared by CEN/TC 114/WG 14.

3.4 material properties of the surface

The chemical/physical composition of the material and the characteristics (rough, smooth) and shape of the surface.

3.5 burn classification

Burns are classified into 3 levels depending on severity:

- a) *superficial partial thickness burn*. In all but the most superficial burns, the epidermis is completely destroyed but the hair follicles and sebaceous glands as well as the sweat glands are spared.
- b) *deep partial thickness burn*. A substantial part of the dermis and all sebaceous glands are destroyed and only the deeper parts of the hair follicles or the sweat glands survive.
- c) *whole thickness burn*. When the full thickness of the skin has been destroyed and there are no surviving epithelial elements.

3.6 burn threshold

The surface temperature defining the boundary between no burn and a superficial partial thickness burn, caused by contact of the skin with a hot surface for a specified contact period.

4 Burn thresholds

4.1 General

This clause provides surface temperature data for burn thresholds. An estimate of the risk of burning is possible by measuring the surface temperature and by comparison with the values specified in 4.2. The burn thresholds specified in 4.2 may also be used for the establishment of surface temperature limit values of machinery for protection against burns.

NOTE. The occurrence of burning depends on the temperature of the skin and on the duration of raised skin temperature. The connection between skin temperature, duration of its influence and occurrence of burning has been scientifically studied and is known (see Annex A). But it is not practicable by simple means to measure the temperature of the skin during its contact with the hot surface of a machine. Therefore in this standard it is not the temperature values of the skin which are specified but the temperature values of hot surfaces of machinery which, when in contact with the skin, lead to burns (the burn thresholds). The temperature of a surface of a machine is simply measurable by appropriate measuring facilities.

The surface temperatures which lead to burns during contact of the skin with a hot surface depend on the material of which the surface consists, and on the duration of the contact of the skin with the surface. This relationship is presented in figure 1. Figure 1 shows this relationship for several groups of materials which have similar heat conductivity properties and therefore similar burn thresholds.

A point on a burn threshold curve indicates, for a particular contact period, that surface temperature which lies between non-injury of the skin and the onset of a superficial partial thickness burn when the skin comes into contact with the hot surface.

Surface temperature values lying below the curve in general do not lead to a burn. Surface temperature values lying above the curve will lead to a burn of the skin (see also annex A).

The illustrative figure 1 only serves to provide better understanding and does not accurately represent the burn threshold data. The exact burn threshold values have to be taken from figures 2 to 6 and table 1.

For short contact periods the burn thresholds are not drawn as lines in the illustrative figure 1 and the detailed figures 2 to 6, but are drawn as spreads. This takes into account the fact that for short contact periods the knowledge of the temperature boundary between non-burning and the onset of burning is not complete. The burn threshold depends on several factors which include: thickness of the skin at the touching point; moisture of the skin's surface (sweating); contamination of the skin (e.g. grease); touching force; differences between the heat conductivity properties of materials which have been combined in one group; uncertainties of the scientific determination of the burn threshold values (see also annex A). However, these influences are considered to be small compared to the influence of the heat conductivity properties of the different material groups.

For longer contact periods the uncertainties are less than for short contact periods. So for long contact periods exact values for burn thresholds are specified. The differences in the values for different groups of materials also disappear for long contact periods.

4.2 Burn threshold data

4.2.1 Burn thresholds for a contact period below 1 s

Reliable data for burns with contact periods below 1 s do not exist. The curves shown in figures 2 to 6 cannot furnish burn thresholds for contact periods below 1 s.

NOTE. The application of the standard for very short contact periods is specified in 5.3.2.

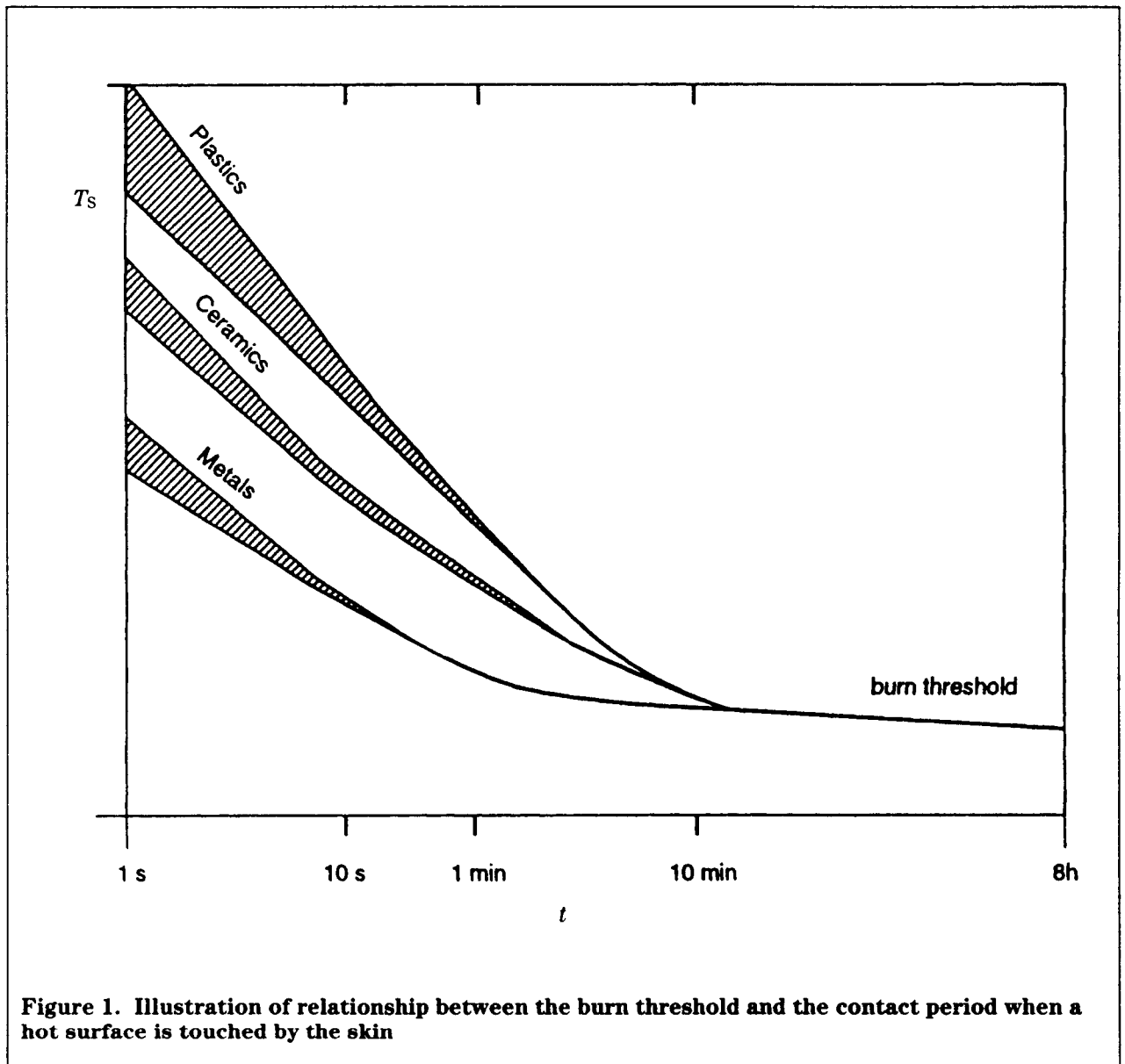
4.2.2 Burn thresholds for contact periods between 1 s and 10 s

4.2.2.1 General

In the case of short contacts (contact periods of 1 s to 10 s), the burn threshold spreads are not set in numbers but are reflected in graphs in dependence upon the contact period. The burn thresholds of materials with similar heat conductivity properties were combined to represent one range.

4.2.2.2 Uncoated metals

The burn thresholds presented in figure 2 are valid for smooth surfaces of uncoated metal. In the case of rough metal surfaces however, the values may lie above those for smooth surfaces but not more than 2 °C beyond the upper limit of the indicated burn threshold spread.



4.2.2.3 Coated metals

The values for the effect of coating a metal are shown in figures 3a and 3b. The values are presented as temperature rise above the burn threshold for uncoated metal. To obtain a burn threshold for coated metal itself, the value for the temperature rise ΔT_s in figure 3a or 3b and the burn threshold for the uncoated metal T_s in figure 2 have to be added.

4.2.2.4 Ceramics, glass and stone materials

The burn threshold spread for ceramics, glass ceramics, glass, porcelain and stone materials (marble, concrete) is shown in figure 4.

The burn thresholds for marble and concrete lie towards the lower limit of the spread. Burn thresholds for glass lie towards the upper limit of the spread.

4.2.2.5 Plastics

The burn threshold spread for plastics (polyamide, acrylglass, polytetrafluorethylene, duroplastic) is indicated in figure 5.

NOTE. Plastics have very different levels of thermal conductivity, depending on the chemical composition. The burn threshold spread for most solid plastics is indicated in figure 5. However, for plastics with heat conductivity properties which differ markedly from those of the materials given in 4.2.2.5, burn thresholds as indicated in figure 5 cannot be used. For these materials burn thresholds have to be calculated, estimated or measured as indicated in annex A.

4.2.2.6 Wood

The burn threshold spread for wood is shown in figure 6.

For soft woods with low moisture content the values at the upper limit of the spread are applicable. For hard woods with high moisture content the values at the lower limit of the spread are relevant.

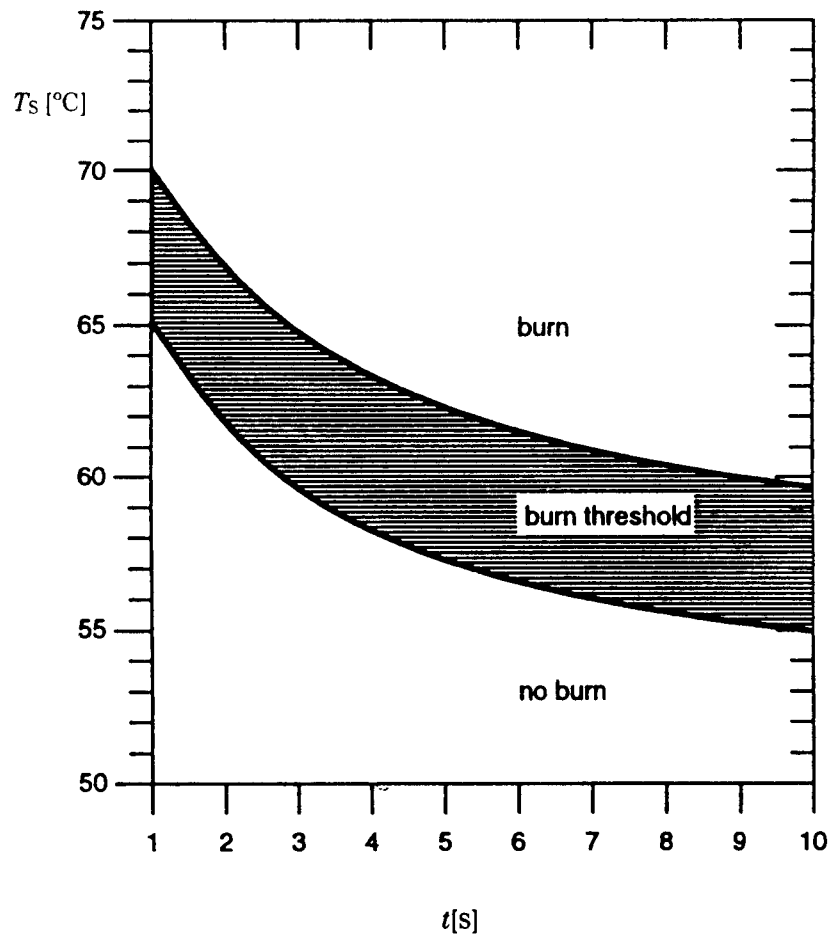


Figure 2. Burn threshold spread when the skin is in contact with a hot smooth surface made of bare (uncoated) metal