



**International  
Standard**

**ISO 8025**

**Ergonomics of the thermal  
environment — Management  
of working conditions in hot  
environments**

*Ergonomie de l'environnement thermique — Gestion des  
conditions de travail dans les environnements chauds*

**First edition  
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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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## Foreword

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

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 5, *Ergonomics of the physical environment*.

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

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## Introduction

This document belongs to a group of thermal standards intended for use in the assessment and management of work in hot environments.

Several outdoor and indoor lines of industries, commerce and occupations involve substantial exposure, where individuals can be exposed to high temperatures, humidity and/or thermal radiation. Working in such hot environments can lead to several adverse effects on human performance and health, such as thermal discomfort, increased strain, decreased performance and heat-related disorders. Heat can also interfere with several other factors in the workplace, modifying or aggravating the risk of common hazards and increasing the risk of heat-associated disorders. In addition, skin contact with hot surfaces can lead to burns.

Due to the negative impact of heat on human health and performance, as well as on work productivity, quality and safety, it is necessary to consider a comprehensive strategy of risk assessment and management practices.

While other standards have described specific indices to be used to assess the hot work environment and the potential physiological consequences, this document describes the methods and practices for organizing the management of these work environments and the supervision of the exposed persons.

The choice of when to use the methods described in this document is at the discretion of the persons responsible for occupational safety and/or health.

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# Ergonomics of the thermal environment — Management of working conditions in hot environments

## 1 Scope

This document adopts an approach where actions, particularly control measures and medical supervision, are specified as a function of the class of severity of the potential effects. It provides instructions for appropriate management practices for hot workplaces and describes:

- a procedure for managing work in hot environments;
- guidelines on how to apply the different International Standards in the field of thermal environments when assessing heat-related risks;
- guidelines to organize the medical supervision of the people working in hot environments;
- information for instructing the persons working in hot environments;
- an example of assessment of a hot working situation.

The procedure described in this document aims to anticipate the problems related to work in warm to hot environments by classifying the different work situations according to their potential health effects, informing the persons concerned (workers and management) of the seriousness of these effects, planning appropriate measures to be implemented to prevent these effects and providing medical surveillance of exposed persons.

This document supports good occupational safety and health practices and is applicable to both indoor and outdoor work situations.

## 2 Normative references

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

ISO 15265:2004, *Ergonomics of the thermal environment — Risk assessment strategy for the prevention of stress or discomfort in thermal working conditions*

## 3 Terms, definitions and symbols

### 3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

### 3.2 Symbols and abbreviated terms

Symbol or abbreviated term	Definition	Units
$D_{lim}$	duration limit of exposure	min
EC	exposure class of a work situation	
$I_{cl}$	static (or basic) clothing thermal insulation	clo
$M$	metabolic rate	W
$p_a$	partial water vapour pressure	kPa
PHS	predicted heat strain	
PMV	predicted mean vote	
PPD	predicted percentage of dissatisfied	%
RH	relative humidity	%
$t_a$	air temperature	°C
$t_g$	globe temperature	°C
TEF	thermal exposure form of a work situation	
$v_a$	air velocity	m·s <sup>-1</sup>
WBGT	wet bulb globe temperature	°C
WBGT <sub>lim</sub>	limit of the WBGT index as a function of metabolic rate	°C

## 4 Classification of the working situations in hot environments

### 4.1 General

The nature and the urgency of the control measures to improve and eliminate a working situation where a heat-related health problem could occur depend upon the severity of this problem. [Table 1](#) defines the six ECs and the classification criteria, according to the PMV value and the  $D_{lim}$  of the thermal condition. As defined in ISO 7933,  $D_{lim}$  is the duration of exposure after which either the total sweating exceeds 3 % of the body weight of the average worker or the core temperature reaches 38 °C.

**Table 1 — Definition of the six ECs for hot working situations**

EC	Definition	Criteria
1	Thermal comfort as defined in ISO 7730 <sup>1)</sup>	$-0,7 < PMV < 0,7$
2	Light thermal discomfort	$0,7 \leq PMV < 1,7$
3	Strong thermal discomfort	$1,7 \leq PMV$ and $D_{lim} \geq 480$ min
4	Thermal constraint in the long term	$120 < D_{lim} < 480$ min
5	Thermal constraint in the short term	$30 < D_{lim} \leq 120$ min
6	Immediate thermal constraint	$D_{lim} \leq 30$ min

This document describes the procedure to identify as soon as possible the EC of a given work environment, select accordingly the optimal control measures to eliminate or minimize the exposure, organize the working situation in consequence and protect adequately the exposed persons.

1) Under preparation. Stage at the time of publication: ISO/DIS 7730:2024.

## 4.2 Risk management system

The heat risk management model shall be fully integrated into the occupational health and safety management system and practices of the organization, to ensure the implementation and continuance of the activities.

NOTE This kind of system can be established according to, for example, ISO 45001, which was prepared to be compatible with ISO 9001 for quality management systems and ISO 14001 for environmental management systems.

## 4.3 Exposure assessment and prevention procedure

### 4.3.1 General

The exposure assessment procedure follows the principles presented in ISO 15265, with the addition of an initial stage for the recognition of the situations where a heat-related health problem could occur. The procedure therefore includes four stages and is illustrated in [Figure 1](#).

- Stage 1, screening: where the working situations that are causing or are likely to lead to heat stress exposures are identified and listed.
- Stage 2, observation: where the working situations identified in stage 1 are reviewed qualitatively to determine the simple and straightforward measures to be implemented to reduce the class of the working situation to EC 1, or at least EC 2.

A decision is made to perform a further analysis if the problem is neither eliminated nor sufficiently reduced, or whenever it is uncertain whether the preventive actions will be or have been sufficient to guarantee the persons' health and safety.

- Stage 3, analysis: where quantitative evaluations are made of the parameters characterizing the working situations and the thermal indices defined in ISO 7730 (PMV and PPD), ISO 7243 (WBGT) and ISO 7933 (PHS) are computed. Additional control or organisational measures are determined and their effects to improve the working situations are evaluated.

It is anticipated that most common problems of work in hot situations can be managed using the methods and procedures in stages 1 to 3. For unusual or peculiar work circumstances, a further expertise stage is conducted (stage 4).

- Stage 4, expertise: will usually deal with highly complex thermal working circumstances and require sophisticated or specific measurements. This stage is conducted by the same persons as stage 3, with the additional assistance of highly specialized experts. The approach and techniques that are required will vary according to the nature of the problem and are within the responsibility of the intervening experts. This stage will therefore not be further discussed in this document.

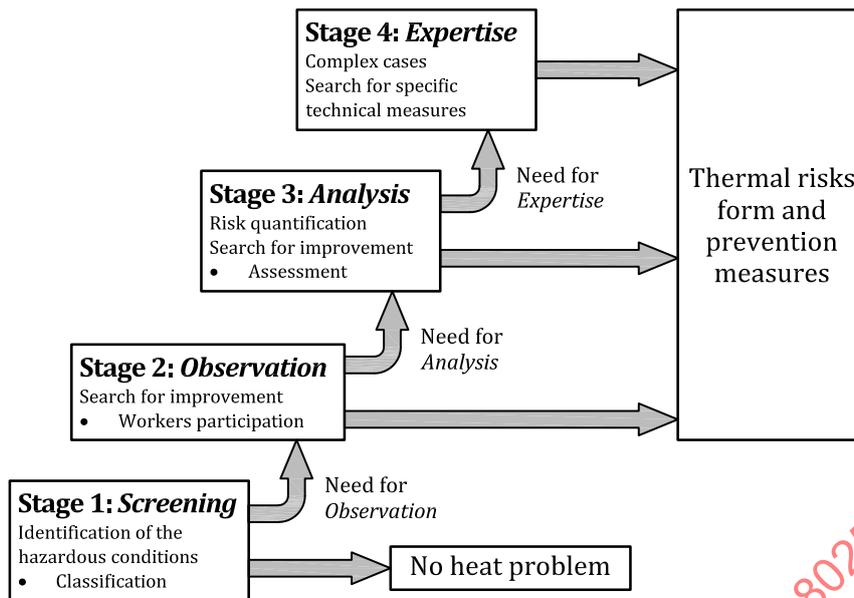


Figure 1 — Model for heat risk assessment in workplaces

#### 4.3.2 Stage 1, screening

The screening datasheet presented in [Annex A](#) can be used to conduct this screening to identify the climatic working situations that need to be assessed, as these can lead to thermal problems for the persons exposed. This stage is performed in anticipation of the problems by a qualified health and safety professional.

The procedure is as follows:

- Consider the work situation as a whole: before using the checklist, review the different exposure circumstances that can exist (e.g. day, night, season, production demands).
- Categorize these work circumstances and choose to study the circumstance(s) that is (are) most thermally problematic.
- Complete the data sheet for each selected work circumstance by checking separately each aspect listed and retaining the options that best match.
- Collect the opinion of the workers involved in the activity.
- Record any information related to each aspect.

At the end of this stage, it is decided:

- whether the working situation is definitely of EC 1 or 2, in which case the procedure comes to an end;
- whether additional information needs to be collected to reach a professional decision, in which case the procedure of evaluation proceeds to stage 2.

This screening data sheet shall be periodically reviewed in one of the following instances:

- at least once a year, preferably before the hot season in the case of seasonal variations;
- when the work activity has changed substantially;
- when the work environment has changed significantly.

### 4.3.3 Stage 2, observation

It is recommended that this observation study be performed by the health and safety professional who prepared the screening datasheet, with the close participation of the people directly exposed to these situations, as they know best all the variants of the work activity and the possibilities of improvement that can be achieved locally.

It consists of examining, for each work situation identified in stage 1, the reasons why the situation deviates from comfort and what can be done about air temperature, humidity, heat radiation, ventilation, workload, clothing and work organization in general to minimize or eliminate any thermal risk.

The procedure at stage 2, observation, shall be in accordance with ISO 15265 as follows:

- Assess the situation for each of the seven parameters separately, using the rating scales described in [Annex B, Table B.1](#).
- Record the general opinion of the workers.
- Identify with them the necessary measures to eliminate or at least reduce risks and determine how and when to implement them.
- Determine, if needed, the short-term measures to be taken, for example drinks, recovery periods, work organization, adaptation of work clothing.
- Assess, based on the scales in [Annex B](#), the expected ratings in the future condition, when the considered prevention measures will be implemented.

If the future condition is predicted to be of EC 1 or 2, then the procedure comes to an end.

If it is not the case or the future class proves difficult to estimate, this indicates the need to carry out an in-depth analysis to identify more precisely the factors on which to act through additional control measures.

[Annex C](#) describes the methods for assessing work metabolism and, in particular by means of [Table C.1](#), makes it possible to easily determine whether the workload is light, moderate, heavy or very heavy.

### 4.3.4 Stage 3, analysis

It is recommended that this analysis be conducted by occupational health and safety professionals qualified concerning the measurements and evaluation of the basic parameters, the use of different standards and the estimation of the risks.

The assessment of the exposure class of a work situation requires an evaluation of:

- the air temperature ( $t_a$ , in °C) by any suitable device whose sensor is protected against radiation;
- its humidity, usually the relative humidity (RH) in %;
- the radiant heat, usually by measuring the temperature of the black globe,  $t_g$ , in °C;
- the air velocity, in m/s, using a hot wire anemometer or equivalent;
- the energy expenditure related to work, i.e. the metabolic rate in watts, estimated or measured using one of the methods at levels 2 to 4 described in ISO 8996 and briefly presented in [Annex C](#);
- the clothing thermal insulation  $I_{cl}$ , in clo, estimated or measured based on ISO 9920.

The measuring instruments fulfil the requirement of ISO 7726 for the measurement of air temperature, air humidity, air velocity and thermal radiation, and of ISO 7243 for the evaluation of the natural wet bulb temperature. They are calibrated according to manufacturer recommendations.

ISO 7726 describes the procedures to be used to evaluate as accurately as possible the exposure of a given person in a given environment at a given time. This is required for instance in cases of dispute in the interpretation of data. In the context of this document, the objective being the definition of the exposure

class of a work situation for a group of persons in certain climatic and production circumstances and of the best prevention measures, the same degree of accuracy is not required and the procedure, detailed as follows, is less exacting:

- The measurements are performed during the hottest periods of the exposure, the day and the year or during particularly heavy work phases (e.g. production peaks, machine breakdowns) or when wearing less suitable clothing.
- These environmental measurements are carried out at the place where the workers are exposed or, if this is not feasible, at the place where they would be exposed to the thermal environment, or as close as possible to this place, at 110 cm above the ground if the workers are standing and at 60 cm if seated.
- When parameters in the space surrounding the persons are not homogeneous, measurements are made at the work position where the parameters are estimated to be the highest, for the exposure class to characterize the worst possible situation.
- When the exposed person changes work location between areas with different environmental characteristics, measurements are made in each area and the sequence of time periods spent by the operator in the different areas is recorded. If the duration of stay in the second environment is short (less than 5 min) and the environmental parameters do not vary greatly (less than two times the required accuracy according to ISO 7726 for the respective parameters) from the values of the previous period, the two periods together can be analysed using the mean parameters obtained by a time-weighted average of the individual values. If these conditions are not met, the work situations in the different environments are analysed separately.
- Similarly, if the workload varies in the short term (periods of less than 5 min), a valid estimate of the mean parameters is obtained by a time-weighted average of the individual values. If this condition is not met, the different work situations are analysed separately.

The evaluation of the exposure class is done by calculating the PMV-PPD indices (ISO 7730) and from the evolutions of water loss and central body temperature predicted by the predicted heat strain (PHS) model (ISO 7933). Optionally, the WBGT index (ISO 7243) is calculated. These evaluations are made using the average weight and size of the workers concerned and considering they are not acclimatized.

NOTE Using the temperature of the black globe,  $t_g$ , in °C, will overestimate radiant heat if the person is working outdoors under solar irradiation.

### 4.3.5 Thermal exposure form (TEF) of the work situation

At the end of the exposure assessment and prevention procedure, a thermal exposure form (TEF) is prepared for each work situation. It includes:

- a detailed description of the work to be performed throughout the duration of the work cycle;
- the EC from 1 to 6, determined at the end of the assessment procedure;
- all planned and scheduled technical and organizational control measures decided based on the recommendations set out in [Clause 6](#);
- possible emergency and first aid procedures;
- the recommendations of the responsible healthcare provider regarding health requirements and restrictions for working in that heat exposure situation.

An example of a TEF is given in [Annex D](#).

An example of application of the first three stages of the strategy is presented in [Annex E](#).

## 5 Control measures

### 5.1 Work organization

When possible, operations in high EC situations are shifted to cooler hours of the day (morning or evening, possibly night-time) or during cooler periods of the year. Such operations can also be shifted to cooler premises or with less stressful operations (lighter work).

This requires that the tasks that can be moved be previously identified and that some adjustments be made to operational schedules. The provisional list of such operations is established from the maintenance programme of hot equipment or from incidents that warranted urgent attention in the past.

### 5.2 Air temperature

Air temperature can be reduced in the following ways.

- Reduction of internal heat gains from sources in the workplace by:
  - insulating hot fluid pipes, furnace walls, etc.;
  - locally exhausting hot gases generated by the various equipment.
- Reduction of external heat gains through:
  - opaque walls and roofs by:
    - making the surfaces exposed to sun more reflective with appropriate building materials;
    - using insulation materials;
    - cooling;
  - glass walls by:
    - reducing the incident heat flux, considering the orientation of windows, horizontal canopies, external blinds, etc.;
    - using more reflective glass using, for example, special glazing;
    - covering them with a translucent material opaque to infrared radiation.

### 5.3 Air humidity

Air humidity can be lowered in the following ways.

- Reduction of the internal gains by:
  - locally exhausting the vapours released from internal sources;
  - strictly controlling steam leaks wherever and whenever they occur.
- Reduction of external gains by:
  - eliminating any rainwater (or watering) input;
  - drying all wet products outside.

### 5.4 Thermal radiation

Thermal radiation can be lowered in the following ways.

- Reduction of the exposure to sunlight by providing, for example, curtains, blinds or screens, preferably placed outside.

- Reduction of radiation from hot surfaces by:
  - reducing the surface temperature by appropriate thermal insulation;
  - making these surfaces smooth, shiny, using low-emissivity paint in order to reduce the emissivity compared with rough and dull surfaces;
  - interposing one of the following reflective physical barriers between the radiation sources and the person:
    - preferably plain, opaque and covered with a glossy material (aluminium);
    - very fine wire mesh if it is necessary to keep a visual contact with the radiant surface.

## 5.5 Air velocity

The work zones should be ventilated to ensure conditions as near as possible to comfort.

The maximum speed to be considered to improve a situation of work for endurable continuous exposure is  $1 \text{ m}\cdot\text{s}^{-1}$  and ideally  $0,5 \text{ m}\cdot\text{s}^{-1}$ .

For occasional and short interventions in a very hot environment, ventilation at a higher speed can be accepted by the person as long as it reduces the difficulty of the task to be performed. It will be uniform over the surface of the body (preferably from the front) and at the most comfortable temperature possible. The maximum speed accepted is of the order of  $5 \text{ m}\cdot\text{s}^{-1}$ .

## 5.6 Clothing

From a thermal standpoint, the garment should ensure adequate protection against radiant heat while allowing vapour diffusion.

If possible from a safety viewpoint, work clothes lighter and less insulating than the standard garments shall be provided.

Search for special clothing to ensure protection against radiation, taking into consideration:

- the direction of radiation, allowing the use of clothing aluminized on one side only;
- the workload, because if physical activity is intense, evaporative needs are hampered by wearing the garment.

Protective clothes, however, are a last resort, protection being generally obtained at the expense of thermal comfort. The main disadvantages of these garments are their weight, the limitation of movement due to their size or rigidity and especially the interference with the evaporation of sweat.

If protective clothing against non-thermal hazards has to be worn, most likely in situations of EC 5 and EC 6, it is recommended that the use of personal cooling systems be considered. Such systems can comprise vests or devices worn beneath the clothing which cool with ice or phase-change materials or by ventilation. Cool and dry air could also possibly be blown into the workplace by means of a flexible tube.

The protective clothes shall be easily slipped over the usual work wear when the intervention in front of the radiant source is intermittent.

## 5.7 Workload

The workload, and therefore the metabolic rate, can be lowered by making work easier and less tiring through, in particular:

- mechanization of some operations;
- reduction of effort through using more appropriate tools;

- provision of tools with mechanical assistance;
- reduction of displacements;
- improvement of posture.

## 5.8 Rehydration

Rehydration is promoted to enable people to compensate for water loss caused by sweating. This can include:

- offering a selection of fresh drinks, such as still drinking water and non-carbonated and unsweetened lemonade, and low-sugar electrolyte replenishing fluids;
- prohibition of any alcohol or beverages that could slow down rehydration;
- installation of cool water fountains (10 °C to 15 °C) close to work sites;
- provision of beverages with salt content when recommended by an occupational physician.

Depending on the EC of the work situation, short work breaks should be organized every 15 min to 20 min to allow frequent drinking in small quantities (150 ml to 200 ml).

## 5.9 Rest pauses and recovery

If the work situation is EC 3 or EC 4, rest pauses can be organized with the possibility of rapid local cooling, such as immersion of the hands or forearms in cool water (20 °C).

In the case of EC 5 or EC 6, recovery facilities are required. As the thermohygro-metric conditions of the recovery room play an important role, it is necessary to:

- locate this room close to the workplace to maximize its use;
- make the room thermally comfortable, taking account of the clothes worn by people when recovering.

## 5.10 Acclimatization to heat

Persons repeatedly working in hot environments develop an additional tolerance called acclimatization that translates into earlier onset of sweating, greater sweat rate, more even distribution of sweat secretion on the body surface, decreased ion concentration in sweat and, consequently, reduction of the core temperature and heart rate.

This acclimatization is achieved by daily exposure for several hours to heat during the first five consecutive normal days of exposure.

During this period, the exposure shall progress according to the following scheme.

- For persons familiar with the task: 50 % of normal hours the first day, 60 % on the second day, 80 % on the third day and 100 % from the fourth day.
- For persons newly affected by the task: 20 % on the first day, possibly increasing by 20 % each successive day.

During this period, the persons are supervised by someone trained to recognize early signs or symptoms of heat-related illness.

Repeated full-day heat exposure without a staged acclimatization as described can lead to cumulative fatigue and dehydration, with increasing strain, rather than having a beneficial acclimatization effect.

Acclimatization being rapidly reversible, a person not exposed to heat regularly for 15 days or more shall be considered as unacclimatized and will therefore have to be subjected again to the acclimatization procedure described previously.

## 6 Information and training

The employer develops a programme addressed at all persons before they begin to work in hot situations, as well as at those responsible for the organization of these working situations, to inform them about the risks linked to these situations and to train them to anticipate and reduce these risks.

All this information is made readily and freely available for all employees near the workstations concerned by these measures.

The nature and extent of this information and training depend on the EC of the situation encountered, as follows.

- For all situations:
  - a description of the activities to be performed;
  - a description of the EC of this work situation and of the nature and severity of the constraints to which people are exposed.
- In addition, for situations EC 3 to EC 6:
  - a description of the signs and symptoms of heat-related illness, such as heat cramps, heat exhaustion and heat stroke, as well as the actions to be taken when such signs and symptoms occur;
  - the need to regularly drink small amounts of cool water;
  - non-occupational factors predisposed to heat problems, such as alcohol, drugs, obesity, excessive thinness or fatigue;
  - circumstances that contribute to reducing the duration (even to abstain from any exposure) and the actions to be taken in the event of such circumstances:
    - the first days following a return from leave or the resumption of work after disease;
    - fever or the beginning of an infection;
    - the use of anticholinergic substances (e.g. in nasal drops) to treat infections of the higher respiratory tracts;
    - a lack of complete recovery from any previous alcohol consumption;
    - a feeling of great tiredness in the previous hours;
  - working situations influencing the risk: clothing, effort, climatic parameters;
  - technical measures to reduce the risks and how and when to implement them;
  - the importance of acclimatization and the progressiveness of the exposure for unacclimatized persons;
  - the correct use and maintenance of heat-protective clothing and equipment.
- In addition, for situations EC 5 or EC 6:
  - the risk of working alone isolated in the hottest areas;
  - procedures to follow in the case of signs or symptoms of heat-related illness or of accident or incident, such as first aid or persons to call;
  - obligation and procedure to report, for individuals and their colleagues, any symptom of heat-related illness and any accidents or incidents involving potentially high exposure levels;

- a surveillance system where each person exposed to heat is accompanied by another person or a supervisor responsible for observing them at periodic intervals and signalling any symptoms of heat-related illness.

## 7 Medical surveillance of people working in hot environments

### 7.1 General

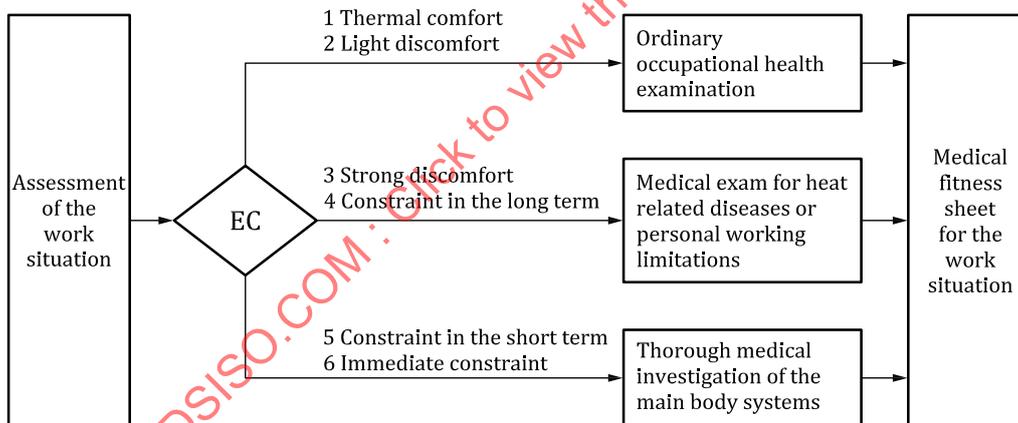
Human responses to heat include complaints, a decrease in mental and physical performance, illness and injuries. The responses show great individual variations and some individuals can suffer from much more serious effects than others. To prevent this, it is essential to collect medical information from the individuals potentially exposed to heat, evaluate their ability to sustain heat strain, identify those particularly at risk and adopt for them special prevention measures. This medical supervision involves:

- an initial evaluation before a person is exposed to a new working situation in a hot environment;
- a periodical evaluation for people who remain exposed to the same working and environmental situations of EC 3 to EC 6;
- personal monitoring each time a person is working in a situation of EC 6.

### 7.2 Initial evaluation

#### 7.2.1 General

This heat-related health assessment will differ according to the EC of the working situation ([Figure 2](#)).



**Figure 2 — Initial evaluation of the fitness of a person for a given working situation with exposure to heat, as a function of the EC**

For working situations of EC 1 or EC 2: no special measures should be taken, and the general procedure used in the organization to evaluate the fitness to work is adequate to protect all persons from heat-related disorders.

In addition, for working situations in EC 3 to EC 6: a health assessment is done by a responsible healthcare provider with the objective of identifying individuals having diseases or conditions that can exacerbate the impact of heat or have heat-related personal working limitations.

If a final decision concerning the ability to work in the heat situation concerned cannot be taken based on this assessment, a more thorough medical examination, possibly with clinical investigation, is required.

In addition, for working situations in EC 5 or EC 6: due to the severity of the physiological consequences and the very large scattering of the human responses, a complete health assessment is performed by a

responsible healthcare provider with a thorough anamnesis as well as specific clinical investigations, as recommended in ISO 12894:2001, Clause F.3.

As a result of this process, the responsible healthcare provider makes a decision to accept or not the employee for the work situations envisaged and a medical fitness sheet is completed, recording all the possible heat-related disorders and/or limitations of the person.

The content of the information and training given to the accepted persons is adapted as a function of the work situation and the individual heat-related diseases or limitations to ensure their optimal health and performance in the hot working situation.

### 7.3 Periodical evaluations

People particularly at risk are provided with a medical examination by a responsible healthcare provider every year (or according to local regulations). This includes:

- persons exposed to work situations of EC 3 to EC 6;
- persons identified previously as presenting limitations for working in hot environments.

People who have experienced signs of heat-related disorders are subjected to a proper examination before any further exposure to heat.

These examinations include an update of all information previously collected and, when required, specific additional clinical investigations.

The medical fitness sheet is confirmed or amended for each person for their situations of exposure.

### 7.4 Personal monitoring

In the case of situations of EC 6, personal monitoring of the exposed persons is organized. This includes:

- the continuous observation of the person;
- the possibility of rapidly resorting to first aid (including means to rapidly cool the worker) and qualified personnel in case of a problem.

Where possible, and particularly in the first days of occurrence of EC 6 situations, it is recommended that the trend of physiological data of some of the workers most at risk of developing high levels of strain be monitored. This can be done by:

- continuous recording of the heart rate during the whole period of work as well as for 30 min after the end of work;
- measurement of the core temperature at regular time intervals and at the end of the exposure or, when possible, continuously.

ISO 9886 sets the requirements for the instruments and procedures to measure heart rate and core temperature. It also provides recommendations for limit values for core temperature, heart rate and water loss.

### 7.5 Information for workers

The responsible healthcare provider informs each worker of the conclusions of the medical surveillance. This information includes:

- results of the medical tests;
- a conclusion regarding fitness to work in hot situations in general and in specific working situations;
- recommendations for limiting exposure to hot environments;

- recommendations for further evaluation and treatment of medical situations detected.

## 7.6 Information to the employer

The responsible healthcare provider informs the employer about:

- the ability of each exposed person having to work in a given hot work situation as a function of the EC of this situation;
- recommendations for reducing the risk of heat-related illness, such as recovery measures, work-rest schedules, workload reduction or reassignment to another job.

## 8 Contact with hot surfaces

In addition to being exposed to a risk of thermal strain, people working in hot environments also run a risk of burns due to intentional or involuntary contact with hot surfaces. ISO 13732-1 describes a procedure to assess the risk of burns when unprotected human skin comes into contact with hot surfaces.

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**Annex A**  
(informative)

**Datasheet for identifying working situations with heat-related problems (stage 1, screening)**

This annex presents the screening datasheet that is used at stage 1, screening, to identify the climatic working situations that need to be assessed, as they can lead to thermal problems for the workers exposed.

**Screening datasheet**

Working activity: .....

Location in the organization: .....

1. Air temperature

Air temperature does not cause any problems	Remarks:
Air temperature might cause some problems	
Air temperature definitely causes problems	

2. Air humidity

Neither too dry nor too humid	Remarks:
Conditions rather too humid	
Conditions very humid (e.g. wet industrial process)	

3. Thermal radiation

No additional thermal radiation	Remarks:
Medium exposure to radiating hot surfaces or to the sun	
High exposure to radiating hot surfaces or to the sun	

4. Wind/air movements

No air movements	Remarks:
Light air movements (e.g. sensation of draught, light wind)	
Strong air movements (e.g. strong wind)	

5. Contact with hot surfaces while handling tools/materials

None	Remarks:
Handling or touching of hot items with bare or insufficiently protected hands or body surface	
Handling or touching of very hot items with bare or insufficiently protected hands or body surface	

6. Clothing

Adequate	Remarks:
Partly inadequate (e.g. slightly too much insulating)	
Inadequate (e.g. too heavy, in a bad state)	

7. Personal protective equipment (PPE) (body, hands, head)

Not applicable	Remarks:
Interferes to some extent (e.g. clumsiness, restricted movements, impaired protection against heat)	
Considerable interference (e.g. difficulties in combining heat protective clothing and use of PPE)	

8. Other factors related to heat

Duration of the heat exposure	
Workload	
Variation of the thermal conditions (e.g. moving between hot and cooler environments)	
Relative location of the workplaces and heat sources	
Work organization	
Other factors, what? .....	
...	

9. Opinions of the exposed persons

Slightly cold: light embarrassment (locally)	Remarks:
Comfortable: no embarrassment	
Slightly hot: light sweating, light embarrassment, thirst	
Too hot: heavy sweating and thirst, slowing of the work rhythm	
Much too hot: excessive sweating, very painful work, wearing of special clothing	

10. Conclusion

No heat problem
Further investigation needed at stage 2, observation

Responsible person:

Date:

Signature

## Annex B (informative)

### Scoring scales for stage 2, observation

**Table B.1 — Scoring scales for stage 2, observation<sup>a</sup>**

Score	Condition
Air temperature	
0	low (18 °C to 25 °C)
1	moderate (25 °C to 32 °C)
2	high (32 °C to 40 °C)
3	very high (greater than 40 °C)
Humidity	
0	normal
1	moist skin
2	skin completely wet
Thermal radiation	
0	no radiation discernible
1	warm on the face after 2 min to 3 min
2	unbearable on the face after more than 2 min
3	immediate burning sensation
Air movements	
-2	cold strong air movements
-1	cold light air movements
0	no air movements
1	warm light air movements
2	warm strong air movements
Physical workload (see <a href="#">Table C.1</a> )	
0	light
1	moderate
2	high
3	very high
Clothing	
0	light, flexible, not interfering with the work
1	long, heavier, interfering slightly with the work
2	clumsy, heavy, special for radiation, humidity or cold temperatures
3	special overalls with gloves, hoods, shoes
Opinions of the persons	
-3	shivering, strong discomfort for the whole body
-2	strong local discomfort, overall sensation of coolness
-1	slight local cool discomfort
0	no discomfort
<sup>a</sup> Adapted from ISO 15265:2004, Table 2.	

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Table B.1 (continued)

Score	Condition
1	slight sweating and discomfort, thirst
2	heavy sweating, strong thirst, work pace modified
3	excessive sweating, very tiring work, special clothing
<sup>a</sup>	Adapted from ISO 15265:2004, Table 2.

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**Annex C**  
(informative)

**Metabolic rate**

ISO 8996 describes methods for estimating the metabolic rate. These methods are classified in four levels of increasing accuracy.

— Level 1

A simple method to quickly classify as light, moderate, high or very high the mean workload according to the kind of activity. [Table C.1](#) provides the data to easily classify the average workload for the different activities at stage 1, screening.

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Table C.1 — Classification of metabolic rate by category

Class	Examples
0. Resting	<ul style="list-style-type: none"> <li>— Resting, sitting at ease.</li> </ul>
1. Light meta- bolic rate	<ul style="list-style-type: none"> <li>— Sedentary activity (writing, typing, drawing, sewing, bookkeeping in an office, dwelling, school or laboratory).</li> <li>— Standing, light activity (shopping, laboratory, light industry).</li> <li>— Hand and arm work (small bench tools, inspection, assembly or sorting of light materials).</li> <li>— Light arm and leg work (driving vehicle in normal conditions, operating foot switch or pedal).</li> <li>— Machining with low-power tools [drilling (small parts), milling (small parts), coil winding, sawing].</li> <li>— Casual walking (<math>2 \text{ km}\cdot\text{h}^{-1}</math>) on a level, even path, solid with load <math>\leq 30 \text{ kg}</math>.</li> </ul>
2. Moderate metabolic rate	<ul style="list-style-type: none"> <li>— Sustained hand and arm work (hammering in nails, filing, loading, polishing).</li> <li>— Arm and leg work (off-road operation of lorries, tractors or construction equipment).</li> <li>— Arm and trunk work (work with pneumatic hammers, tractor assembly, plastering).</li> <li>— Weeding, hoeing, picking fruits or vegetables.</li> <li>— Pushing or pulling lightweight carts or wheelbarrows.</li> <li>— Bricklaying, five bricks/min.</li> <li>— Intermittent handling of moderately heavy material.</li> <li>— Walking (<math>2,5</math> to <math>5 \text{ km}\cdot\text{h}^{-1}</math>) on a level, even path, solid with load <math>\leq 20 \text{ kg}</math>.</li> <li>— Walking (<math>2,5</math> to <math>3 \text{ km}\cdot\text{h}^{-1}</math>) on levelled but irregular, unstable ground with load <math>\leq 20 \text{ kg}</math>.</li> <li>— Walking (<math>\leq 2,5 \text{ km}\cdot\text{h}^{-1}</math>) on stable ground uphill (<math>\leq 5 \%</math>) with load <math>\leq 20 \text{ kg}</math>.</li> </ul>
3. High meta- bolic rate	<ul style="list-style-type: none"> <li>— Intense arm and trunk work with hand tools or machines.</li> <li>— Carrying heavy material, shovelling.</li> <li>— Sledgehammer work, sawing, planing or chiselling hard wood, hand mowing, digging.</li> <li>— Walking (<math>5,5</math> to <math>7 \text{ km}\cdot\text{h}^{-1}</math>) on a level, even path, solid with load <math>\leq 20 \text{ kg}</math>.</li> <li>— Walking (<math>3,5</math> to <math>5 \text{ km}\cdot\text{h}^{-1}</math>) on levelled but irregular, unstable ground with load <math>\leq 20 \text{ kg}</math>.</li> <li>— Walking (<math>2,5</math> to <math>3 \text{ km}\cdot\text{h}^{-1}</math>) on stable ground uphill (<math>\leq 5 \%</math>) with load <math>\leq 10 \text{ kg}</math>.</li> <li>— Pushing or pulling heavily loaded hand carts or wheelbarrows.</li> <li>— Chipping castings, concrete block laying.</li> </ul>
4. Very high metabolic rate	<ul style="list-style-type: none"> <li>— Intense activity at fast-to-maximum pace.</li> <li>— Working with an axe, intense shovelling or digging, climbing stairs, ramps or ladders.</li> <li>— Walking (<math>&gt;7 \text{ km}\cdot\text{h}^{-1}</math>) on a level, even path, solid, with or without load.</li> <li>— Walking (<math>&gt;5 \text{ km}\cdot\text{h}^{-1}</math>) on levelled but irregular, unstable ground with or without load. Walking (<math>&gt;3 \text{ km}\cdot\text{h}^{-1}</math>) on stable ground uphill (<math>\geq 5 \%</math>) with or without load.</li> <li>— Running (<math>&gt;6 \text{ km}\cdot\text{h}^{-1}</math>).</li> </ul>

— Level 2

A time-and-motion study to characterize, on average, a working situation at a specific time. This method can be used by people with full knowledge of the working conditions but without necessarily any training in ergonomics.

— Level 3

A method to estimate the metabolic rate from a heart rate recording over a representative period of time. This method is addressed to people trained in occupational health and ergonomics of the thermal environment.

The method, including the mandatory correction for thermal effects on heart rate, is highly recommended at stage 3, analysis.

— Level 4

Three methods requiring very specific measurements made by experts: oxygen consumption measurement, the doubly labelled water method and the direct calorimetry method.

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**Annex D**  
(informative)

**Thermal exposure form**

Thermal exposure form (TEF)	
Working activity	
Location in the organization	
Responsible person	
Occupational health and safety responsible	
...	
Description of the task to be performed and corresponding metabolic rate	
Tasks	
Metabolic rate	

<b>Exposure class</b>	
-----------------------	--

	Preventive measures	Responsible person	Date	Control
Air temperature				
Humidity				
Thermal radiation				
Air movements				
Workload				
Clothing				
Hand wear against radiation PPE/ others				
Work planning				
Work organization				
Time schedules				
Rehydration				
Information and training				
Occupational health care				
Emergency and first aid				

Heat exposure assessment to be repeated before (date).

Responsible person:

Date

Signature

**Annex E**  
(informative)

**Example of application of the heat stress assessment procedure**

**E.1 Stage 1, screening**

**Screening datasheet**

Working activity: Kitchen.

Location in the organization: Canteen.

1. Air temperature

Air temperature definitely causes problems	Sources of heat: grills, hobs, frying pans.
--	---

2. Air humidity

Condition very humid	High humidity coming from the pans and the dishwasher.
----------------------	--

3. Thermal radiation

High exposure to radiating hot surfaces	Radiation sources: grills and hobs on which the persons lean.
---	---

4. Wind/air movements

No air movements	The windows should be kept closed (hygiene). The hoods apparently are not functioning properly. There is no ventilation.
------------------	--

5. Contact with hot surfaces while handling tools/materials

Handling or touching of very hot items with bare or insufficiently protected hands or body surface	First-degree burns frequent. Some textile/non-woven potholders are available, but no oven mitts.
--	---

6. Clothing

Partly inadequate	Kitchen apron, chef's hat, long trousers, heavy safety shoes.
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7. Personal protective equipment (body, hands, head)

No applicable	None, aside from the potholders.
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