

INTRODUCTION

Human beings are warm-blooded animals, and need for their internal temperature to be practically constant ($37\text{ }^{\circ}\text{C} \pm 1^{\circ}\text{C}$). For this, they have effective temperature regulation mechanisms, even in very aggressive environmental conditions.

Through physical activities, human beings generate heat and depending on how intense it is, the magnitude will be greater or lesser. There exist physical and physiological processes that dissipate the excess of heat to avoid the accumulation of heat produced by the body and/or gained from the environment.

These mechanisms are as follows:

- Radiation: is the thermal exchange produced by two objects that have different temperatures. The amount of lost or gained heat by radiation depends on the temperature of the objects.
- Conduction: is the thermal exchange produced by two objects that are in contact. The gain or loss of heat by conduction depends on the temperature of the objects.
- Convection: is the thermal exchange produced between the skin and the air that is around. The gain or loss of heat by convection depends on the temperature of the objects.
- Evaporation: The evaporation of sweat is the only mechanism that implies loss of heat. This loss depends on the humidity and speed of air.

The most important physiological mechanisms are:

- In cold, the reduction of the superficial blood flow and the increase of physical activity.
- In heat, the increase of sweating and blood flow, and the decrease of physical activity.

The relationship between human beings with the thermal environment defines the scale of sensations that oscillate from heat to cold, passing through a zone that can be qualified as thermally comfortable. The most important effects of exposure to hot environments are: sunstroke, fainting, dehydration, etc. The most important effects of exposure to very cold environments are hypothermia and frostbite.

BASIC PREVENTIVE CRITERIA

Heat:

Control the radiant sources by placing shields. Also, limiting the physical workload, and programming the most difficult tasks during the coldest periods of the working shift.

Acclimatize in a complete and adequate way as a previous step to the definitive incorporation to the place of work. Limit the time of exposure increasing the frequency and duration of the working intervals, or allowing the auto-limitation of the exposure. Also, the heat transmission can be reduced using walls and roofs, or incorporating an air conditioning system.

To eliminate hot air around the sources, a local exhaust can be installed.

Supply with salt and potable water in the place of work.

Isolate processes and equipment or the warm parts to avoid contact.

Provide heating protection clothing.

Implement training programs for the staff and the recognition and application of First Aid procedures when a thermal overload occurs.

Perform constant and previous medical examinations.

Thermal Comfort:

Adjust the environment to the recommended values through air conditioning systems.

Reduce the transmission of heat through walls and blinds, tempered-windows and/or the distribution of the conditioning systems.

Adequate the thermo-environmental parameters to the physical activity performed.

Check that the air distribution system is balanced, so that the air flow and speed are the right ones to avoid discomfort due to drafts.

Cold:

Provide protective clothing against the cold, taking into account three important aspects: these clothes should insulate against the cold, wind and humidity; should allow perspiration and dissipation of heat generated by work, and should allow carrying out work comfortably (weight and volume).

Provide cold air distribution systems of air nozzle elements that prevent or minimize the direct action of air currents; isolate processes and equipment or their very cold parts to avoid contact.

Reduce or eliminate simple monitoring tasks involving little physical activity.

Increase efforts for those tasks involving the performance of light work.

Limit the time of exposure increasing the frequency and duration of the working intervals, or allowing the auto-limitation of the exposure.

Conduct staff training programs for the recognition of symptoms and signs of exposure and freezing processes.

BASIC REGULATION

Decree 486/1997 on minimum safety and health in workplaces; heat environments; instruments and methods of measurement of physical parameters; Spanish rule UNE-EN 27726, March 1995; Ergonomics; Determination of Metabolic Heat Production; Spanish Rule UNE-EN 28996, March 1995.

Heat environments; Estimation of heat stress on working man based on WBGT index; Spanish Rule UNE-EN 27243, January 1995; Ambiances thermiques chaudes; Détermination analytique et interprétation de la contrainte thermique fondées sur le calcul de la sudation requise; International Rule ISO 7933, July 1989; Moderate thermal environments; Determination of the PMV and PPD indices and specification of the conditions for thermal comfort; European Rule CEN 27730, July 1993. TLV's de la ACGIH (Cold Stress)

ENVIRONMENTAL CONDITIONS

16. COLD AND HEAT

Personnel affected

Working Area

Date

Next Revision Date

Completed By

1. The temperatures are above 26°C	YES			NO	Jump to question 10.
2. The work in these environments often requires Walking, climbing stairs, carrying weights or making efforts with certain frequency.	YES			NO	Jump to question 10.
3. Relative humidity is below 60%	YES	NO	Relative humidity should be maintained, if possible, below this level		
4. Hot surfaces such as windows, ceilings or existing machinery in the surroundings, are shielded or isolated	YES	NO	Must proceed to be screened or isolated.		
5. There are cooler drafts than the environment of the area, that is in contact with workers	YES			NO	The heat problem can be alleviated by the impulsion of fresh air on working area.
6. The amount of time of workers in these types of situations is limited.	YES			NO	In situations of hot environments, the working periods should be reduced.
7. Water is supplied to those who work in high temperatures and considerable physical effort.	YES			NO	In these situations, it is necessary to drink water frequently to replace lost through sweat.
8. There is a prior period of time of acclimatization for people working for the first time in this environment	YES			NO	Limit to 50% the time of exposure the first day and increase 10% daily for new workers or after vacations.
9. Medical examinations are conducted for those exposed to heat.	YES			NO	Specific medical examinations should be performed at the beginning and periodically.
10. Temperature is between 20-24°C in winter and 23-26°C in summer.	YES			NO	Temperature must be kept in this range so that the working environment is comfortable.
11. Hot surfaces are screened and shielded (windows, roofs and machinery)	YES			NO	Although this range is not excessive, it can cause discomfort if these surfaces are not shielded.
12. Relative humidity is maintained around 50%.	YES			NO	Environments that are too hot or too cold can produce discomfort.
13. Air drafts on working people are controlled.	YES			NO	Air drafts, if not controlled its speed, temperature and direction, can be the cause of discomfort.
14. Sudden temperature changes are avoided.	YES			NO	Avoid or mitigate these changes, if possible.

15. Work is carried out in low temperatures.	YES			NO	Jump to question 19.
16. Workers are protected from direct air drafts, either forced (cold storage rooms) or natural (outdoor jobs).	YES	NO	Workers should be shielded from cold drafts.		
17. Workers have protective clothing against cold.	YES	NO	Usually is the only possible action against the risk of cold stress. Sufficient clothing insulation should be supplied.		
18. Breaks are established in areas with milder temperatures.	YES	NO	Recovery periods should be established and have appropriate workplaces for low temperature tasks		
19. There are surfaces at very high temperatures or facilities that can produce, at a certain time, very low temperature points.	YES			NO	Jump to another questionnaire
20. There is available enough thermal insulation to avoid fortuitous contact with those hot or cold points.	YES	NO	Should proceed with isolation		
21. There are appropriate precaution signs.	YES			NO	Danger must be signaled
22. There are available garments for workers that will perform tasks close to these sources.	YES	NO	Certified protection garments should be provided.		

ASSESSMENT CRITERIA

VERY POOR	POOR	NEEDING IMPROVEMENT
3 & 4 together, and 5,6,7,8 or 9 Two or more between 16, 17, 18, 20 & 22.	3 and 4 together 16, 17, 18, 20, 22.	5, 6, 7, 8, 9, 10, 11, 12, 13, 14

VALUATION RESULTS

	VERY POOR	POOR	NEEDING IMPROVEMENT	CORRECT
OBJECTIVE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SUBJECTIVE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

MEASURES TO BE TAKEN IN ORDER TO CORRECT THE DETECTED DEFICIENCIES