Working in Cold Environments

Thermal Comfort Through Design & Control

Introduction:

When it comes to employees working in various environments the ‘comfort zone’ is documented to be between 13 degrees C and 24 degrees C. According to the Mosby’s 2009 Medical Dictionary, temperatures of 10 degrees C and below is defined as being a ‘cold environment’ with which the human body generally begins to experience some functional impairment when unprotected. The most noticeable being the hands and fingers lose sensitivity, and the risk of errors and accidents increases.
Working in cold environments also poses other risks such as work environmental risks of slippery floors and stairs.

Health Risks:

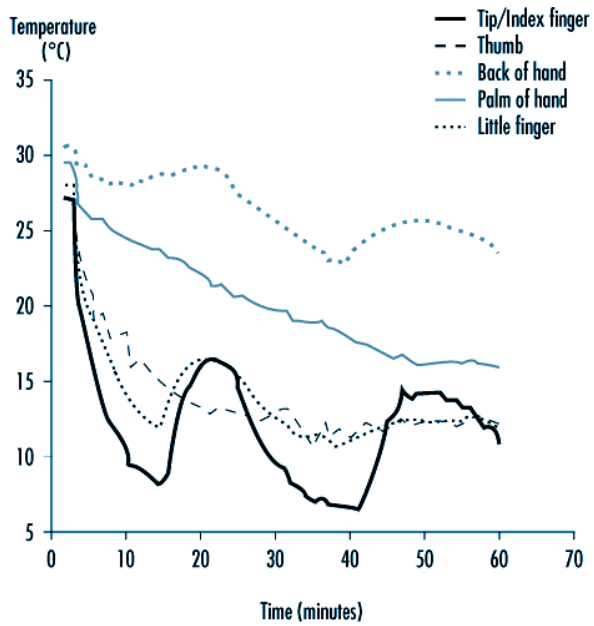
Exposure to cold environments can result in decreased blood circulation in the muscle tissue of the extremities (hands and feet) which can result in a reduction in staff’s ability to function adequately. The result is a faster rate of fatigue and consequently a higher rate of accidents (see graph below).

Exposure to the wind and draught can also compound the health issues by increasing ear and eye infections, which in turn can impair hearing and vision which may increase the risk of accidents.

Long-term exposure to cold environments can lead to a worsening of existing rheumatic conditions and occurrence of Raynaud's Syndrome, a vascular disease in which constricts blood vessels in the extremities such as the hands and feet, causing the blue colouring of the affected areas accompanied by ongoing pain and discomfort and cold stress.

Exposure to cold environments also increases the risk to persons with known asthma or cardiovascular disease.

Figure 42.18 Cold-induced vasodilatation of finger vessels causing cyclic rises in tissue temperature



Associated Risks:

Tools, Equipment and Machinery

- Select tools and equipment intended and tested for cold conditions.
- Choose design that allows operation by gloved hands.

Work Areas

- Non slip flooring to minimise risk of condensation on flooring and stairs
- Minimise air velocity through work area
- Thick mats to be made available to assist with insulating flooring at work stations

Lighting

- Adequate lighting that's designed to withstand cold environments

Influencing factors:

Wind/Draught Factor:

Wind velocity can impact on the ambient air temp as the chart below outlines. In an environment where ambient temperature is at 4 degrees C an 8km wind can cause the ambient temperature to drop by 1 degree C to 3 degrees C. So, it is important to factor in any draught or wind when managing a cold environment as this may effect the ambient temperature and increase the overall health and safety of the environment.

WIND CHILL CHART

		Ambient Temperature (∞C)								
		4	-1	-7	-12	-18	-23	-29	-34	-40
Wind km/h	Velocity mph	Equivalent Chill Temperature (∞C)								
Calm										
0	0	4	-1	-7	-12	-18	-23	-29	-34	-40
8	5	3	-3	-9	-14	-21	-26	-32	-38	-44
16	10	-2	-9	-16	-23	-30	-35	-43	-50	-57
24	15	-6	-13	-20	-28	-36	-43	-50	-58	-65
32	20	-8	-16	-23	-32	-39	-47	-55	-63	-71
40	25	-9	-18	-26	-34	-42	-51	-59	-67	-76
48	30	-16	-19	-22	-36	-44	-53	-62	-70	-78
56	35	-11	-20	-29	-37	-46	-55	-63	-72	-81
64	40	-12	-21	-29	-38	-47	-56	-65	-73	-82

Adapted from: Threshold Limit Values (TLV™) and Biological Exposure Indeces (BEI™) booklet; published by ACGIH, Cincinnati, Ohio

Little danger in less than one hour exposure of dry skin

DANGER – Exposed flesh freezes within one minute

GREAT DANGER – Flesh may freeze within 30 seconds

Maximum danger of false sense of security

Different types of commercially-available anemometers are used to measure wind speed or air movement. These are calibrated in meters per second (m/s), kilometres per hour (km/h) or miles per hour (mph). Air movement is usually measured in m/s while wind speed is usually measured in km/h or mph. The following is a suggested guide for estimating wind speed if accurate information is not available:

8 km/h (5 mph): light flag moves,
16 km/h (10 mph): light flag fully extended,
24 km/h (15 mph): raises newspaper sheet,
32 km/h (20 mph): causes blowing and drifting snow.

Work rate/metabolic heat:

The work or metabolic rate, is essential for a thermal risk assessment. It describes the heat that we produce inside our bodies as we carry out physical activity.
The more physical work we do, the more heat we produce. The more heat we produce, the more heat needs to be lost so we don't overheat. The impact of metabolic rate on thermal comfort is critical.
When considering these factors, it is also essential to consider a person's own physical characteristics.
A person's physical characteristics should always be bourne in mind when considering their thermal comfort, as factors such as their size and weight, age, fitness level and sex can all have an impact on how they feel, even if other factors such as air temperature, humidity and air velocity are all constant.

Controls:

In organisations where thermal discomfort in indoor environments is a risk, it is vital that management provides a visible commitment to the health and well-being of their employees.

Eliminating and Engineering Controls

These should be the first choice to reduce or eliminate the hazard. Although the initial cost of eliminating and engineering controls seems high, it has been found that the implementation cost is often offset by the resulting improvements to production and decrease in downtime, with reduced absenteeism and improved motivation.
It is important to stress that any practical solution to controlling thermal comfort is likely to require a combination of different options alongside consultation between employers, employees and their representatives.

Air movement

Reduce draught discomfort by directing the ventilation or air movement so that it doesn't blow directly onto the workers.

Separate the source of cold from the worker

Erect barriers, shield the work area or restrict access.

Redesign jobs to remove the worker from the area.

Control the task

Restrict the length of time that workers are exposed to cold conditions by allowing sufficient breaks to enable employees to get hot drinks or to warm up in heated areas.

Control the amount of work that workers are expected to do.

Introduce mechanical aids to aid physically demanding jobs in warm and hot environments or when workers are wearing a lot of clothing.

Administrative Controls

Administrative controls include planning and rescheduling work times and practices and rest schedules. Administrative controls are generally of a short term, temporary nature and are also widely recognised as being more expensive and less cost-effective than engineering controls in the long-term.

Control the clothing

If PPE is worn, make sure that workers are not wearing more PPE than is required (ie a higher protection factor than is needed).

If uniforms are worn, evaluate alternative designs, new materials etc to improve wearability of clothing.

Providing insulating floor coverings or special footwear when workers have to stand for long periods on cold floors;

Evaluate dress code and allow workers to adapt their clothing where possible.

Multiple layers of clothing enable workers to make reasonable adjustments to their clothing based on their own subjective feelings.

Adequate PPE (as per ISO 15743:2008)

Clothing:
In the case of new clothing it is best to test the garments and adjust the insulation level according to the level of activity. As a rule it is best to layer;
The first (inner) layer should be cotton or synthetic weave to wick perspiration away from the body. The second (middle) layer should be wool or synthetic fabric to absorb sweat and retain as much body heat as possible. The third (outer) layer should be something like Gore-Tex or nylon to shield the wind and allow some ventilation if required.

Hand wear:
Mittens and finger gloves provide the best thermal insulation however, thin inner gloves can be used as well.

Footwear:
Select boots with good thermal insulation or enough room for thick socks and has good anti-slip properties.

Allow for the worker to make behavioural adaptations

Where possible, remove all restrictions that may prevent employees from making minor adjustments to their clothing or work rate.

Provide warm-up or cool-down areas.

Provide personal heaters or fans.

Allow workers to adjust thermostats or open windows as appropriate.

Monitor the worker

Provide appropriate supervision.

Obtain medical advice for workers who are pregnant, have an illness or disability, or are on medication.

As required undertake a specific risk assessment for pregnant workers to identify and manage any risks.

Risk Management

Based on the information surrounding the risks associated with staff working in a cold environment then it may be beneficial to implement a system that adequately manages and monitors the effects of continuously working in a cold environment.

Implement a 'Thermal Comfort Program'

If thermal discomfort is a risk, and your employees are complaining and/or reporting illnesses that may be caused by the thermal environment, then it may be beneficial to develop a thermal comfort program:

Look at training and/or re-train staff. Training may be required for the thermal comfort risk assessments, analysis of data, and interpretation of results and implementation of controls. Training may also be required to explain to staff how, by modifying their working practices (such as clothing worn, work rate etc), they may be able to adapt to their thermal environment.

The thermal conditions may need to be monitored and where possible recorded.

Health surveillance or medical screening may be required for staff that have special requirements such as pregnancy, certain illnesses, disabilities and/or maybe taking medication. Medical advice should be sought if necessary.

Adequate and appropriate risk assessment procedures are essential. Records of all procedures and results should be kept as part of your risk management programme. Working habits and current practices need to be reviewed periodically and (where necessary) changed, to meet your obligations to control the risks your employees may face.

Education and Training

Provide education and information on the special problems of working in cold environments at the induction phase. Include information on the importance of rest breaks and the use of personal protection clothing.

Provide information and training in first-aid and treatment of cold injuries.

Conclusion

Working in cold environments has the potential if not managed properly to cause an increase in incidences and injuries. However, if managed properly through the appropriate controls and at the design stage the risks can be minimised.

A healthy person with appropriate clothing and equipment and working in an organisation suitable for the task is not in a health risk situation, even if it is very cold. However, for individuals with pre existing health problems the situation is quite different, and cold exposure could be a problem. In certain situations cold exposure or exposure to cold-related factors or combinations of cold with other risks can produce a health and safety risk. It is therefore important to factor in working in a cold environment in the pre employment phase to identify any conditions that may be exacerbated by working in a cold environment as well as review existing staff moving into a cold environment.

Written by Tracey Cameron

References:

- Ingvar Holmer, Per-Ola Granberg, Goran Dahlstrom (http://www.ilo.org/safework)
- Health and Safety Guidance Note GN28 (British Meat Processors Association)
- ISO 15743 – Ergonomics of the thermal environment- Cold workplaces-Risk assessment and management