Children's Services

CODE OF PRACTICE & GUIDELINES FOR SCHOOLS, NURSERIES AND CHILDREN CENTRES ON THERMAL COMFORT

School Service Health & Safety

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Creating a Learning Culture

Ealing Education Services

Thermal Comfort Guidance for Schools

Index

Introduction

Thermal comfort is defined in British Standard BS EN ISO 7730 as: *'that condition of mind which expresses satisfaction with the thermal environment.'* The term 'thermal comfort' describes a person's psychological state of mind and is usually referred to in terms of whether someone is feeling too hot or too cold. Thermal comfort is difficult to define, as a range of environmental and personal factors must be taken into consideration when deciding what will make people feel 'comfortable'. The Health & Safety Executive (HSE) has stated that the "best that you can realistically hope to achieve is a thermal environment that satisfies the majority of people in the workplace, or put more simply, 'reasonable comfort'. The HSE considers 80% of occupants as a reasonable limit for the minimum number of people who should be thermally comfortable in an environment". Ensuring thermal comfort is essential because of it's psychological implications, for example, it may affect overall morale, staff complaints may increase, productivity may fall and in some cases people may refuse to work in a particular environment. Some aspects of the thermal environment, such as air temperature, radiant heat, humidity and air movement, may also contribute to the symptoms of 'sick building syndrome'.

Too much heat can cause extra strain on the heart and lungs and produce a variety of other health conditions including headaches, dizziness, fainting or a lack of concentration, which could also increase the likelihood of accidents. Stress levels can be higher in extreme heat whilst irritability could heighten the risk of disruptive behavior within the classroom. Hot, dry air can raise the risk of eye and throat infections and breathing problems such as asthma.

The following documentation is provided as guidance for schools and shows the types of thermal comfort schemes that could be put in place to improve conditions for staff and pupils. This includes both immediate changes and those that will require longer term capital investment by the school.

Before making any investment in cooling schemes the school needs to assess and understand the following in relation to their site –

- Understanding what thermal comfort is and the regulations governing it
- Identifying if there are problems on site and performing a thermal comfort risk assessment
- Managing thermal comfort in the workplace and choosing the most efficient and cost effective comfort scheme

The following guidance is aimed at helping the school in adopting the right approach to maintaining reasonable conditions for staff and pupils.

Health and Safety Legislation

The Workplace (Health, Safety and Welfare) Regulations (as amended) 1992 set down specific requirements for most aspects of the working environment. Regulation 7 deals specifically with the temperature in indoor workplaces and states that during working hours, the temperature in all workplaces inside buildings shall be reasonable. However, there is no maximum temperature stated in the Regulations or associated Approved Code of Practice. The Health & Safety Executive's (HSE) guidance document, HSG194, 'Thermal Comfort in the Workplace' states that *'an acceptable zone of thermal comfort for most people in the UK lies roughly between 13°C (56°F) and 30°C (86°F), with acceptable temperatures for more strenuous work activities concentrated towards the bottom end of the range, and more sedentary activities towards the higher end'.* Additionally, the Chartered Institute of Building Services Engineers (CIBSE) in Section 1 (Environmental criteria for design) Guide A:

Environmental Design, suggests that for offices the temperature range for comfort should be 21-23º C in winter and 22-24º C in summer. The latter range applies to air-conditioned buildings. Higher temperatures may be acceptable in non-air conditioned buildings (no figures are quoted however). The World Health Organisation (WHO) also recommends a similar maximum working temperature of 24º C.

Thermal Comfort Requirements
Thermal comfort in the workplace is covered by the following legislation.

The Workplace (Health, Safety and Welfare) Regulations 1992:

Regulation 6 - workplaces must be adequately ventilated.
Regulation 7 - the temperature during working hours must be "reasonable" and thermometers should be provided in the workplace to measure temperatures.

Whilst standards have been defined for minimum temperatures, there is no legal upper temperature limit. The Health and Safety Executive (HSE) suggests that a zone of thermal comfort that may be acceptable to most people in the UK lies roughly between 13°C (56°F) and 30°C (86°F).

Thermal comfort depends on a range of environmental factors; including air temperature, relative air humidity, ventilation, building design, and personal factors, such as age and fitness level, affecting individual people and the work undertaken. Thermal comfort describes whether the temperature within a certain environment is comfortable, i.e. not too hot, not too cold.

Given individuals different preferences for temperature in the working environment it is only possible to aim to achieve a temperature that satisfies the majority of the building occupants for the majority of the time.

The legal requirement is that workplace temperatures should be reasonable, and it's important that schools put actions in place to remain within the HSE suggested acceptable limits where viable.

Thermal comfort cannot be simply 'measured' with a thermometer. For example, a normal dry-bulb thermometer in a classroom may read 21ºC (70ºF) but if the humidity is high, people are likely to feel uncomfortable unless some form of air-cooling or ventilation is provided.

What We Know
People are more comfortable when ambient temperatures are neutral, allowing the body to maintain thermal equilibrium without sweating or shivering. Increased humidity at the skin's surface can lead to sitting discomfort. The human body is designed to maintain thermal equilibrium with its outside environment, so that body heat produced by activity and metabolism roughly equals the amount of body heat lost to the ambient air. When this equilibrium is disturbed, the body compensates by shaking to generate more heat or sweating to transfer heat away from the body surface through evaporation. Thermal comfort, then, is relative to body temperature. One study found that its subjects' definitions of a comfortable temperature varied with the current temperature of their own bodies (Shitzer et al. 1978). "Ideal" ambient temperatures vary from person to person and over time as body temperature varies. Humidity is another important aspect of thermal comfort. A seated person usually experiences humidity build-up at the skin's surface as uncomfortable because moist skin creates increased friction coefficients (Reed et al. 1994), causing it to stick to

clothing or chair upholstery and inhibiting the small movements required to shift weight off pressure points.

Comfort, Health and Climate
In physiological terms, thermal comfort is what we experience when the body functions well, with a core temperature of around 37°C and skin temperature of 32-33°C. There are many ways of maintaining these body temperatures in a wide range of climates and this has been the case for centuries. If it were not so, large parts of the globe would be uninhabited. In the UK climate, comfort is a major consideration when considering the future demand for space heating and cooling, and the ways in which this can be met. There are interactions between climate, behaviour, building design and heating, cooling and insulation technologies.

Risk Assessment and Measurement
The assessment of risks to the health, safety and welfare of employees, including the effects of heat, cold and humidity, is the responsibility of the Headteacher. If staff complain about being too hot or too cold it is important that a local thermal comfort risk assessment is carried out to identify areas of concern and develop an action plan for maintaining reasonable temperatures.

An important part of assessing the risks and developing an action plan is to establish the effects of temperature on the different areas of the building. Staff should be encouraged to record temperature readings (with time and date) if they believe that there is a problem with particular areas such as classrooms, staff areas etc. It is important that external temperature readings are taken at the same times.

Schools should consider providing ordinary thermometers for classrooms, staff areas etc. You are not required to provide a thermometer in every room and should concentrate on areas where temperatures are believed to be a problem, alternatively, where appropriate, it may be worth obtaining electronic temperature loggers for those specific areas to provide full data.

Monitoring should be carried out for a minimum of two weeks to give a clear picture of the level of problem and indicate what type of scheme should be implemented.

Special consideration should be given to the risks to staff members and pupils with conditions that may be exacerbated by higher or lower temperatures e.g. heart disease, stroke, blood disorders, diabetes pregnancy and menopause. The Schools Service H&S Officer will be able to provide help and advice.

Schools should keep records of temperature readings, thermal comfort risk assessments and action plans

For further guidance on the best methods to use in monitoring buildings and in interpreting results please contact the Schools Service H&S Officer.

Some specific thermal and air-conditioning hazards and their consequences include:

Heat:

- Heat stress – this is the heat load imposed on the body by environmental thermal conditions and activity levels. It can normally be managed through physiological heat loss (e.g. perspiring);
- Heat strain – occurs when heat stress cannot be counteracted adequately by physiological heat loss. This may lead to more threatening conditions;

- Heat cramp – muscle spasms resulting from profuse sweating without timely restoration of the body's salt/water balance;
- Skin disorders – including prickly heat;
- Dehydration – fluid deficiency. A fluid deficiency of about 10% seriously affects an individual's capacity to work and a 15% deficiency can result in death;
- Heat exhaustion – a disorder where the common symptoms are nausea, weakness, thirst and giddiness. It is frequently accompanied by a small increase in normal body temperature; and
- Heat stroke – this is a medical emergency requiring immediate first aid and medical treatment. Body temperatures of 40C - 41C may result from untreated heat exhaustion. It is characterised by headache, confusion, bizarre behaviour, lack of sweating, eventual loss of consciousness, and in extreme cases can be fatal.

Cold:

- Frost nip – occurs when the face or extremities are exposed to cold wind, causing the skin to turn white;
- Frost bite – occurs when skin temperature falls below freezing and results in changing skin colour, pain, blisters and numbness and may lead to gangrene and loss of affected tissue;
- Chilblains – which are inflammatory swellings and sores associated with exposure to cold; and
- Hypothermia – a medical emergency requiring immediate first aid and medical treatment. The lowering of core body temperature where symptoms progress from initial shivering to numbness, confusion, drowsiness, muscular weakness and cramps - which in extreme cases can be fatal, causes it.

Air Conditioning:

In rare cases respiratory illnesses, such as Legionnaires' Disease, Pontiac Fever, and Hypersensitivity Pneumonitis can be spread by air-conditioning systems. These illnesses are generally related to bacteria and fungi growing in cooling towers or other parts of the system.

Ways of minimising discomfort

Although capital investment in mechanical, electrical and natural means can make long-term improvements to the thermal comfort of a building, in some cases the use of some basic schemes may reduce users discomfort effectively.

Schools may wish to consider immediate improvements to thermal comfort in hot weather and can implement the following ideas

- **Relax formal dress codes**, for example the wearing of ties. However do ensure that personal protective equipment continues to be worn if applicable e.g. in laboratories or technology areas.
- **Provide plenty of cold/chilled water dispensers** near to where people are working or studying. Water is preferable to caffeine/carbonated drinks. Allow sufficient breaks for people to get cold drinks or cool down.
- **Alter schedules to avoid using rooms** or areas affected by uncomfortably high temperatures during very hot weather. (Subject to having the flexibility and spare space to do this).
- Consider creating an **'outdoor classroom'** if a suitable space is available. Outdoor teaching areas must offer sufficient shade and schools must ensure that an adequate sun protection policy is in place to protect staff and pupils
- **Site workstations** away from direct sunlight or objects that radiate heat to minimise discomfort
- **Open windows** to improve airflow and cooling (note: if you are having to do this when the heating is still on there is something wrong – get the heating turned down first)
- **Implement a manual "free-cooling" regime** with the assistance of caretaking staff. This requires classroom and staff room windows to be opened as early in the morning as possible to cool down rooms before the school day starts. Windows can also be left open until early evening to help cool the building before it is locked up. This will require extra input from caretaking staff and should consider the security risks, so is probably practicable only above the ground floor. Other risks are possible damage to curtains/blinds by wind, and sudden onset of rain. Fire precautions must be observed (do not prop fire doors open).
- **Close blinds** on windows to reduce gains from direct sunlight (this may have to be balanced against having the lights on but on a hot day is probably worthwhile, solar gain could be 10~20kW+ so even with the lights on there is a significant reduction in heat gain.
- **Place insulation** around hot plant and pipes to minimise additional radiated heat
- **Switch off unnecessary electrical equipment** e.g. lights (even high efficiency), computers, projectors etc all give off heat when in use, increasing the temperature build-up in a room. Switching off the lights in a largish classroom may reduce the heat load by 1kW – equivalent to a single bar electric heater. 5-8 PCs with CRT monitors could be about the same.
- **Implement power-saving modes** to shut down screens and PCs automatically. Appliances that produce a lot of heat (e.g. photocopiers) should be located in well-ventilated areas away from where people are working or studying.
- Always **specify energy saving appliances**. Most of the energy used in electronic appliances ends up as heat, so the less energy used, the less heat emitted. TFT flat-screen monitors should always be preferred to bulky CRT monitors, but check manufacturers power ratings on equipment. Consider power ratings when choosing other equipment – whiteboards, projectors, fridges etc., and remember that saving energy will also save money.

- Be aware of the **potential dangers** when wedging fire doors open and act responsibly so as not to leave doors in an open position permanently.

Thermal Comfort Improvement Schemes
Where necessary the school may need to consider implementing devolved capital schemes to improve the thermal comfort in problem locations. Such investment should be considered carefully as the costs involved may be high, especially if the areas will remain unused over the summer holiday period when the temperature is generally at it's highest.

Design of new buildings now has to include consideration of control of summer temperatures. Designers use computer simulation thermal modelling to anticipate where over-heating might occur and design-in measures to counteract. However there are practical limitations to what modifications can be made to existing buildings to achieve the desired levels of thermal comfort. Some may only be viable as part of a major refurbishment project.

Although any investment in thermal comfort schemes is made from schools devolved capital and as such will be the schools decision, it is recommended that Property Services should be consulted on the final option to be taken. Where schools buy into the service and maintenance contracts run by Property Services, the service reserve the right to refuse to accept a scheme, which does not meet acceptable standards e.g. poor workmanship or non-compliance with British or European Standards or building regulations.

Measuring Thermal Comfort
A simple way of estimating the level of thermal comfort in your school is to ask your staff or their representatives, such as Unions or employee associations – if the majority of staff are dissatisfied with the thermal environment, if so then you will need to take action: See the HSE: five steps to risk assessment for more details for more details.

Use the HSE table at Appendix B to help you identify whether there may be a risk of thermal discomfort to your staff.

School Closure
The need for school closure to children should be minimised. Based on the risk assessment the Authority will assist the school in determining if the school should stay open, introduce control measures or close. The decision to close a school for operational reasons will be made jointly between the school and the Authority.

Appendix A – A guide to Thermal Comfort Schemes

The following sets out some of the main schemes that can be used for improving thermal comfort. Please note all costs given are an estimate and individual schemes will vary.

Scheme	Cost	Comments
Solar reflective Window Blinds	Low/Medium	Pros – • Reduce solar gain • Allow through ventilation • Allows some natural light Cons – • Risk of vandalism and accidental damage • Require manual adjustment throughout day for best effect
Solar reflective Window film	Low/Medium	Pros – • Most effective on south facing windows (but can be effective on East and west facing windows as well) • Reduces glare • Different levels of tint available • Protects glazing from damage as improves strength of glass Cons – • Higher levels of tint can make rooms gloomy when not sunny • Less effective when windows open for ventilation
Ceiling Fans (Punka Fans)	Low	Pros – • Approximately £200 per fan • Increased ventilation • Low running costs (if switched off when room not in use) Cons – • Require minimum ceiling height of 3m to install • Not suitable for suspended ceilings • Risk of vandalism or misuse

Scheme	Cost	Comments
Mobile Air Conditioners	Low/Medium	Pros – • £25 per week to hire and £300-£500 to buy a unit • Effective in small areas such as offices Cons – • Bulky units require storage when not in use • Noisy when in use • Not suitable for larger spaces such as classrooms • Require exhaust hose, for generated heat, to be vented outside (window or vent hole) • Risk of theft and vandalism • High energy consumption • High carbon emissions • Risk of overloading electrical supply
Installed Air Conditioning	High	Pros – • Reliable temperature control • Able to cope with extreme temperatures • Installation to a single area can be done quickly • Most suitable for small areas where short periods of excessive temperatures are recorded Cons – • High capital investment and high maintenance costs • High energy consumption • Noisy when in use • High carbon emissions • Risk of poor design and whole building integration making indoor environment worse • Risk of not turning off when leaving room/building

Scheme	Cost	Comments
Mechanical Ventilation	High	Pros – • Extracts stale air and replaces with fresh air • Effective cooling • Ability to apply to deep plan buildings Cons – • Requirement for bulky ductwork • Disruptive to install • Medium running cost • Requires cleaning every few years • Noisy when in use • No cooling of fresh air intake so if ambient temperature higher than indoors may raise temperature inside.
Modern Standard Insulation	High	Pros – • Reduces temperature build up through fabric of building • Retains warmth in winter • Different types available • Highly suitable for installation when refurbishing roof or curtain walling. • One off cost Cons – • Difficult to retrofit to building • High cost to install
Comfort Cooling (Chilled beams or under-floor cooling used to circulate cool water through room and lower temperature)	High	Pros – • Effective cooling • Able to cope with extreme temperatures • Quiet to run • Low running costs if ground source water used (boreholes or buried collector loops etc) • Can be installed as dual under floor heating and cooling Cons – • High installation cost • Disruptive to install • Medium running cost if chiller unit required to cool water.

Scheme	Cost	Comments
Replacement Windows	High	Pros – • Low-E glass helps reject solar gain • Improved ability to open and close for effective ventilation • Ability to incorporate internal Venetian blinds between panes for additional solar reflection • Double glazing reduces winter heat loss • Easy to clean and maintain Cons – • High installation costs
Brise Solaire	High	Pros – • External blinds or shades highly effective at reducing solar gain • Reduction in glare • Robust • No running costs and minimal maintenance • Does not interfere with use of windows for ventilation • Decorative feature Cons – • New to UK (common in Southern Europe) so hard to find experienced designers / installers to fit • High installation cost • Does not cool building (prevents heat gain through windows) • May require building consent

Scheme	Cost	Comments
Enhanced Natural Ventilation	High	Pros – • Effective ventilation of building through air inlets and outlet grills • Can be automated to reduce build up of heat whilst building is not in use • Low running cost • Low carbon emissions • Minimal maintenance • Maintains security Cons – • High installation costs • Disruptive to install • May be unsuitable for some buildings • No cooling of fresh air intake so if ambient temperature higher than indoors may raise temperature inside.

Appendix B – HSE Checklist

Please note that this is a basic checklist and does not replace an adequate thermal comfort risk assessment. Read the descriptions for each thermal comfort factor, and tick the appropriate box. If you tick two or more 'YES' boxes there may be a risk of thermal discomfort and you may need to carry out a more detailed risk assessment.

Factor	Description	YES
Air temperature	Does the air feel warm or hot?	
	Does the temperature in the workplace fluctuate during a normal working day?	
	Does the temperature in the workplace change a lot during hot or cold seasonal variations?	
Radiant temperature	Is there a heat source in the environment?	
Humidity	Is there any equipment that produces steam?	
	Is the workplace affected by external weather conditions?	
	Are your employees wearing PPE that is vapour impermeable?	
	Do your employees complain that the air is too dry?	
	Do your employees complain that the air is humid?	
Air movement	Is cold or warm air blowing directly into the workspace?	
	Are employees complaining of draught?	

Metabolic rate	Is work rate moderate to intensive in warm or hot conditions?
	Are employees sedentary in cool or cold environments?
PPE	Is PPE being worn that protects against harmful toxins, chemicals, asbestos, flames, extreme heat, etc?
	Can employees make individual alterations to their clothing in response to the thermal environment?
	Is respiratory protection being worn?
What your employees think	Do your employees think that there is a thermal comfort problem?

Links

Useful links and related documents for further information

RS Components – Suppliers of temperature logging devices
http://rswww.com

CLEAPSS - Support for schools in science and technology
http://www.cleapss.org.uk/

Health and Safety Executive - Guidance on Thermal Comfort
http://www.hse.gov.uk/temperature/thermal/index.htm

NHS Direct - Guidance on thermal comfort
http://www.nhsdirect.nhs.uk/articles/article.aspx?articleId=493&sectionId=18074

Department of Health - Heat wave plan
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_084670

Cancer Research UK - Advice on creating a sun protection policy for schools
http://info.cancerresearchuk.org/healthyliving/sunsmart/schools/?a=5441

Building Bulletin 101 – Design performance standards for ventilation in new school buildings (See section 8 for overheating)
https://www.gov.uk/government/publications/acoustics-lighting-and-ventilation-in-schools

EGfL- https://www.egfl.org.uk/

New & Expectant Mothers – Schools Service generic risk assessment:
https://www.egfl.org.uk/facilities/health-and-safety/new-expectant-mothers