

Code of practice for

Low temperature hot water heating systems of output greater than 45 kW —

**Part 3: Installation, commissioning and
maintenance**

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- British Combustion Equipment Manufacturers' Association
- British Gas plc
- Building Services Research and Information Association
- Chartered Institution of Building Services Engineers
- Department of Health and Social Security
- Department of the Environment (Property Services Agency)
- Electricity Supply Industry in England and Wales
- Health and Safety Executive
- Hevac Association
- Institute of Refrigeration
- Institution of Gas Engineers
- Ministry of Defence
- Royal Institute of British Architects
- Sealed Expansion Vessel Association

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Foreword

This Part of BS 6880 has been prepared under the direction of the Refrigeration, Heating and Air Conditioning Standards Committee.

BS 6880 is published in three Parts which together form a full technical revision of CP 341.300-307:1956 which is withdrawn.

This Part gives recommendations on the installation, commissioning and maintenance of low temperature hot water heating systems.

The other two Parts are:

- *Part 1: Fundamental and design considerations;*
- *Part 2: Selection of equipment.*

The policy adopted when writing this code has been to avoid repetition of material for which other bodies are the accepted authority, except in so far as limited extraction assists the understanding of this code. Consequently the code provides general recommendations only on certain topics. References in this category are as follows.

- a) For detailed procedures:
 - 1) publications of the Chartered Institution of Building Services Engineers (CIBSE), particularly:
 - i) CIBSE Guide [1];
 - ii) CIBSE Building Energy Code [2];
 - iii) technical memoranda relating to fire in buildings;
 - iv) practice notes relating to provision of combustion and ventilation air for boiler installations;
 - 2) handbooks published by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
- b) For detailed commissioning arrangements:
 - 1) CIBSE commissioning codes;
 - 2) application guides published by the Building Services Research and Information Association (BSRIA).

It should be noted that references to such applications are deemed to refer to the current edition, whereas specific extracts reproduced in this code are from the edition current at the time of preparation of this code.

Whilst the recommendations made in this code generally relate to current practice, they are not intended to inhibit the use of innovative systems or equipment which an experienced designer considers appropriate to the application, and which meet all statutory requirements and the safety and general good practice recommendations of this code. It is desirable that the principal interested parties should be made aware of such proposals at the design stage.

Reference is made in the text to a number of Acts of Parliament and to various regulations made under them. Such lists are necessarily incomplete, and in any particular circumstance the users of this code should acquaint themselves with the relevant regulations in force at the time. Attention is drawn to the requirements of the Building Regulations of England and Wales, of Scotland, Northern Ireland and of Inner London.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and iv, pages 1 to 34, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This Part of BS 6880 gives recommendations regarding the work involved in installation, commissioning, operation and maintenance of low temperature hot water (see **1.2.1**) heating systems of output greater than 45 kW, open vented or sealed. It is primarily intended for use by building owners, building managers, installers and associated professionals. It is not intended to serve as a detailed design guide (see foreword).

The recommendations recognize the need to optimize the use of energy, reduce hazards and minimize effects detrimental to the environment.

Solar heating is outside the scope of this code.

NOTE The titles of the British Standards publications referred to in this standard are listed on the inside back cover. References in the text to other publications are identified in the text by numbers in square brackets, and are listed in Appendix A.

1.2 Definitions

For the purposes of this Part of BS 6880 the definitions given in BS 1523, BS 3533 and BS 5643 apply together with the following.

NOTE See also the CIBSE Building Energy Code [2].

1.2.1

low temperature hot water (LTHW)

water used as the heating medium such that its temperature does not exceed 100 °C at any point in the system, whether open or sealed

NOTE Various safety considerations may require that the actual design flow temperature of an LTHW system should be significantly less than 100 °C (see Section B.1 of the CIBSE Guide [1], HSE Guidance Note PM5 [3] and section three of BS 6880-1:1988).

1.2.2

boiler

an appliance designed for heating water either for space heating or for space heating combined with hot water supply

1.2.3

heat emitters

equipment emitting heat for the purpose of space heating

NOTE This equipment includes radiators, convectors, skirting heating and radiant panels.

1.2.4

radiator

a unit for space heating that warms the air by convection and provides radiation

Section 2. Installation

2.1 General

This section of the code gives general recommendations on the installation of LTHW heating systems and equipment. It deals with the installation of the principal items of equipment associated with the utilization, distribution, energy conversion and control subsystems, including associated pipework installations, thermal insulation and electrical work.

Attention is drawn to the need to observe all statutory regulations and safety recommendations. Careful thought should be given to the storage and protection of equipment and system components to prevent deterioration or damage.

2.2 Statutory regulations/safety

2.2.1 Safety, statutory requirements and other regulations

Principal sources of reference are given in 2.4 of BS 6880-1:1988.

Some further guidance is given in the following, but it should be appreciated that the references quoted in this code are not fully comprehensive:

CIBSE Technical Memorandum No. 2 [4]

CIBSE Technical Memorandum No. 3 [5]

“Construction Safety: Policy, Organization, Administration” issued by the National Federation of Building Trade Employers [6]

“Safety Manual for Mechanical Plant Construction” issued by the Oil and Chemical Plant Contractors’ Association [7].

It is every employer’s responsibility to ensure that all safety and other related regulations are complied with. All individuals have a duty of care to others under the requirement of the Health and Safety at Work etc. Act, regardless of contractual relationships.

2.2.2 The Health and Safety Executive

The Health and Safety Executive should be consulted if any doubts arise regarding safety, health or welfare matters. It should be noted that inspectors have power to enter any premises that are subject to the Health and Safety at Work etc. Act 1974 or to Construction Regulations, to examine relevant registers and certificates and exercise the other powers specified in clause 20 of the aforementioned Act.

2.2.3 Statute law

The Health and Safety at Work etc. Act 1974 and associated regulations and legislation (The Factories Act 1961 and Offices, Shops and Railway Premises Act 1963) require that adequate steps be taken to safeguard the health, safety and welfare of persons at work, and others who may be affected by the work. The main sections of the Health and Safety at Work etc. Act relating to the supply and installation of heating equipment are:

Section 2, requiring employers to ensure the health, safety and welfare of their employees.

Section 3, requiring employers and the self employed to conduct their work in a way that does not put persons other than their employees at risk.

Section 6, which places an obligation on designers, manufacturers, importers and suppliers of equipment.

The Factories Act 1961, as its title suggests, applies mainly to factories but there are sections that apply to building operations and works of engineering construction.

The following topics, which relate to the construction industry, are covered in the Factories Act 1961 and attention is drawn to the need to comply with its requirements on these matters (see also 2.2.1).

Sanitary accommodation

Steam boilers and air receivers

Welfare

Special Health and Safety Regulations

Notification of accidents and industrial diseases

Notification of work starting, if the work is for more than 6 weeks duration

Notification of employment of young persons

Keeping of records and posting of notices

2.2.4 Common law

Under common law, an employer has a “duty of care” for his employees. Basically, this means that an employer has, for example, to:

- provide a safe place of work;
- provide safe plant and equipment;
- ensure a safe system of work;
- make sure employees are competent to do the work given to them.

2.2.5 Construction regulations: principal requirements

The Health and Safety at Work etc. Act gives the Minister responsible the power to make special regulations relating to safety and health in particular types of work. A number of such regulations exist relating to construction work. These comprise the main body of statute law affecting site work. The principal regulations are as follows.

- Construction (General Provisions) Regulations 1961
- Construction (Lifting Operations) Regulations 1961
- Construction (Working Places) Regulations 1966
- Construction (Health and Welfare) Regulations 1966

The following topics cover areas of requirements related to the construction industry, details of which can be found in the legislation quoted in 2.2.3.

- Responsibilities of employers
- Responsibilities of employees
- Appointment of safety supervisors
- Excavations
- Dangerous fumes
- Fencing of machinery
- Electricity and temporary lighting
- Projecting nails and loose material
- Protection of the eyes and protective clothing
- Cranes and hoists
- Scaffolding
- Welfare facilities

In respect of installation work carried out in certain types of premises, the legislation listed in this subclause may not have statutory effect. Nevertheless, the observance of its requirements is recommended as a minimum standard of safety.

2.2.6 Other regulations relevant to the heating and ventilation industry

It should be appreciated that any person on a construction site or similar place of work may be exposed to the risks associated with all of the operations being carried out, rather than those associated with a specific trade. However, attention is drawn to the following statutory regulations and other recommendations which are directly relevant to those engaged in the installation of LTHW heating systems.

- a) Statutory regulations
 - Abrasive Wheels Regulations 1970
 - Asbestos Regulations 1969

- Employer's Liability (Defective Equipment) Act 1964
- Employer's Liability (Compulsory Insurance) Act 1969
- Electricity (Factories Act) Special Regulations 1908 and 1944
- Fire Certificates (Special Premises) Regulations 1976
- Protection of the Eyes Regulations 1974
- Highly Flammable Liquids Petroleum Gas Regulations 1972
- Gas Safety (Installation and Use) Regulations 1984
- Asbestos Regulations 1969. First list of approved dust respirators
- Ionizing Radiations (Sealed Sources) Regulations 1969

b) Other recommendations

- Health and Safety Executive Guidance Notes
- Other Health and Safety Executive Publications
- "Approved Code of Practice and Guidance Notes on Work with Asbestos" [8]
- HSE "Guide to the Asbestos (Licensing) Regulations 1983" [9]

Attention is also drawn to the particular hazards associated with refrigeration systems, where the requirements of BS 4434 apply. There is also a particular risk of suffocation associated with the use of certain pipe freezing techniques in confined spaces. The "Code of practice for reducing the exposure of employed persons to noise" [10] should also be noted.

Reference should also be made to 2.4 of BS 6880-1:1988 in respect of risks and safety requirements associated with installations and equipment which may form part of an LTHW heating installation, including fuel storage and combustion, rotating equipment, electrical installations and hazardous chemicals.

The provision of water to the site should be in accordance with the relevant Water Byelaws.

2.2.7 Protective clothing and equipment

Employers are required by law to provide the following.

- a) Suitable protective clothing for operators working out of doors in rain, snow, sleet or hail.
- b) Suitable protective clothing for operators working with asbestos or asbestos-based materials (see Regulation 8 of the Asbestos Regulations 1969).

c) Insulation screens, hoods and gloves to prevent danger of electric shock (see Regulations 23 and 24 of the Electricity Regulations).

d) Goggles or screens:

- 1) when grinding metal, stone or similar materials with power driven wheels or discs;
- 2) when chipping or scaling painted or corroded metal surfaces or wire brushing them with power tools;
- 3) when cutting out or cutting off cold rivets or bolts;
- 4) when welding or cutting metal with electrical, oxyacetylene or similar equipment; this includes the provision of suitable welding screens for electric arc welding operations to protect others not involved with welding but in the vicinity of such operations; (see Regulation 21 of the Construction (General Provisions) Regulations 1961).

e) Respirators to avoid breathing injurious fumes or dust (if adequate ventilation is impracticable); (see Regulation 20 of the Construction (General Provisions) Regulations 1961 and Regulation 8 of the Asbestos Regulations 1969).

f) Shelter accommodation for use when work is interrupted by bad weather (see Regulation 11 of the Construction (Health and Welfare) Regulations 1966).

g) Storage accommodation for protective clothing and equipment when not in use.

h) Safety nets, belts, harness, lines, etc. where it is not practicable to provide standing working platforms (see Regulation 38 of the Construction (Working Places) Regulations 1966).

Employees are required by law to wear and use the items listed, as appropriate (see section 143 of the Factories Act 1961).

Legal requirements should be regarded only as a minimum. The regular use of the following items should be strongly advised:

- 1) safety helmets complying with the requirements of BS 5240;
- 2) protective footwear complying with the requirements of BS 1870;
- 3) industrial gloves complying with the requirements of BS 1651.

Operators carrying out electric arc welding operations and oxyacetylene cutting should be provided with suitable aprons, sleeves, gloves and skull caps, in addition to eye protection [see 2.2.7 d)].

2.2.8 Avoidance of nuisance

Nuisance by the more Widely used definition means anything obnoxious to the community or individual by offensiveness of smell, noise or appearance, or by causing obstruction or damage, and may cause legal proceedings to be taken against the offending body or individual. Consideration should be given, therefore, to the avoidance of such nuisance when installing LTHW heating systems.

2.3 Site facilities

2.3.1 Legal responsibilities

Reference should be made to the relevant information regarding facilities that should be provided for site works in the Construction (Health and Welfare) Regulations 1966 and amendments. A particular amendment relating to welfare facilities is the amendment of 1 April 1974. Site offices are also covered by the Offices, Shops and Railway Premises Act 1963 (paragraph 50 and 51).

2.3.2 Access and site accommodation

Before setting up site accommodation, the following should be checked or noted (as applicable).

- a) Access to the site accommodation should be suitable throughout the duration of the project and should not be affected by building progress.
- b) Access should be suitable for the various types of vehicles delivering plant and equipment (with possible heavy and wide loads) to the stores and direct to plant rooms.
- c) Access to sites will require approval by the Highways Authority; the routing and timing of the delivery of materials, and in particular large plant involving the use of a mobile crane positioned on the highway, may require police involvement in the control of traffic. Access should be suitable for all types of weather conditions, including the winter.
- d) Good walking access should be provided from such places as car parking facilities to site accommodation and to places of work, considering wet weather and winter working conditions, with operatives carrying tools and materials. Adequate lighting should be provided for access roads and paths for winter working conditions.

2.3.3 Welfare facilities

Adequate first aid boxes, accommodation for clothing and the taking of meals, washing facilities and sanitary conveniences should be provided according to the number of persons employed on the site.

Any sharing arrangement by various contractors should be recorded on the approved form “Register and certificates of shared welfare arrangements”. It is the employer’s responsibility to ensure that facilities provided comply with the relevant regulations.

2.3.4 Accommodation

In setting up site accommodation attention should be given to factors such as the following.

- a) Proximity to main welfare facilities should be ensured.
- b) The accommodation should not be affected by, or impede, building progress.
- c) All accommodation should be confined to one area to provide easy control of stores, time keeping, good housekeeping and security.
- d) Proximity to main areas of work should be ensured.
- e) Where any separate welfare facilities are provided within the site accommodation either in part or as a complete unit and in addition to the main site facilities, it should be ensured that the provision of adequate water, sanitary conveniences, electrical and first aid services can be maintained at all times.
- f) Adequate lighting should be provided in the accommodation areas for both safety and security reasons.
- g) Clocking-in facilities should be provided, with adequate weather protection and with sufficient wall space for displaying essential notices.
- h) Fireproof cabinets for important documents should be provided.
- i) Adequate fire-fighting facilities should be available.
- j) With the larger type of projects, controlled car parking facilities with proper and approved access to the site should be provided.
- k) If inflammable materials are to be stored, proper storage facilities should be provided and should comply with the relevant regulations.
- l) Any special security arrangements that may be necessary for offices and stores with alarm systems to meet insurance company requirements should be provided.
- m) If small stores, messing and clothing accommodation local to major areas of work are provided within the building, adequate protection of any finished surfaces should be provided and good housekeeping should be maintained.
- n) It should be ascertained whether it is necessary to obtain large storage areas for materials and equipment within the building.

It should also be ensured that storage areas have good access and security and that the equipment and materials may remain in the storage area until required without impairing other building trade progress, and that no damage will be caused to any finished work when they are moved.

2.3.5 Lifting facilities

Cranes and hoists may be provided by another contractor, but it is advisable for the LTHW heating installation contractor to determine the conditions for the use of these facilities. Such facilities as cranes and hoists may only be available when not being used by other contractors, and unless positive arrangements are made for the use of such plant, delays may occur in offloading, lifting essential equipment into plant rooms and, in particular into high rise buildings.

2.3.6 Scaffolding

Scaffolding may only be available for a limited period unless otherwise agreed. It is therefore desirable that prior agreement is reached on the availability and the conditions of the use of scaffolding when required for the installation of the LTHW installation.

Mobile platforms, or towers, may be provided in lieu of, or additional to, fixed scaffolding. It is advisable to determine the suitability and the exact conditions of use, together with availability, good surfaces to facilitate movement, the responsibility for erection, possible alterations to suit varying site conditions and dismantling. Particular attention should be given to the implementation of appropriate procedures for the use of such equipment; in particular, they should not be moved with anyone on them.

2.3.7 Services (water and electricity)

It is advisable to determine whether sufficient water and pressure are available for filling the system for progressive pressure testing, particularly with high rise buildings.

It is essential that adequate lighting is provided and that all distribution equipment control and plug points comply with the relevant regulations. Electricity for power tools should be provided at the correct capacity and voltage. (230 V/250 V) supply should not be used for electrical hand tools except in workshops, where they should comply with the relevant regulations. When 110 V supply is not available for electrical hand tools, it is essential to provide suitable portable transformers properly wired with trailing leads and plug connections. (230 V/250 V): (400 V/415 V) supply portable transformer type welding machines should be properly wired with the necessary isolators and fuses. It is the employer's responsibility to ensure that all regulations are strictly adhered to when employees use electricity for lighting and power tools.

2.4 Storage and protection

2.4.1 General

It is essential to provide adequate storage and protection of equipment on site, at all stages of building progress, to minimize deterioration of the working parts and of the manufacturer's finishes.

2.4.2 Equipment

It is good practice to have equipment delivered and installed at the proper time related to the building progress, to minimize the period of time it is standing before being put into operation. It is advisable to check with manufacturers, particularly where major items of plant are concerned such as boilers, pressurization equipment, console control units, etc., as to the precautions to be taken where the equipment is likely to stand without being commissioned or operated for a prolonged period of time. This may also apply to smaller items with electrical equipment, such as fan convectors, etc.

2.4.3 Delivery of equipment

It is advisable to arrange for manufacturers to provide lifting points, clearly indicated, so that unloading and hoisting into position can be carried out in accordance with the Construction (Lifting Operations) Regulations 1961 (see 2.2.5).

Protection of equipment delivered to site should be examined for suitability for site storage purposes and improved as necessary.

2.4.4 Storage

Each consignment of equipment delivered should be checked and such items as starter equipment should be reconciled with motor sizes and other plant ancillary equipment.

Drawings, wiring diagrams, installation, operating and maintenance instructions and keys are very often delivered with the equipment. It is advisable to collect such items and file them away until required to prevent them being damaged or lost.

It may be necessary to accept delivery of equipment before the building is ready for the installation of the equipment. It is necessary, therefore, to provide suitable storage facilities, which should meet the following conditions:

- a) easy access at all times;
- b) good unloading facilities;
- c) protection against weather;
- d) proper security;
- e) available until such time as the equipment can be installed.

It may be necessary to use off-site storage and in addition to checking the items above, the following additional points should be taken into account:

- 1) adequate insurance cover;
- 2) additional cost of transport;
- 3) additional handling;
- 4) possible use of lifting equipment or plant;
- 5) accessibility to site at a later date.

2.4.5 Protection of equipment

2.4.5.1 General considerations. It is essential that all equipment on site should be protected whether it is in storage or installed. Satisfactory security arrangements should be made to prevent unauthorized interference at all stages of the project.

Control panels and other lockable equipment should always be locked when not being worked on and the keys removed for safe keeping.

Most equipment is provided with a works-painted finish, very often in special colours that are difficult to match by touching-up on site if damaged by other building operations or owing to deterioration from being exposed to the weather. It may be necessary and expensive to completely repaint or respray plant before it is acceptable for handover. It is usually necessary for protective coatings to be removed from metal areas before welding.

Special consideration should be given to the protection of bearings and of electrical, pneumatic and refrigeration equipment to prevent ingress of moisture and dust, the presence of which, particularly in combination, can cause rapid deterioration of electric motor windings, contact points, terminals, switchgear, resistors, transistors, valves and printed circuits and may involve expensive and specialist remedial work with possible delays in obtaining replacements. Particular attention should be given to the protection of boilers and associated refractories. The manufacturer's recommendations should be ascertained and followed.

Refrigeration equipment, particularly packaged units, is usually delivered with a holding charge of refrigerant to minimize the possibility of air and moisture entering the refrigeration system. It is essential, therefore, for such equipment to be checked for leakages on delivery and periodic checks made of all glands, joints and pipework. If refrigeration equipment is likely to stand for a prolonged period of time before being commissioned, it is advisable to contact the manufacturer to seek his advice on checking it and arrange for regular visits of a refrigeration service engineer.

It may be necessary to protect the equipment on site using temporary heaters, dehumidifiers, silica-gel or other means to prevent moisture affecting it while it is standing. In regard to the use of portable gas heaters (which have a high moisture content in the products of combustion), special consideration to provide adequate ventilation is necessary, particularly if drying out electrical equipment. Large electric motors, compressors, and other such equipment with ball and roller bearings should be periodically rotated to reposition the shaft in order to prevent flattening of the bearings. The protection of the equipment should be maintained at all times during installation, particularly with control panels and monitoring consoles as damage and deterioration can occur if left exposed during the installation and connecting up of the wiring and/or pneumatic systems.

It is recommended that all bearings and moving parts are checked before running the equipment to ensure adequate lubrication is provided and that the lubricant is free from contamination. Manufacturers' recommendations should always be strictly adhered to when using lubricating oils and grease.

2.4.5.2 Removal of protective coatings. Equipment may be delivered on site with protective coatings such as transparent film, grease or varnish. The protective coats should be left on as long as possible and then removed as recommended by the manufacturer to prevent possible damage to the finish or working parts of the equipment. Before using chemical cleaners or similar liquids, it should be ensured that no damage will be caused to the equipment.

2.4.5.3 Special protection. With the use of many types of chemicals and cleaning agents by other trades in the building industry, it may be necessary to provide special protection of equipment after it is installed. Polyethylene sheeting, being of petrochemical base, may prove unsuitable.

2.4.5.4 Protection of equipment from other trades. The use of equipment as a platform and as a base for ladders, trestles, shuttering and any other such purposes should not be allowed, as it invariably results in damage to the equipment as well as being a safety hazard.

Insulation is always vulnerable to damage and may require special consideration regarding protection from other services and trades.

Pipework should not be used as supports for other services, as this may cause excessive loading, deflection and leakage.

2.4.6 Care and maintenance

Where equipment is to be operated between start-up and handover, arrangements for appropriate maintenance and operational supervision should be made.

2.5 Equipment and system installation: general

2.5.1 General principles

It should be appreciated that a successful LTHW system requires that design, installation and commissioning should be satisfactory and compatible. Nothing in these subclauses is intended to imply any particular division of responsibility between designer and installer. Equipment specifically associated with air handling systems (fans, ductwork, diffusers, etc.) is covered in 5.5 of BS 5720:1979.