CI/SfB

(56.4)

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

**Wirsbo**
A division of Uponor Limited
Space House
Satellite Business Village
Crawley
West Sussex RH10 2NE
Tel: 01293 548512 Fax: 01293 548552

**Agrement Certificate No 87/1799**
*Third issue**

Designated by Government to issue European Technical Approvals

# WIRSBO UNDERFLOOR HEATING SYSTEM

Systeme de chauffage de plancher
Bodenheizungssystem

## Product


- *THIS CERTIFICATE RELATES TO THE WIRSBO UNDERFLOOR HEATING SYSTEM, COMPRISING CROSS-LINKED POLYETHYLENE PEPEX TUBING, MANIFOLDS AND THE ANCILLARY COMPONENTS DESCRIBED IN THE* TECHNICAL SPECIFICATION *PART OF THIS CERTIFICATE.*
- *The Wirsbo system of underfloor central heating is for use in conjunction with a suitable source of heated water to provide space heating in domestic, commercial or public buildings where the system is designed or the design approved by the Certificate holder.*

continued

## Regulations

**1 The Building Regulations 1991 (as amended) (England and Wales)**

The Secretary of State has agreed with the British Board of Agrément the aspects of performance to be used by the BBA in assessing the compliance of cross-linked polyethylene pipes with the Building Regulations. In the opinion of the BBA, the Wirsbo Underfloor Heating System is not subject to these Regulations.

**2 The Building Standards (Scotland) Regulations 1990 as amended**

In the opinion of the BBA, the use of the Wirsbo Underfloor Heating System is not subject to these Regulations.

**3 The Building Regulations (Northern Ireland) 1994 (as amended)**

In the opinion of the BBA, the use of the Wirsbo Underfloor Heating System is not subject to these Regulations.

continued

*• The Wirsbo system is for use in new or existing floors as described in section 5 of this Certificate.*

*• This Certificate does not cover the boiler, calorifier, pumps or controls necessary to complete the heating system, which are assumed to be conventional items.*

*• This Certificate is limited to situations where there is no connection between the heating system and the main water supply.*

**4 Water Supply (Water Fittings) Regulations, England and Wales, Water Byelaws, Scotland and the Water Regulations, Northern Ireland**

**England and Wales**

In the opinion of the BBA, the Wirsbo Underfloor Heating System satisfies the requirements of the Water Byelaws.

**Scotland**

In the opinion of the BBA, the Wirsbo Underfloor Heating System satisfies the Water Byelaws issued by the Regional Authorities.

**Northern Ireland**

In the opinion of the BBA, the Wirsbo Underfloor Heating System satisfies the Water Regulations (Northern Ireland) 1991.

## Technical Specification

### 5 Description

5.1 The Wirsbo Underfloor Heating System is based on a number of separate loops of pePEX tubing conveying hot water.

5.2 The system is incorporated in solid floors by:

burying the tubing in the concrete screed or
clipping it into polystyrene boards and covering it with a secondary floor deck.

5.3 In suspended timber floors, the tubing is clipped into:

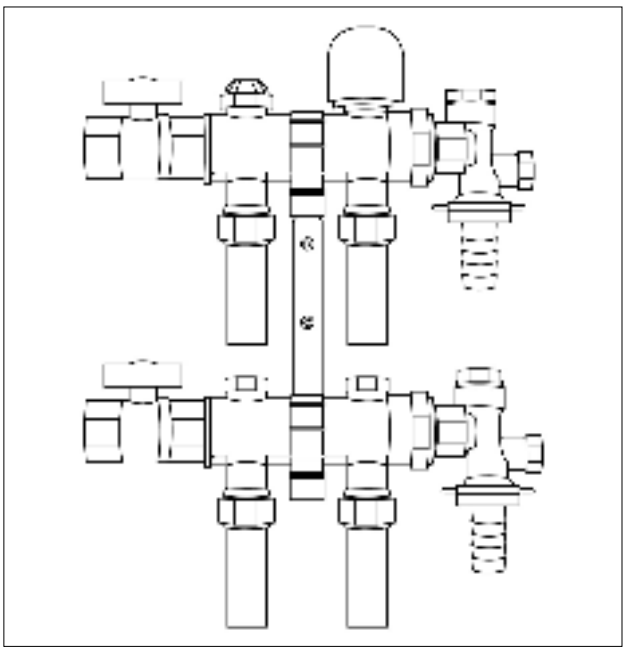
purpose-made heat emission plates nailed to cross-battens above the floor joists, or
polystyrene boards laid over the floor deck and covered with a secondary deck

5.4 The system covered by this Certificate comprises:

Tubing — the pePEX tubing consists of a base tube which is a cross-linked polyethylene tube of wall thickness 1.60 mm, a 0.09 mm thick diffusion barrier and an outer silan cross-linked polyethylene layer 0.25 mm thick giving a nominal outside diameter of 20 mm and a nominal wall thickness of 2 mm. Tubing is normally supplied in coils of 80 m, 100 m, 120 m or 240 m.

Manifolds — typical manifolds are shown in Figure 1. These are cast from brass and incorporate butyl rubber seals. The illustrations show manifolds which would accommodate two heating loops. Where additional loops are required, several manifold sections may be coupled together. The manifolds for use on the flow side of the circuit incorporate a hand wheel valve to allow individual loops to be isolated. Manifolds for use on the return side of the circuit incorporate lock shield valves to allow the flow in individual loops to be regulated. The manifolds incorporate compression couplings for jointing to the cross-linked polyethylene tubing.

*Figure 1 Typical manifolds*

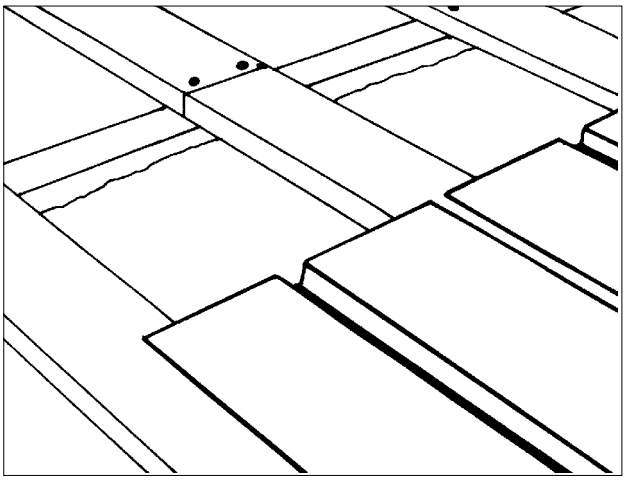


Ancillary components:

Polystyrene board — polystyrene bead board has dimensions 1.2 m by 1.2 m for laying the tubing runs. The board is available in three thicknesses — 30 mm, 50 mm or 70 mm. The board is used where the system is laid on a solid concrete floor or over the existing deck of a suspended floor. It is grooved to accommodate heat emission plates and tubing. The floor deck is laid with the tongue-and-groove to float on the system.

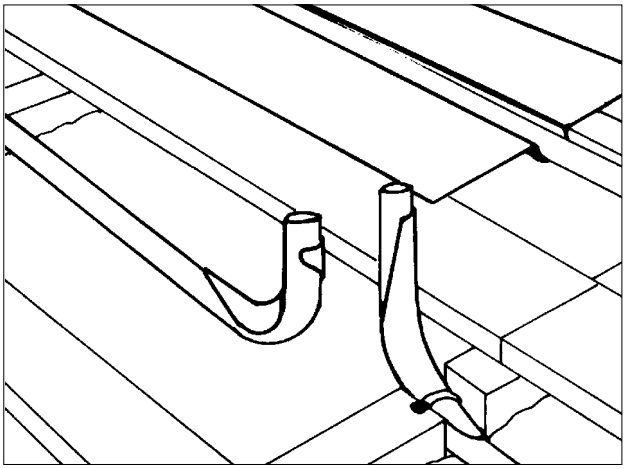
Heat emission plates (Figure 2)— these are formed from 0.6 mm thick aluminium sheet profiled to accept the tubing. They are used where the system is to be fitted under the deck of a suspended timber floor or over a concrete slab or timber floor deck.

*Figure 2 Heat emission plates*



Pipe bend supports (Figure 3) — produced from zinc-plated mild steel and are used to ensure that bends remain smoothly curved where the tubing runs outside the floor structure, eg, approaching a manifold.

*Figure 3 Bend supports*



5.5 The cross-linked polyethylene base tube is produced by extrusion. An oxygen diffusion resistant film and an outer protective film of silan cross-linked polyethylene are heat welded to the base pipe as it passes through a die. Continuous quality control is carried out during manufacture, including checks on dimensional accuracy, degree of cross-linking, short- and long-term strength, leak-tightness and thermal stability.

5.6 Sheet metal components, polystyrene boards and manifolds complete with compression couplings are bought in by the Certificate holder, to an agreed specification. They are manufactured using conventional techniques.

## 6 Delivery to site and storage

6.1 Wirsbo pePEX tubing is supplied in 80 m, 100 m, 120 m and 240 m coils. The tubing bears a continuous mark showing the manufacturer's trade mark, tubing size, supervision mark, batch identification and length identification on every metre.

6.2 Manifolds and other small components are normally supplied in cardboard packaging; polystyrene boards are supplied in a protective wrapping of polyethylene shrink film.

6.3 All components should be stored under cover until required.

# Design Data

## 7 General

7.1 The Wirsbo system is suitable for use in domestic, commercial or public buildings. It should be especially effective in buildings with a high roof or ceiling, such as gymnasia or swimming pools, where adequate comfort levels can be difficult to achieve by other means.

7.2 Underfloor heating systems are characterised by a relatively low heat output. The building into which the system is installed must therefore be provided with adequate insulation if the system is to achieve adequate comfort levels and acceptable response times. The response time depends, to an extent, upon the ability of the floor to store heat due to its thermal mass. The floor covering will affect the heat emission properties of the system and its response time. A thick wall-to-wall carpet, for example, will act as insulation and thus a higher water temperature is required to reach a given surface temperature than for a floor having a thinner covering. The Certificate holder's publication *Wirsbo Underfloor Heating* shows the water temperature and heat emission for different floor materials.

7.3 In designing the system, including its controls, the Certificate holder will take account of the factors necessary for satisfactory performance.

7.4 The Wirsbo system can readily be installed in new or existing buildings.

7.5 It is essential that the installation is carried out with care to ensure that no damage occurs to the cross-linked polyethylene tubing due, for example, to penetration by nails.

7.6 Where the system is installed in an existing building on a timber floor construction [see section 16.1(iii)], the additional floor deck will result in a loss of room height of at least 48 mm. Account must be taken of this factor in relation to building regulations requirements.

## 8 Design procedure

### Heating design

8.1 The design procedure follows conventional practice with the exception of the methods for determining the best layout of the heating loops and the required water temperatures.

8.2 In the case of suspended concrete floors, it should be checked with the structural engineer that

the heat emitted from the loops will not adversely affect the floor construction. In any new building the effect of of the system must be considered at the structural design stage.

8.3 Heating requirements for a particular building are evaluated in the manner detailed in the CIBSE Guide 1980, Part A *Structural Design*.

8.4 The heat loss to the ground floor or lower floors and edge losses are added to the heat loading and are calculated using the method given in the CIBSE Guide 1980, Part B, pages 7–10. In multi-storey buildings, this process will begin at the top floor and the downward losses will be subtracted from the loadings in the lower storey rooms.

8.5 When designed by the Certificate holder, in accordance with the procedures and data contained in the CIBSE Guide 1980 and the publication *Wirsbo Underfloor Heating*, the use of the Wirsbo system can produce acceptable temperatures and restrict air temperature swing to 3.5°C. The output of the system is limited by the acceptable surface temperature of the floor. This temperature would generally be limited to 26–27°C. A temperature up to 29°C may be acceptable on floor areas of a room which are seldom walked upon. The design of the system will ensure that these maximum temperatures are not exceeded.

Structural design

8.6 When using installation arrangements incorporating polystyrene boards [see section 16.1(ii)], the ability of the polystyrene boards to withstand the required floor loads must be considered in the design. Floor loads associated with domestic dwellings as given in BS 6399-1 : 1984 can be accommodated, without excessive deflection, by a floor deck of 18 mm tongue-and-groove chipboard to BS 5669-2 : 1989 Type II or Type III. Where greater floor loadings are anticipated checks must be made to ascertain that the floor deck can spread the imposed load and thus avoid loads on the polystyrene exceeding 15 $kNm^{-2}$.

8.7 Floor constructions must be designed to comply with the relevant technical specifications selected from:

BS 8110-1 : 1985
BS 5268-2 : 1988
the national Building Regulations:

*England and Wales*

Approved Document A 1/2, Section 1, Part B

*Scotland*

Regulation 11 *Structure,* Standard C2.2

*Northern Ireland*

Part D *Structure.*

## 9 Safe working temperatures and pressures

The safe working pressure and continuous temperature rating for the pePEX cross linked polyethylene pipes is 6.0 bar at 60°C. Test data shows that the base pePEX tube can operate at 6.0 bar at 110°C for limited periods without damage. There is an adequate safety factor to ensure that damage to the tubing will not occur as a result of boiler thermostat or other control failure.

## 10 Oxygen diffusion

Independent tests carried out at 40°C show that the oxygen permeability of the pePEX pipes is approximately 0.2% of cross linked polyethylene pipes without the oxygen diffusion barrier. See section 14.5.

## 11 Chemical resistance

11.1 The materials used in the Wirsbo Underfloor Heating System will not be adversely affected by corrosion inhibitors used in central heating systems. Cross-linked polyethylene will be unaffected by accidental contact with soldering flux or linseed oil based sealing compounds, although these materials should not normally be used in making joints to the tubing.

11.2 Cross-linked polyethylene will be unaffected by hard, soft or aggressive potable water.

## 12 Sound insulation

Where impact sound reduction requirements apply to a floor, the effect of using the Wirsbo system must be considered as it may influence the floor's performance.

## 13 Maintenance

13.1 The Wirsbo system presents no special maintenance problems unless it is damaged. Work will normally be confined to regular maintenance of the associated heating plant and control equipment.

13.2 In the event of a leak in the pePEX tubing due to local damage, repairs can be effected by a heating contractor using a section of tubing and suitable brass compression couplings (not assessed by the BBA, but supplied by the Certificate holder). However, location of the source of a leak and subsequent repair can cause considerable disruption and inconvenience to users of the building.

13.3 To minimise the risk of damage it is essential that the precautions regarding carpet fitting and display of a notice, given in section 16.6 are observed.

## 14 Durability

14.1 The Wirsbo system of underfloor heating has been widely used in Sweden and other European

countries for 30 years. Experience to date with the system has proved favourable.

14.2 This experience, together with long-term data involving significantly higher temperatures and pressures than those included in the Wirsbo design manual shows that the pePEX tubing will perform satisfactorily and with an adequate safety margin.

14.3 The manifolds are produced from materials known to be durable in plumbing applications. They may require replacement within the life of the pePEX tubing and other underfloor components. Seals incorporated in the hand wheel and lock shield valves may require periodic replacement.

14.4 The polystyrene boards and aluminium heat emission plates will not deteriorate significantly in the service conditions assessed.

14.5 The oxygen diffusion barrier may eventually be subject to thermal degradation but this will not affect the durability or thermal performance of the pipe.

14.6 The Wirsbo pePEX tubing and associated underfloor components will have a minimum life of 60 years when used in the context of this Certificate.

## Installation

### 15 General

15.1 Installation must be carried out in accordance with the Certificate holder's instructions *Wirsbo Underfloor Heating*. General installation details are shown in Figures 4 to 6.

15.2 Before installation the tubing should be kept in a warm room (approximately 20°C) to improve its workability. Failure to do this can result in difficulty in positioning the tubing in the grooved polystyrene boards or heat emission plates.

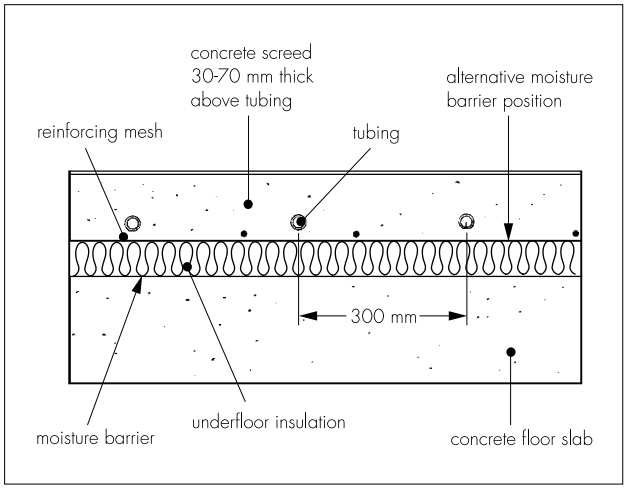
15.3 Heating loops must always be formed from continuous lengths of tubing. If a joint beneath the floor is unavoidable, due for example, to local damage, a compression fitting approved by the Certificate holder must be used for the purpose.

### 16 Procedure

16.1 The installation procedure varies according to the type of floor construction:

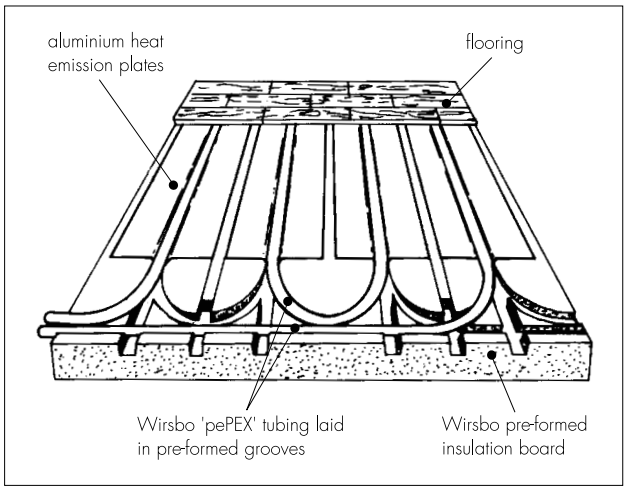
(i) Where the system is to be laid over a concrete floor (see Figure 4) and covered with a concrete screed, a moisture barrier of polyethylene sheet or other suitable material is first laid over the concrete slab. Reinforcing mesh is placed over the underfloor insulation. The pePEX tubing is uncoiled and attached to the mesh using soft iron wire or plastic cable ties. The system is pressure tested before the concrete screed is laid over the tubing. A concrete screed is laid over the tubing. The thickness of the screed will be dependent upon the loading requirements for the floor, but the cover to the tubing must never be less than 30 mm. The screed should be laid in accordance with the relevant requirements of CP 204-2 : 1970.

*Figure 4 Typical solid concrete floor application*




(ii) Where the tubing is to be laid in grooved polystyrene boards (see Figure 5) the boards are cut as necessary and positioned over the floor of the area to be heated. Where the floor is of concrete it should first be covered with polyethylene sheet or other suitable material to act as a moisture barrier between the polystyrene boards and the concrete. When laying of the polystyrene boards is complete, the heat emission plates are pressed into the board and the pePEX tubing is uncoiled and pressed into the plates within the polystyrene boards. The secondary floor deck, of tongue-and-groove chipboard Type II or Type II/III to BS 5669 : 1989 may be laid over the polystyrene boards. The chipboard should be floated onto the polystyrene boards and system and all joints between adjacent sheets of chipboard should be glued.

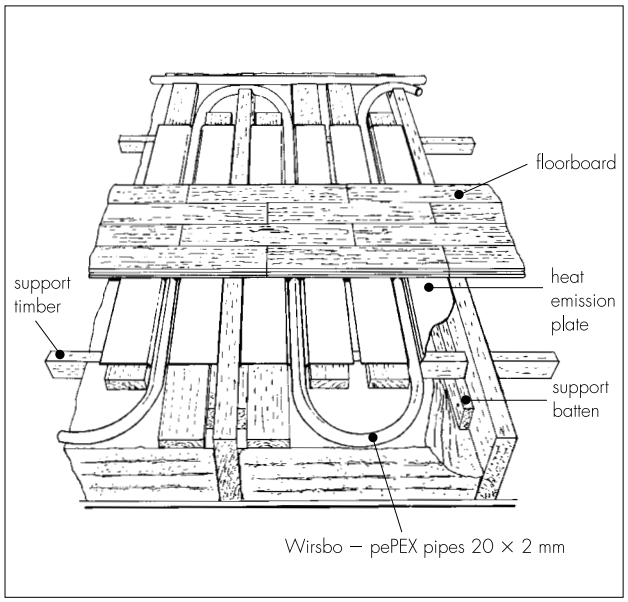
*Figure 5 Typical application using grooved polystyrene insulation boards*




(iii) Where the system is to be laid in a suspended timber floor without an existing deck (see Figure 6) the timber joists must be cross-battened at 300 mm

centres. Appropriate insulation should be used to fill the void between the joists. Heat emission plates (see also Figure 2) are nailed or stapled in place between the battens. The cross-linked polyethylene tubing is uncoiled and pressed into place between the battens. The floor deck is laid and nailed to the battens. Care must be taken to avoid damaging the tubing when nailing the floor deck.

*Figure 6 Typical suspended timber floor application*




16.2 The ends of the loops of tubing are connected to the boiler circuit through manifolds, which allow the flow in individual loops to be regulated.

16.3 The flow side of the circuit must be fitted with a vent to allow the escape of dissolved air, in accordance with normal practice. Venting provisions must also be made at manifolds to facilitate the removal of air from individual loops.

16.4 The system must be checked for leaks after all the air has been removed and before the floor is covered with either concrete or chipboard. When commissioning the system it must be flushed, filled with water, the pump started and residual air removed by opening the valves to each loop.

16.5 The flow through the heating loops cannot be accurately adjusted until the floor is dry and warm. The regulating equipment should be adjusted in accordance with the Certificate holder's instructions, and the flow through the loops adjusted in accordance with the technical printout supplied for the project.

16.6 A notice should be displayed in buildings where the Wirsbo system is installed, drawing attention to the risks of damage associated with nailing through the floor decks. Carpet fitting and the associated nailing may present a significant risk. To minimise this risk, runs of tubing should be kept clear of room perimeters and, where possible, doorways.

## Technical Investigations

The following is a summary of the technical investigations relating to the Wirsbo Underfloor Heating System.

### 17 Tests

Test evidence was examined relating to:

dimensional accuracy
degree of cross linking
stress rupture performance of the tubing on straight, bent and scratched samples using water at 95°C with and without stress cracking agents as a medium
effect of thermal cycling on tubing
resistance of joints to pull out
resistance of joints to thermal cycling
oxygen diffusion.

### 18 Other investigations

18.1 Existing data were examined relating to the following:

thermal stability of oxygen diffusion barrier
behaviour in fire
effect on impact sound performance
maintenance requirements
durability.

18.2 Existing evidence relating to the performance of the Wirsbo Underfloor Heating System in the UK was examined.

18.3 The Wirsbo design and installation method were examined and compared with conventional practice in the UK.

18.4 Visits were made to sites in progress in Sweden and in the UK to assess practicability of installation.

18.5 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

## Bibliography

BS 5268 *Structural use of timber*
BS 5268-2 : 1989 *Code of practice for permissible stress design, materials and workmanship*

BS 5669 *Particleboard*
BS 5669-2 : 1989 *Specification for wood chipboard*

BS 6399 *Loading for buildings*
BS 6399-1 : 1996 *Code of practice for dead and imposed loads*

BS 8110 *Structural use of concrete*
BS 8110-1 : 1985 *Code of practice for design and construction*

CP 204 *In-situ floor finishes*
CP 204-2 : 1970 *Metric units*

## Conditions of Certification

### 19 Conditions

19.1 This Certificate:

(a) relates only to the product that is described, installed, used and maintained as set out in this Certificate;

(b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;

(c) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;

(d) is copyright of the BBA.

19.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, shall be construed as references to such publication in the form in which it was current at the date of this Certificate.

19.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabricating process(es) thereof:

(a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked by the BBA or its agents; and

(c) are reviewed by the BBA as and when it considers appropriate.

19.4 In granting this Certificate, the BBA makes no representation as to:

(a) the presence or absence of any patent or similar rights subsisting in the product or any other product;

(b) the right of the Certificate holder to market, supply, install or maintain the product; and

(c) the nature of individual installations of the product, including methods and workmanship.

19.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

In the opinion of the British Board of Agrement, the Wirsbo Underfloor Heating System is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 87/1799 is accordingly awarded to Wirsbo.

On behalf of the British Board of Agrément

Date of Third issue: 2nd August 2000

Chief Executive

**Original Certificate issued on 23rd January 1987. This amended version includes reference to the revised national Building Regulations, water supply regulations/byelaws, change of manifolds and new* Conditions of Certification.

British Board of Agrément
P O Box No 195, Bucknalls Lane
Garston, Watford, Herts WD25 9BA
Fax: 01923 665301



e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk