Internal services

Chapter 8.1

This chapter gives guidance on meeting the Technical Requirements forinternal services, including:

- **the supply of hot and cold water**
- **plumbing**
- **gas**
- **electrical installations.**

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8.1.1 Compliance

Also see: Chapter 2.1

Internal services shall comply with the Technical Requirements and take account of service entries, ground hazards and chemical attack.

Internal services which comply with the guidance in this chapter will generally be acceptable.

Adequate precautions against ground hazards and the entry of gas i.e. radon or gas, from landfill sites, should be provided as necessary. Further guidance can be found in BRE Report 211 'Radon: guidance on protective measures for new dwellings', and BRE Report 212 ' Construction of new buildings on gas-contaminated land'.

8.1.2 Provision of information

Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to the appropriate personnel.

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design. Designs should be issued to site supervisors, relevant specialist subcontractors and suppliers, and include the following information:

- Location of sanitary fittings.
- Drainage runs.
- Location and size of water storage cisterns and cylinders.
- Hot and cold water pipe runs.
- Central heating pipe runs.
- Underfloor heating pipe runs.
- Gas supply pipe runs.
- Electrical outlets, switches and consumer units.

8.1.3 Water services and supply

Also see: water regulations and guides

Water services shall be based on the pressures and flow rates supplied from the incoming main. Components shall be selected and installed to ensure satisfactory service for the life of the system, with suitable precautions taken against corrosion and damage. Issues to be taken into account include:

a) suitability of materials and components
b) adequate supply
c) durability
d) protection from the cold.

Suitability of materials and components

Relevant standards for materials and components used in domestic water systems include:

BS EN 806	'Specifications for installations inside buildings conveying water for human consumption'.
BS EN 12897	'Water supply. Specification for indirectly heated unvented (closed) storage water heaters'.
BS EN 1057	'Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications'.
BS 1566	'Copper indirect cylinders for domestic purposes'.
BS 3198	'Specification for copper hot water storage combination units for domestic purpose'.
BS 7291	'Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings'.
BS 8558	'Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806'.

Adequate supply

The design and installation of the water services supply should:

- be in accordance with building regulations, statutory requirements and the recommendations of the water supplier
- ensure drinking water is provided at the kitchen sink direct from the supply pipe or, where this is impracticable, from a storage cistern containing an adequate supply of drinking water
- be based on a minimum 1.5 bar dynamic pressure at the stop valve inside the home
- ensure a minimum 20L/min flow rate is available at the stop valve inside the home
- account for pressure and flow rate reductions (a wider supply pipe may be required inside the home)
- account for pressure fluctuations and surges, which may occur within the system and potentially damage fittings (surge arresters may be required)
- ensure that stop valves within the curtilage and outside the home are protected by a shaft or box
- ensure service pipes are a minimum of 750mm below the ground surface – where this is not possible, adequate precautions should be taken against frost and mechanical damage
- ensure that underground ducts are sealed at both ends to prevent the entry of fluids, vermin and insects
- be of materials which are safe and minimise the risk of corrosion
- be in accordance with the recommendations of the water supplier, including compatibility of the supply with the materials and fittings.

The water system should be capable of being drained (hot and cold services separately).

Durability

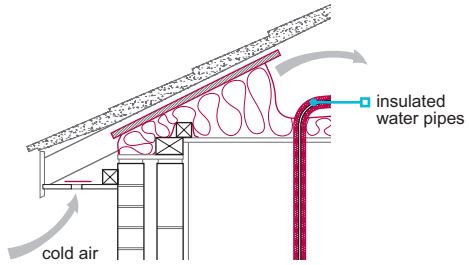
The hot and cold water service should be installed using corrosion resistant pipes and fittings.

In areas where pitting corrosion of copper cylinders occurs, it may be necessary to fit aluminium protector rods. These should be fitted during manufacture in accordance with the relevant British Standard. Sacrificial anodes should be installed where required by the water supplier.

Protection from the cold

To reduce the risk of freezing, water services should be located in the warm envelope of the home. Where they are located in unheated spaces, they should be insulated and not affected by cold. Insulation should be provided:

- around water services, including pipework (in accordance with Tables 1 and 2), cisterns and vent pipes (particular care is needed around bends and junctions, especially near openings to the outside air, such as eaves)
- as specified in the design (but not beneath a cold water tank)
- on each side of raised tanks in unheated roof spaces
- in accordance with BS EN 806 and BS 8558.



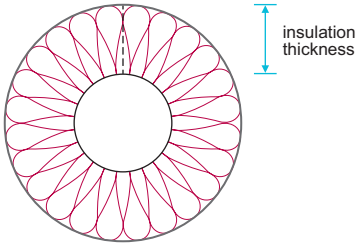


Table 1: Minimum insulation thickness to delay freezing inside domestic premises for cold water systems

Outside diameter (mm)	Thermal conductivity at 0°C W/(m.K)			
	0.025	0.035	0.045	0.055
	Thickness of thermal insulation (mm)			
15	30	62	124	241
22	12	20	30	43
28	8	12	17	23

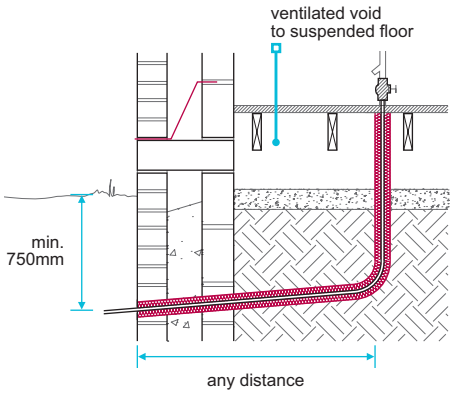
The conditions assumed for the table are:

- air temperature -3°C
- water temperature +5°C
- permitted ice formation 50%
- evaluation period 24 h.

Table 2: Examples of insulating materials:

Thermal conductivity W/(m.K)	Material
Less than 0.020	Rigid phenolic foam
0.021 to 0.035	Polyurethane foam
0.040 to 0.055	Corkboard
0.055 to 0.07	Exfoliated vermiculite (loose fill)

Where the floor is of suspended construction, the underfloor water service should be insulated as it passes through the ground and the ventilated space.



8.1.4 Cold water storage

Cold water service shall be provided in accordance with statutory requirements and be adequate.

Cold water storage should be provided with suitable capacity and include primary feed cisterns where indirect water heating systems are installed. Cold water storage should be provided:

- to supply an open vented hot water storage system (where required by the water supplier)
- to supply cold water outlets (where not connected to the mains supply).

Cisterns should:

- be accessible for inspection and maintenance
- be protected by a rigid close-fitting cover (non-airtight) that also excludes light and insects
- have holes neatly formed with a cutter in the positions shown in the design
- be suitably supported.
- Storage capacity for small homes – only cold water fittings – 100-150L.
- Storage capacity for small homes – supplying hot and cold outlets – 200-300L.
- Storage capacity for larger homes – 100L per bedroom.

Warning and overflow pipes:

- should be provided at each cold water cistern, to a suitable external discharge, unless permitted by water regulations where it may be internal if it is conspicuous
- should be adequately sized (19mm minimum)
- should be situated 25mm from the shut-off water level in the cistern
- may dip below the water level in accordance with water regulations, terminate vertically downwards or be fitted with a horizontal tee where it discharges.

The cistern bottom should be continuously supported by materials such as:

- softwood boarding
- marine plywood
- chipboard type P5 to BS EN 312
- oriented strand board type OSB3 to BS EN 300, laid with the stronger axis (as marked on board) at right angles to the bearers.

Access should:

- be provided to the main roof space and voids that contain cisterns and tanks, etc. (not required to roof spaces containing only water pipes)
- be via an opening (access hatch) with a minimum width of 520mm in each direction
- not be located directly over stairs or in other hazardous locations
- include a minimum 1m^2 platform located for maintenance purposes
- include securely fixed boarded walkways between the opening and the cistern or other permanent equipment (boarding should be securely fixed without compressing the insulation).

8.1.5 Hot water service

Also see: BS 8558

Hot water service shall be provided in accordance with statutory requirements and be adequate for the demand and consumption.

Hot water services should be designed in accordance with Tables 3, 4 and 5, and:

- the minimum flow rate should be in accordance with the statutory requirements and generally be available; it may be less where the pressure and flow rate of the incoming supply falls below 1.5 bar
- have the design flow rate available at each outlet when the total demand does not exceed 0.3L/s (where simultaneous discharge occurs, the flow rate at individual outlets should not be less than the minimum rate).

Table 3: Flow rate and temperature requirements

Outlet	Design flow rate (1)		Minimum flow rate (2)		Supply temperature °C (3)
	L/sec	(L/min)	L/sec	(L/min)	
Bath (from storage)	0.30	(18)	0.15	(9)	48
Bath (from combi)	0.20	(12)	0.15	(9)	40
Shower (non-electric)	0.20	(12)	0.10	(6)	40
Wash basin	0.15	(9)	0.10	(6)	40
Sink	0.20	(12)	0.10	(6)	50

Notes

1 The design flow rate should be used to establish the hot and cold pipe sizes to provide the flow rate quoted at each outlet when that outlet is used on its own.

2 The minimum flow rate should be available at each fitting when that fitting is used simultaneously with one or more other fitting(s) as shown in Table 4.

3 The supply temperature is the temperature at the outlet. In accordance with BS 8558 the water temperature at an outlet or thermostatic mixing valve should be at least 50°C within 1 minute of running the water.

Table 4: Hot water demand and simultaneous use

Bathroom		Shower room		Hot water demand (5)	
Bath only	Bath + Shower (1)	1st Shower room	2nd Shower room	L/sec	(L/min)
✓ (2)				0.20	(12)
		✓ (3)		0.15	(9)
✓		✓		0.25	(15)
✓		✓	✓	0.35	(21)
	✓ (2)			0.20	(12)
	✓ (4)	✓		0.20	(12)
	✓ (4)	✓	✓	0.30	(18)
		✓	✓	0.20	(12)

Notes

1 Shower may be over the bath or in a separate enclosure within the bathroom.

2 Demand based on 'Design' flow rate of bath.

3 Demand based on minimum acceptable boiler output.

4 Demand based on use of the shower in preference to the bath.

5 The hot water system should supply at least the hot water demand stated and take account of distribution heat losses through the pipework. The suitability of instantaneous systems (combination boilers) will be limited by their performance as quoted by the boiler manufacturer.

Hot water storage should comply with the minimum capacity in Table 5 (based on a draw-off temperature of 60°C), and where appliances require greater volumes, the capacity should be increased accordingly.

Table 5: Minimum storage requirements

Shower only	Bath only	Bath and shower(s)(1)	Two baths
60L	120L	145L	180L

Note

1 Maximum of two showers (excludes instantaneous electric showers).

Where systems are heated by off-peak electricity, the storage capacity should be in accordance with the recommendations of the electricity supplier.

Where homes have one bathroom or shower room, the system should be able to provide adequate hot water:

- immediately after the bath has been filled, for tasks such as washing
- for a second bath after 20 minutes.

Where homes have two or more bathrooms, the system should be able to provide adequate hot water immediately after each of the baths have been filled, for tasks such as washing.

Where a shower is installed, adequate provision should be made to ensure that the outlet temperature of the water is not significantly affected by the use of other hot or cold outlets in the home. This may be achieved by the provision of a thermostatic shower mixing valve, the appropriate design of pipe sizes or dedicated supplies.

Instantaneous systems (using combination boilers) produce hot water on demand (generally at lower flow rates than storage systems), and should only be used where:

- simultaneous demand for hot water is limited. Where there are three or more outlets, the design for simultaneous discharge can omit the outlet at the kitchen sink
- storage combination boilers have the capacity as required in Table 5. Where boilers can control and prioritise hot water outputs the storage capacities can be less than the figures in Table 5 subject to manufacturer's recommendations on meeting the demand.

Storage systems provide higher flow rates than instantaneous systems, and:

- require a suitable space for the siting of the storage vessel
- where vented, should be provided with an expansion pipe.

Unvented hot water storage systems should be:

- assessed in accordance with Technical Requirement R3, or meet the requirements of BS EN 12897 and be the subject of third-party certification, e.g. Kitemarking (applies to both the assembled system and components)
- installed by competent installers.

Hot water cylinders should be:

- supported in accordance with manufacturer's recommendations
- installed vertically, unless designed otherwise
- accessible for maintenance
- insulated as specified in the design.

Where an immersion heater is fitted, it should be:

- appropriate for the type of water supplied to the home
- controlled by a thermostat
- located to facilitate replacement
- fitted with an on/off switch.

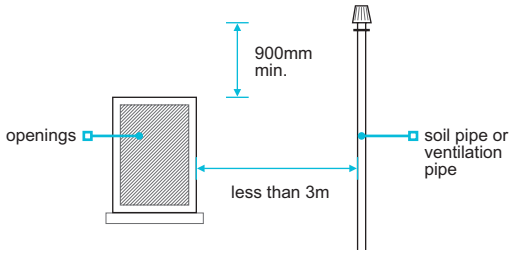
8.1.6 Soil and waste systems

Also see: BS EN 752 and BS EN 12056

Soil and waste systems shall be in accordance with relevant building regulations and installed to ensure that effluent is removed without affecting health or creating unnecessary noise and smell.

Soil and waste systems should be:

- in accordance with the requirements of the water supplier
- adequately ventilated at the head of underground drains (this may be by a soil pipe or separate ventilation pipe)
- adequately ventilated at each branch
- arranged to ensure foul air from the drainage system cannot enter homes (e.g. ventilated to 900mm above openings when within 3m)
- fixed neatly and securely to provide the correct falls
- fitted to prevent the entry of vermin.

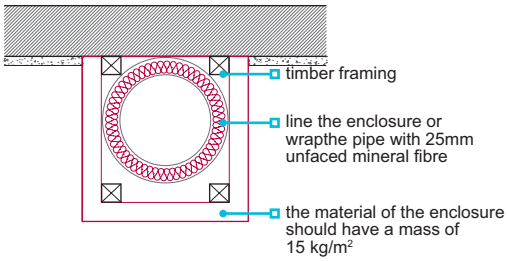


Air admittance valves should:

- be used to allow air to enter the drainage system (but do not avoid the need to ventilate it adequately)
- where used to terminate a soil pipe, comply with BS EN 12380 or be assessed in accordance with Technical Requirement R3
- not be positioned in areas which are liable to freezing
- have free movement of air around them which can be achieved by ventilation grilles, discreet gaps around the boxing or ventilation of the boxing into a ventilated roof void (the ventilation area should be 2500mm^2 minimum unless otherwise specified by the manufacturer)
- where positioned within the home, be accessible for maintenance.

Sound insulation should be provided to soil pipes passing through homes by:

- an encased boxing, using a minimum 15kg/m² board material and wrapping the pipe with a minimum 25mm of unfaced mineral fibre (the insulation should be continued through the thickness of each sound-insulating floor).



Sanitary fittings should be:

- installed with accessories, such as chains and plugs
- secured using non-ferrous or stainless steel screws or fixings appropriate to the weight of item being secured
- fitted without using excessive packing
- fitted to ensure WC lids and seats are stable when open.

Waste disposal units should be:

- provided with adequate support
- fitted with a tubular trap (not bottle or resealing)
- connected to the drainage system in accordance with the manufacturer's instructions.

The junctions of wall tiling with baths and showers should be made watertight using a flexible sealant to accommodate movement. The manufacturer's instructions should be followed.

8.1.7 Electrical services and installations

Also see: BRE report 'Thermal insulation: avoiding risks'

Electrical installations shall be provided in accordance with relevant regulations, codes and standards. The installation shall ensure safe and satisfactory operation and be protected from chemical attack.

Electrical services and installations should:

- comply with BS 7671 'Requirements for electrical installations'
- comply with BS 6004 'Electric cables. PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting'.
- have fittings and components located in accordance with relevant building regulations
- be installed in accordance with the manufacturer's recommendations
- ensure cables are not placed under, against or within thermal insulation, unless they have been appropriately sized and derated
- ensure PVC covered cables are not in contact with polystyrene insulation.

Rooms should be provided with the minimum number of 13A outlets listed in Table 6 (dual outlets count as two).

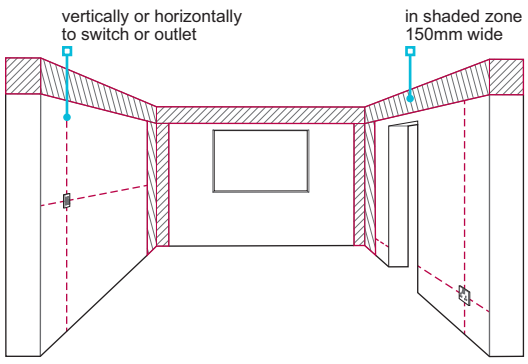
Table 6: Minimum number of outlets

Room	Outlets	Notes
Kitchen/utility	8	Where homes have separate areas, the kitchen should have a minimum of four outlets and the utility room four. Where appliances are provided, a minimum of three outlets should be free for general use.
Living or family room	8	A minimum of two outlets near the TV aerial outlet.
Bedrooms	6 (4)	A minimum of six outlets for the main bedroom and a minimum of four outlets for other bedrooms.
Dining room	4	
Landing	2	
Hall	2	

Cables without special protection, such as an earthed metal conduit, should be positioned:

- vertically or horizontally from the outlet or switch being served
- within the shaded zone in the diagram, or
- a minimum of 50mm from the surface of a wall, or a minimum of 50mm from the top or bottom of a timber joist, or batten in a floor or ceiling.

Where the position of switches or sockets can be determined from the reverse side of the wall or partition, the zone on one side of the wall or partition applies to the reverse side.



Lighting outlets

Lighting outlets should be provided:

- in each room, hall, landing and staircases
- with two-way switching at each floor level in a staircase
- in the common areas of homes and controlled by either manual switching or automatic light-sensitive controls.

Cooking spaces

Cooking spaces should:

- have a minimum 30A supply which is suitably switched and terminated
- have a 13A socket outlet where there is a gas supply
- where provided, have cooker panels located to the side of the cooker space.

Electrical supply to gas appliances

Where a gas appliance requires an electrical supply, a suitable fixed spur or socket outlet should be provided.

TV

Aerials are not required; however, one of the following should be provided:

- a concealed, coaxial cable from the roof void to a terminal outlet in the main living room
- a conduit and draw wire or suitable alternative.

8.1.8 Gas service installations

Also see: Chapters 6.2, 6.8, BS 6400 and BS 6891

Gas service installations shall be adequate and comply with the gas safety regulations, and be in accordance with relevant standards and codes to ensure safe and satisfactory operation.

Gas service installations should ensure:

- service pipework up to and including the emergency control valve and meter is in accordance with the requirements of the gas transporter, gas supplier and primary meter owner
- installation of pipework and appliances complies with relevant standards and codes including those published by the Institution of Gas Engineers and Managers (IGEM) or Gas Safe Register (GSR)
- where there is a gas supply to the home, a gas point at the cooker space should be provided. This is not required where an electric hob is provided
- where gas pipework is to be installed in timber frame, allowance is made for differential movement.

8.1.9 Meters

Also see: Chapter 6.1

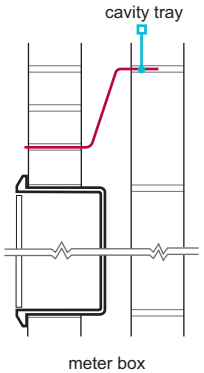
Openings in walls for meter cabinets shall be structurally adequate and prevent dampness entering the home.

Openings set into external walls should be provided with:

- DPCs and cavity trays
- lintels (except for purpose-designed built-in meter boxes).

Meters and associated equipment should be located to be reasonably accessible and not subject to damage.
Domestic meters may be of the following type:

- Built-in (to the outer leaf of the wall).
- Surface-mounted (on an external wall).
- Semi-concealed (sunk into the ground adjacent to the outer wall).
- Individually purpose-made compartments in accordance with the recommendations of BS 6400.



8.1.10 Space heating systems

Also see: Chapter 6.8

Where space heating is provided, it shall be in accordance with the relevant codes and standards, and ensure safe operation.

Where appropriate, space heating systems should comply with the following:

BS 5410	'Code of practice for oil firing'.
BS EN 14336	Heating systems in buildings. Installation and commissioning of water based heating systems.
BS 8303	'Installation of domestic heating and cooking appliances burning solid mineral fuels'.
BS EN 12828	'Heating systems in buildings. Design for water-based heating systems'.
BSRIA guide BG 4/2011	'Underfloor heating and cooling'.

Space heating appliances, including all components and controls, should be of a type approved by the relevant authority, including:

- Solid fuel – Solid Fuel Association, Heating Equipment Testing & Approval Scheme
- Electricity – British Electrotechnical Approvals Board
- Oil – OFTEC.

The provision of whole home or central heating is discretionary. Where provided, it should be designed in accordance with Table 7, recognised standards, and:

- the number of air changes per hour from kitchens and bathrooms should account for any mechanical ventilation
- where rooms contain open flued appliances, the rate of air change used for the design should be increased in accordance with BS EN 12831
- design temperatures should be verified by calculations and not by performance tests
- the main living room should have a heating appliance or a heat output as part of a whole home heating system
- temperature calculations should be based on a -3°C external temperature.

Table 7: Room temperatures and ventilation rates

Room	Room temperature °C	Ventilation rate (air changes per hour)
Living room	21	1.5
Dining room	21	1.5
Bedroom	18	1
Hall and landing	18	1.5
Kitchen	18	2
Bathroom	22	2
Toilet	18	2

8.1.11 Installation

Internal services shall not adversely affect the stability of the home and be installed to ensure satisfactory operation. Issues to be taken into account include:

a) fitting of pipes and cables
b) notching and drilling of joists
c) concealed services.

Fitting of pipes and cables

Services should:

- comply with Chapter 5.1 'Substructure and ground-bearing floors' where they pass through the substructure
- be protected by a sleeve, or ducted, when passing through structural elements and not solidly embedded
- not be located in the cavity of an external wall, except for electricity meter tails
- not be buried in screeds unless permitted by relevant codes of practice.

Where copper pipes are permitted in floor screeds, they should be:

- sleeved or wrapped so that they can move freely along the length and at joints and bends
- jointed with capillary joints.

Pipes should:

- be adequately secured with suitable clips or brackets
- be installed neatly with clips spaced to prevent sagging, but not restrict thermal movement
- have adequate falls (where appropriate)
- be installed with adequate room for thermal expansion and contraction to avoid damage and noise.

Metallic tape should be placed behind plastic pipework, where it is concealed behind wall surfaces, and would otherwise not be located by a metal detector or similar equipment.

Joints in pipes should be made:

- strictly in accordance with the manufacturer's instructions
- using lead-free flux recommended by the pipe manufacturer, with traces removed immediately after jointing.

Fire stopping should be provided around any services which penetrate fire-resisting floors, walls or partitions. Where a proprietary system, such as an intumescent seal is used, it should be installed in accordance with the manufacturer's instructions.

Notching and drilling of joists

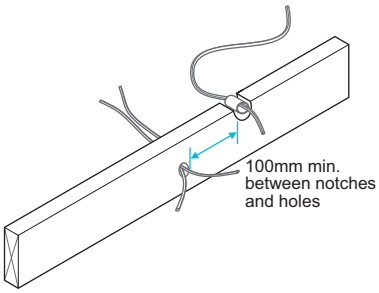
Notching, drilling and chasing to accommodate service pipes and cables should either:

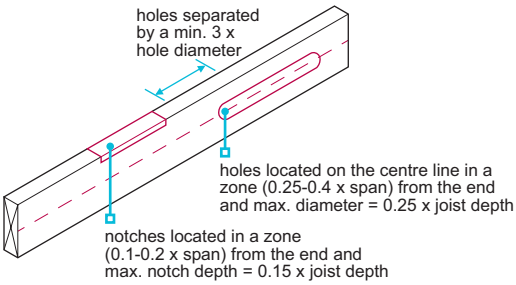
- comply with the clauses below, or
- be designed by an engineer.

Solid timber and studs

Table 8: Limits for notching and drilling solid timber members

	Location	Maximum size
Notching joists up to 250mm in depth	Top edge 0.1-0.2 x span	0.15 x depth of joist
Drilling joists up to 250mm in depth	Centre line 0.25-0.4 x span	0.25 x depth of joist
Drilling studs	Centre line 0.25-0.4 x height	0.25 x depth of stud





Where the structural strength is impaired by notching or drilling, the element should be replaced or correctly repaired.

Holes should be spaced at a minimum of three times the hole diameter.

Notches and holes in the same joist should be separated by a minimum horizontal distance of 100mm.

Instructions should be obtained from the designer when notching and drilling, where:

- the joist is deeper than 250mm, or
- the dimensions are not in accordance with Table 8, or
- it is close to heavy loads, such as those from partitions, cisterns, cylinders and stair trimming.

I-joists

Preformed holes are provided, and additional holes and notches should not be cut without the approval of the manufacturer.

Metal web joists

Services should run in the gaps between the metal webs. Conduits may need to be inserted before the joists are fixed in position.

Lightweight steel

Light weight steel should be used in accordance with Chapter 6.10 'Light steel framed walls and floors'.

Concealed services

Services concealed in walls or floors should be located so that significant cracking of the surface does not occur. Where chases in walls are necessary, their depth should not exceed:

- 1/6 thickness of the single leaf for horizontal chases
- 1/3 thickness for vertical chases.

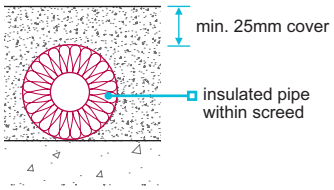
Hollow blocks should not be chased unless specifically permitted by the manufacturer.

Pipes under floor screeds should:

- be protected by wrapping or ducting
- have adequate allowance for thermal expansion, particularly at changes of direction.

Screed cover should be a minimum of 25mm over pipes and insulating material, and:

- where pipes cross, it may be necessary to form a duct to achieve adequate cover



- for in-situ suspended concrete floors, the location and depth of pipes should be approved by the designer.

8.1.12 Extract ducts

Also see: Chapter 8.3

Ductwork to intermittent and continuously running mechanical extract ventilation systems shall ensure satisfactory performance and durability. Issues to be taken into account include:

a) building integration
b) resistance to airflow
c) control of condensation
d) installation
e) terminals.

Building integration

The route of ductwork should take account of other building elements. Ductwork passing through structural elements should not adversely affect the structural or fire performance of the building. Where alterations to structural elements, such as I-joists, are required, this should only be carried out in accordance with the manufacturer's recommendations, or be designed by an engineer in accordance with Technical Requirement R5.

The fire requirements of the building should be in accordance with relevant building regulations and standards. Issues that should be taken into account include:

- suitable detailing of components passing through other elements of the building
- the location and type of dampers and firestops to be used
- the integrity of protected stairs and halls
- the integrity of walls and floors.

Resistance to airflow

Ductwork systems should be designed to minimise the resistance to airflow, and be formed from compatible components.

Rigid duct is preferable to flexible, but where flexible duct is used, it should be restricted in length to ensure that the airflow resistance does not prevent the designed ventilation rate from being achieved. Flexible duct should be installed:

- straight
- in accordance with the manufacturer's recommendations.

Bends should generally be formed with proprietary rigid components. Where flexible duct is used to form bends on an intermittent extract system, they should be restricted to a maximum of:

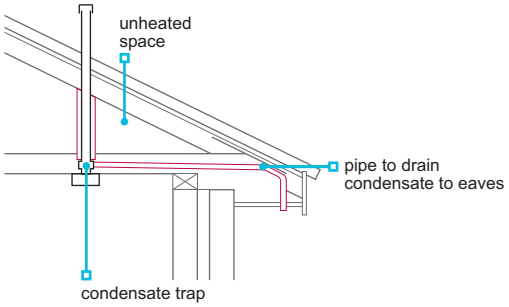
- two for systems up to 30 L/s
- one for extract rates higher than 30 L/s.

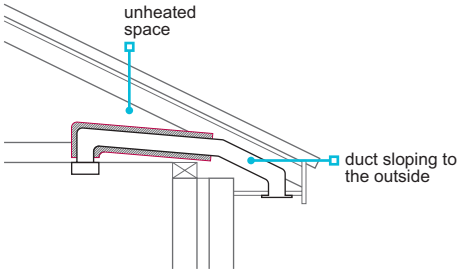
Control of condensation

Where extract ductwork passes through unheated spaces, it should be continuously insulated to achieve a thermal resistance equivalent to a minimum of 25mm of insulating material with a thermal conductivity of 0.04W/(mK). This can be achieved by using:

- suitable pre-insulated ductwork, or
- a proprietary insulation system.

Alternatively, the ductwork can be fitted with a condensate trap that discharges to the outside or installing the duct to slope to the outside.





Installation

Ductwork should be installed in a neat and workmanlike manner, be securely fixed, and have:

- adequate support throughout its length
- sealed mechanically fixed joints and connections.

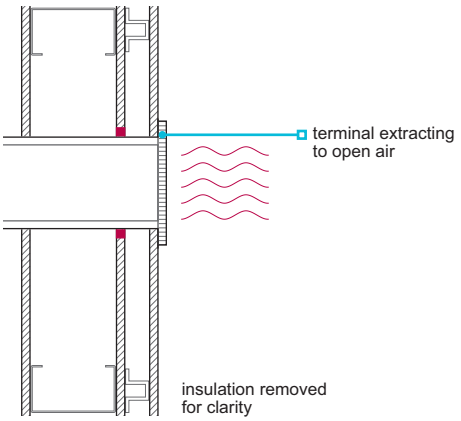
Where ductwork passes through an external wall, it should be positioned to slope slightly outwards to prevent water entering the building. Clips and supports for ductwork should be spaced at equal distances and in accordance with the ductwork manufacturer's recommendations. For rigid ductwork, they should not generally be more than 750mm apart.

Ductwork should not be in direct contact with other surfaces, such as plasterboard ceilings, that may transfer noise to the home.

Terminals

Ventilation systems should terminate freely to open air.

The air flow resistance of terminals should not adversely affect the performance of the ventilation system. Airflow resistance of terminals can be obtained through testing in accordance with BS EN 13141-2.



8.1.13 Testing and commissioning

Services shall be tested and commissioned to ensure satisfactory operation.

Services should be tested:

- in accordance with all relevant regulations and codes of practice
- where pipes are located under screeds (including air or water testing before and after the screed is laid)
- to ensure leaks or other defects are made good prior to the application of finish and handover of the home.

Before completion and handover of the building services should be commissioned in accordance with relevant regulations and codes of practice.