
British Standard Code of practice for
**Accommodation of building
services in ducts**
(Formerly CP 413)

Logement des branchements d'immeubles dans les conduits — Code de bonne pratique

Leitfaden für die Führung von Versorgungsleitungen in Schächten oder Kanälen

Foreword

This British Standard code of practice has been prepared under the direction of the Building Services Policy Standards Committee and is a revision of CP 413 : 1973, which is withdrawn. Appendix A of CP 413 : 1973 dealt with fire precautions for ventilation ductwork. This subject is included in BS 5588 : Part 9.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

This standard represents a standard of good practice. In particular attention is drawn to 5.1.

Although this standard does not set out to include service ducts between buildings, people concerned with these ducts may find it useful.

Figures 3 to 28 and tables 2 to 8 have been taken from the text of ISO/DIS 6604. Figure 2 has been based on Hospital Memorandum 23 with the permission of the Department of Health and Social Security.

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

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Section one. General information

1 Scope

This British Standard gives recommendations for the design, construction, installation and maintenance of fixed ducts in buildings used for the accommodation of services. It also covers enclosures such as ceiling voids and cavities which are used for services but which are not always referred to as ducts.

The recommendations in this standard should also be applied as far as practicable to the adaptation, modification or refurbishment of existing ducts and services within them. Appropriate precautions should be taken in all cases where the existing ducts contain hazardous materials e.g. asbestos.

This standard covers service ducts attached to the outside of buildings but not service ducts between buildings.

This standard does not cover the design and construction of air or refuse ducts, nor with 'heart units', 'packaged plumbing' or 'service walls', although parts of it are relevant to them.

This standard does not cover spaces intended mainly for purposes other than the accommodation of services, nor with plant areas such as boiler and calorifier rooms or gas storage areas.

The piping of radioactive substances and the specialist requirements for piping cryogenic liquids are generally outside the scope of this standard.

Special precautions should be taken where piped cryogenic and radioactive substances are proposed and should only be taken after specialist advice is obtained regarding materials, ducts, installation, marking and protective clothing for operatives (for further information on cryogenic liquids see BS 5429).

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1 cavity barrier. A construction provided to seal a cavity against the penetration of smoke and flame, or within a cavity to restrict the movement of smoke and flame within the cavity.

2.2 fire compartmentation. The division of a building into compartments by elements of building construction intended to resist the passage of fire, and capable of meeting specified performance criteria to those ends.

2.3 fire door. A door or shutter provided for the passage of persons, air or objects which, together with its frame and furniture as installed in a building, is intended when closed, to resist the passage of fire and/or gaseous products of combustion and is capable of meeting specified performance criteria to those ends.

2.4 fire resistance. The ability of a component or construction of a building to satisfy for a stated period of time some or all of the criteria specified in the appropriate Part of BS 476, currently Part 8, namely stability, integrity and insulation.

2.5 fire stop. A seal provided to close an imperfection of fit between elements, components or construction in a building, or any joint, so as to restrict penetration of smoke and flame through that imperfection or joint.

2.6 firm obstacle. Any obstacle such as will interfere with the installation, dismantling or maintenance of a service.

2.7 flash point. The lowest temperature at which vapour from oil, etc. can be ignited by an external source. (See BS 2000 : Part 33 and also 6.2.2.)

2.8 installation space. The recommended minimum space necessary for the installation and maintenance of one or more services, where access is limited by a firm obstacle. It is expressed as a rectangular envelope at right angles to and at any point along a run of services. It includes allowances for supports, thermal and sound insulation, and safety margins.

2.9 material of limited combustibility. Any material which conforms to any of the specifications given for materials of limited combustibility in the Approved Document published in connection with B2/B3/B4 of the Building Regulations 1985.

2.10 nominal size. Reference dimensions used for the purpose of designation of the size of a service.

2.11 non-combustible. Capable of satisfying the performance requirements specified in BS 476 : Part 4.

2.12 protected shaft. A stairway, lift, escalator, chute, duct, or other shaft, which enables persons, objects or air to pass from one compartment to another.

2.13 protected stairway. A stairway, including any exit passageway leading therefrom to its final exit, enclosed with (other than any part that is an external wall of a building) fire-resisting construction.

2.14 service duct. An enclosure for the accommodation of building services.

3 Exchange of information

3.1 Responsibility for design

Before work is begun, a person should be appointed to be responsible for design of the service ducts and coordination of the services within them.

3.2 Consultation and co-ordination

The necessary consultation and co-ordination should be carried out and particular attention should be paid to the following points:

- (a) brief from client;
- (b) system for ensuring that drawings and specifications reach those who need them;
- (c) system for spatial coordination;
- (d) project programme;
- (e) consultation with planning, building regulations and fire authorities;
- (f) consultation with gas, electricity, water, sewerage and telecommunications authorities;
- (g) consultation with insurers;
- (h) consultation with suppliers of special services such as industrial and medical gases (or other authoritative source);
- (i) operation and maintenance instructions.

The possibility of increased future requirements owing to further development within or adjacent to the project should be considered.

NOTE. Lack of systematic advance planning of services can result in delays and expensive alterations.

Section two. Materials and components for the construction of ducts

4 Materials and components

4.1 British Standards

Materials and components should comply with relevant British Standards.

4.2 Choice of materials and components

Factors that should be considered when duct materials and components are selected are as follows, not necessarily in order of importance.

- (a) *Mechanical properties.* Strength, elasticity, ductility and mass.
- (b) *Electrical properties.* Electrical conductivity and electrical insulating strength (for insulators). Insulating materials may create the risk of electrostatic discharges.
- (c) *Chemical properties.* Corrosion, dissolution or other failure may result from reaction with other constituents of the duct or services (e.g. galvanic corrosion of mixed metals), escape of gases or liquids within the duct, or the action of water vapour, steam or other vapours in the air.
- (d) *Thermal properties.* Thermal conductivity, thermal expansion and stability.
- (e) *Acoustic properties.* Acoustic absorption and insulation.
- (f) *Health hazards.* The material or component once installed should not be hazardous to persons or to the environment. Materials that are poisonous or produce

harmful gases or dusts before or during installation should be closely controlled. Attention is drawn to the controls in relation to asbestos imposed by the Health and Safety at Work etc. Act 1974, the Asbestos Regulations 1969, the Asbestos (Licensing) Regulations 1983 and the Asbestos (Prohibition) Regulations 1985.

Guidance on work involving exposure or potential exposure to asbestos is found in various publications issued by the Health and Safety Executive, including the Approved Code of Practice and Guidance Notes E35, E36 and E37. Components should be free of sharp edges and projecting spikes, and be easy to assemble.

(g) *Resistance to fire.* The combustibility, fire resistance and resistance to fire spread of the completed duct and its contents should always be assessed as part of the overall fire engineering design of the building.

(h) *Resistance to pests.* Materials should not be liable to attack by insects, fungi or vermin or should be protected by suitable preservatives.

(i) *Cost and availability.* Cost and availability affect both construction and maintenance.

(j) *Ease of installation and maintenance.* Materials and components should be chosen taking into consideration the labour, tools and equipment likely to be available for installation and maintenance, including cleaning. If installation and maintenance is easy, it is more likely to be done properly.

Section three. Design

5 General

5.1 Statutory provisions

Attention is drawn to the Acts, Regulations and Byelaws listed in appendix D.

5.2 Principles of general arrangement

Most projects require that services be enclosed for part of their route through the building or buildings. Services may be enclosed in a variety of types of space.

Service ducts may be formed as part of the building structure or as non-load-bearing elements.

Service ducts may be inside a building or attached to its outside along their length.

The complexity of the system of service ducts and associated spaces will depend on the size of the project and the density of the services within it. The system should always be considered as a whole. Every effort should be made to simplify it, in order to ease design, construction and maintenance.

The starting point for the general arrangement should be a sketch or sketches showing the proposed service ducts, which services they are intended to contain and the approximate capacities. The point of entry for services should normally be on that side of the building nearest to the street in which the mains are installed.

It is often appropriate to build up the duct system from the following three types of ducts:

- (a) horizontal main ducts;
- (b) vertical main ducts;
- (c) secondary ducts.

The designer may use some other system if appropriate.

In multi-storey buildings, a smaller number of large vertical ducts with adequate provision for horizontal distribution above ceiling level and below structural members, or in service floors, will generally give the most flexible arrangement.

A larger number of smaller vertical ducts with ceiling spaces for horizontal distribution as necessary will generally be less flexible. The omission of space above ceilings generally produces the least flexible arrangement.

In single-storey buildings, accommodation for services may be needed below floor level, or above ceiling level, or both.

External ducts should be weather resistant. Underground ducts should be resistant to the entry of ground water and chemical attack by the soil, and be able to accommodate soil movement.

5.3 Interaction of duct layout with building design

The spaces required for services should be incorporated in the building design from the earliest sketches. If sufficient space is not allowed in the initial concept it can be extremely difficult to achieve a satisfactory solution in the completed project. Information on space allowances for ducts is given in clause 7.

Close co-operation between the designers of the services and of the building is essential. Particular attention should

be given to the design of service entry and exit points, to ensure that the building is not weakened and that services are protected from differential movement. It is sometimes necessary to make holes in load-bearing walls or floors for the passage of services, to resite beams or columns or to re-route services to avoid them.

Openings for services are weak points in the fire compartmentation of a building. Their number and size should be minimized, and close attention paid to their detail design.

Consideration should be given to routing of services to avoid escape routes, hazardous areas and clean areas.

The necessary precautions should be taken in design to provide adequate control of noise transmission between different parts of the building. Suitable planning of the duct position may reduce noise transmission. Structural precautions to reduce transmission include adequate mass of the duct walls, the sealing of gaps to avoid transmission via air paths, adequately designed access panels (which should be kept to a minimum in size and number) and, if necessary, the introduction of barriers at floor levels in vertical ducts. (See BS 8233.)

5.4 Thermal insulation

Hot or cold pipes and air ducts should be insulated in accordance with BS 5422 and BS 5970. Barriers across the duct or thermal insulation of the duct walls may be necessary to prevent damage to the building or contents or discomfort to the occupants (see also 12.2.1).

6 Restrictions on positioning and combination of services

6.1 General

6.1.1 The consequences of the failure of the services by themselves or in conjunction with other services should be considered and if this could introduce a hazard the services should be segregated.

NOTE. Where this standard recommends certain services to be accommodated in separate ducts and the separate ducts are adjacent, the division between the ducts should afford adequate separation and fire resistance consistent with the hazards involved.

6.1.2 Hazardous materials such as flammable, oxidizing, toxic or corrosive gases or liquids should only be run in ducts when there is no safe practical alternative.

Gas pipes may be run in ducts provided the recommendations of 6.2.3 are applied. Where other hazardous materials have to be in pipes in ducts, then the recommendations of 6.2.2 to 6.2.6 should apply.

6.1.3 Services not associated with lifts should not be run in lift wells (see 5.8 of BS 5655 : Part 1 : 1979 and 2.1 of BS 2655 : Part 1 : 1970).

6.1.4 Services should only be run in air ducts if the following points are taken fully into account at the design stage of the air ducts and the system of which they are part.

- (a) The consequences of gases, vapours or liquids escaping from piped services and being transported around the building. In no case should services be run in

toxic or flammable substances be routed through air ducts.

(b) Services within an air duct will increase its resistance to air flow and make it more difficult to clean the duct. Service penetrations through the duct wall may increase air leakage. Both of these factors may increase the duct size and, in the case of mechanical systems, the fan size and power required to achieve specified air flow rates at the terminals.

6.1.5 Cavities in walls and partitions should not be used as service ducts unless suitable for that purpose. Routing of flammable, oxidizing, toxic or corrosive services through such cavities in structural walls should be avoided where practicable, but, if this is necessary, special precautions should be taken. Some points to be considered are as follows.

- (a) The requirements of the Gas Safety Regulations 1972 and the Gas Safety (Installation and Use) Regulations 1984.
- (b) Services should take the shortest practical route through the cavity.
- (c) In the case of flammable, oxidizing, toxic and corrosive services, use of high integrity pipework (e.g. avoiding joints within the cavity etc.) and secondary sleeving as appropriate (see **12.5.7(d)(iii)**).
- (d) The dispersal of any leakage in the cavity.
- (e) Provision of access for inspection and maintenance of the service within the cavity.
- (f) The effect on the fire resistance of the wall.
- (g) The effect on the acoustic integrity of the wall.

6.1.6 The effects of leakage of services and the effect of each service on neighbouring services should be considered. For example, water and other fluids can cause damage by corrosion and solvent action. Hot fluids can cause damage by overheating. A jet of fluid escaping from a pressurized service can cause damage by force of impact. The contents of some pipes may be poisonous or infectious. Pipes conveying gases that are heavier than air should be placed at the top of horizontal ducts and those conveying gases that are lighter than air should be placed at the bottom, so that escaping gas will be diluted as much as possible.

6.2 Restrictions for particular services

6.2.1 Hot water, steam and condensate pipes should be insulated to prevent excessive heat loss and high temperatures within the duct. Hot pipes should not be run adjacent to chilled water services, plastics drainage systems or electrical and telecommunications cables, regardless of insulation. Condensate pipes, and screwed joints in steam and pressurized hot water pipes, are particularly liable to corrosion.

Cold, drinking and chilled water pipes should be insulated to prevent condensation and/or a rise in water temperature. (See also **9.4**.)

NOTE. Pipes containing fire-fighting water do not normally require insulation to prevent condensation, as the water is stationary.

Air ducts conveying clean air for ventilation, heating or air conditioning should be insulated, if necessary, to prevent condensation, a change in air temperature or extremes of temperature in the service duct.

Air ducts conveying polluted air from fume cupboards, industrial processes, etc. should be designed and sited considering the particular hazards involved. They should be segregated from other services, if appropriate. All extract ducts from fume cupboards should be under negative pressure where they run through buildings.

Air ducts serving parts of a building or appliances considered to be special risks should, where necessary, be independent of each other and of any air ducts serving other parts of the building. The possibility of fire in extract ducts from frying areas in kitchens should be considered.

Where practical flue pipes should not be run in the same duct as other services. Where this is not practicable, they should be insulated to prevent excessive heat loss and high temperatures where these could present a hazard. Particular attention should be given to maintain any fire separation.

Compressed air pipes do not normally present a hazard to other installations although leaking compressed air may cause injury to personnel.

Vacuum pipes do not normally present a hazard to other installations. Suitable precautions should be taken if they are run in the same duct as any service conveying flammable, oxidizing or corrosive substances.

Electrical installations should comply with the Regulations for Electrical Installations of the Institution of Electrical Engineers. Telecommunications installations should be in accordance with BS 6701. In particular, the following precautions should be taken.

- (a) Cables, conduits, trunking and cable trays should be separated from pipes or other services by at least 25 mm, and more for large services. Alternatively, adjacent metallic surfaces should be electrically insulated.
- (b) Cables and accessories should be selected and installed such that under reasonably foreseeable fault conditions they will not create a hazard either alone or in conjunction with other services.
- (c) Installations should be protected from overheating.
- (d) Telecommunications installations should be protected from interference from electrical installations.

Discharge pipes and drains should be positioned considering the need for access for rodding and the likelihood of escape of liquid during this operation. In horizontal ducts they should, if possible, be positioned below all other services.

6.2.2 For the purposes of this standard gas, vapour and liquid pipelines are classified into groups depending on the major risk associated with the pipeline contents.

- (a) *Group 1. Flammable.* Flammable gases, (e.g. natural gas, hydrogen, propane, butane) flammable liquids, highly flammable liquids, and higher flash point liquids such as oils.

(b) *Group 2. Oxidizing.* For example oxygen, nitrous oxide and oxygen mixtures.

(c) *Group 3. Toxic or corrosive.* For example ammonia, chlorine and certain laboratory wastes.

(d) *Group 4. Hot services (which may scald or burn).* For example steam, high temperature hot water (HTHW) and medium temperature hot water (MTHW) services.

(e) *Group 5. Cryogenic and radioactive substances* (see clause 1).

(f) *Group 6. Other substances.* For example helium, argon, nitrogen and carbon dioxide gases, compressed air and water below 100 °C.

These examples are intended for guidance only; the list is not exhaustive.

Adequate precautions should be taken to prevent asphyxiation of personnel in the duct. In confined spaces air may be displaced by any gas. Except for oxygen and compressed air, any gas or vapour may cause asphyxiation. This has been a common cause of accidents and adequate precautions should be taken (see 13.1).

Where the contents of a pipeline fall into more than one category, the service should be classified according to the primary hazard likely to be encountered but piping arrangements should have regard to all its properties.

The design, installation, operation and maintenance of pipelines should be appropriate to the pipeline contents.

Pipes should be so positioned or protected that they will not be subject to any source of heat likely to cause overheating.

Services should be arranged so that any escape of the pipe contents cannot damage electrical insulation or equipment.

NOTE. 6.2.3 to 6.2.5 should be read in conjunction with each other. See 6.1.1 and 6.1.2.

6.2.3 Pipes conveying flammable gases where the gas is covered by The Gas Safety Regulations 1972 and The Gas Safety (Installation and Use) Regulations 1984 have to be installed in accordance with these regulations.

NOTE. These regulations will normally cover first and second family gases and in some cases third family gases, e.g. town, natural and LPG gases respectively.

In the case of second family gases due regard should be given to the requirements for pipes in ducts as recommended in BS 6891, British Gas publication IM/16* and Institution of Gas Engineers publication IGE/TD/4†.

6.2.4 Pipes conveying flammable gases or flammable liquids (group 1) should only be run in ducts if the following precautions are taken.

(a) Pipes should be of non-combustible material with a melting point not lower than 800 °C but not of asbestos cement.

(b) Ducts should be well ventilated (see clause 11) or, by some other suitable means, it should be ensured that a hazardous atmosphere cannot develop within the duct (see 11.3).

(c) Flammable gases and liquids may be run in ducts reserved solely for that purpose or in ducts containing other flammable gases or liquids, cold water or group 4 substances but should not be run in the same duct as any other service(s) unless adequate precautions are taken to ensure the safety of the combined installation and the installation does not contravene any Regulations or other codes of practice.

(d) Pipes conveying liquefied flammable gases should not be run in ducts unless the duct is filled with a crushed inert infill to reduce to a minimum the volume of any gas emission which may accumulate. The infill material should be dry, non-absorbent, chemically neutral and non-combustible, e.g. crushed slate chippings or dry washed sand.

6.2.5 Pipes conveying oxidizing gases (group 2) should only be run in ducts if the following precautions are taken.

(a) Pipes should be of non-combustible material with a melting point not lower than 800 °C but not of asbestos cement.

(b) Ducts should be well ventilated (see clause 11). Where ventilation is impractical, adequate precautions should be taken to ensure that it is not reasonably foreseeable for a hazardous atmosphere to develop within the duct (see 11.3).

(c) Pipes conveying liquefied oxidizing gases should not be run in ducts unless the duct is filled with a crushed inert infill to reduce to a minimum the volume of any gas emission which may accumulate. The infill material should be dry, non-absorbent, chemically neutral and non-combustible e.g. crushed slate chippings or dry washed sand.

(d) Pipes carrying oxidizing gases should not be exposed to any leakage of incompatible materials, e.g. from oil or flammable liquid lines (see 6.2.4(c)).

6.2.6 Pipes conveying corrosive or toxic liquids or gases (group 3) should only be run in ducts if the following precautions are taken.

(a) Ducts should be well ventilated or, by some other suitable means, it should be ensured that a hazardous atmosphere cannot develop within the duct (see 11.3). The provision of ventilation should take into account the toxic properties of the substance(s) involved. Reliance should not solely be placed upon fixed gas detectors for the monitoring of the atmosphere.

(b) Services should be arranged so that escaped corrosive liquid or gas will not damage other services.

(c) Corrosive or toxic substances should not be run in the same ducts as air ducts unless suitable precautions are taken to ensure that dangerous substances cannot be transmitted through the ventilation system.

6.2.7 Pipes conveying refrigerants should comply with BS 4434 : Part 1. Pipes conveying flammable, oxidizing, toxic or corrosive refrigerants should in addition be in accordance with 6.2.2 to 6.2.6, as appropriate.

* Available from British Gas, Marketing Division, 326 High Holborn, London WC1V 7PT.

† Available from the Institution of Gas Engineers, 17 Grosvenor Crescent, London SW1X 7ES.

6.2.8 Pressurized pneumatic pipelines for conveying flammable dusts or powders should not be run in ducts. Where unavoidable, the severe risk of fire and the consequence of a leakage should be taken into account.

7 Space requirements

7.1 Space allowances for ducts at the outline design stage

7.1.1 *Space for air ducts.* The installation space required for supply air ducts for low velocity systems can be estimated by dividing the required air volume flow rate by a velocity of 4 m/s. Return air ducts will normally require as much space as supply air ducts.

7.1.2 *Vertical ducts for piped and electrical services.* The installation space required for vertical ducts for piped and electrical services on each floor of a multi-storey building is usually between 1 m² and 2 m² for each 5000 m³ of building volume.

7.1.3 *Space for additions and alterations.* Between 10 % and 15 % extra space should normally be allowed for future additions and alterations.

7.1.4 *Depth of ceiling voids.* Ceiling voids should have a minimum depth of 500 mm free of structural members. To avoid excessively deep ceiling voids and to ease balancing of systems, each vertical service duct should serve a maximum area of about 1000 m².

7.2 Installation

Sufficient space should be provided for services to be installed without difficulty. Designs that require services to be installed in a particular order should be avoided as far as possible. The installation space and its relationship with outlets should be agreed for each service.

The distance between the outer surface of any service or insulation and any obstruction should be at least as follows:

- 25 mm for pipes
- 25 mm for cables
- 75 mm for union joints
- 100 mm for ducts.

NOTE. More detailed information on air ducts is given in appendices A and B.

7.3 Maintenance

7.3.1 Sufficient space should be provided for the operation, inspection and repair of valves, dampers, cleaning points, expansion joints and other fittings, and the cleaning and painting, if applicable, of the inside of the duct and the services within it.

Additional spacing will be needed for access for tools for work on pipes and ducts. This may be in excess of 250 mm for a typical spanner.

7.3.2 Careful consideration should be given to what degree of demolition of the duct and disruption of

other services will be acceptable when a service is to be maintained or modified. Services should preferably be arranged so that it is possible to remove one without disturbing the others.

7.4 Future requirements

Adequate space should be provided initially to allow for the renewal of services. Most building structures can be expected to last much longer than the services.

7.5 Critical points

The size of a duct is usually determined by space requirements at critical points such as changes of direction, branches or crossings rather than on straight runs.

7.6 Flanges and insulation

The size of a pipe or air duct including connections and/or insulation can be much greater than its nominal size.

7.7 Separation of services

Extra space may need to be allowed for separation of incompatible services (see clause 6).

7.8 Modular co-ordination

If a modular system of dimensional co-ordination is being used for the project, the service ducts and their contents should be dimensioned and positioned within this system.

8 Access

NOTE. See also appendix C.

8.1 Frequency of access

It is essential that adequate access is provided to ducts large enough to be entered (see 12.4).

It may be desirable to provide more frequent access openings to aid the operation, maintenance and replacement of the services.

Access to other ducts should be provided so that all operational items such as valves, dampers, cleaning doors and switches may be readily used.

Access should preferably be provided to all joints and other fittings that may require maintenance. However, it may be more economic to destroy finishes to open up a duct than to provide expensive rarely-used access panels.

8.2 Sizes and positions of access openings

Access openings to ducts large enough to be entered should have the following minimum sizes; as shown in figure 1.

(a) Horizontal ducts:

- 600 mm wide x 900 mm high or long.
- (600 mm wide x 600 mm high minimum)

(b) Vertical ducts:

- 600 mm wide x 1800 mm high.
- (600 mm wide x 1400 mm high minimum)

Larger access openings are desirable, and are necessary if space inside or outside the duct is restricted or if persons wearing breathing apparatus will need to enter the duct.

Access openings to other ducts should be sufficiently large to enable the services within the duct to be operated and maintained. (See also 12.4.)

The position of the access and height of the thresholds should be consistent with safe and convenient use.

8.3 Removal of services

It may be desirable for access openings to be large enough and suitably placed to enable services to be installed and removed with ease.

8.4 Space within ducts

If it is necessary for a person to enter a duct to operate or maintain any service, ventilator, drain or other feature, no dimension of the working space provided within the duct should be less than the following.

(a) Horizontal ducts: width 700 mm, height 1000 mm, volume 1.4 m³.

(b) Vertical ducts: width 600 mm, depth 750 mm, volume 0.9 m³.

The working space should be unobstructed by any services, insulation, ladders or other features. In the case of vertical ducts with fixed ladders, the width is measured in the plane of the ladder and the depth at right angles to it.

8.5 Anthropometric data

Suggested anthropometric data on space requirements and reach distances for men in various positions are shown in figure 2.

8.6 Construction of access doors and covers

Doors and covers should be strong enough to carry any loads or traffic which they may reasonably have to bear. Covers should have adequate lifting facilities.

Each door or cover should be light enough to be opened by one person or by two at the most, or other suitable provision should be made.

Doors and covers should be well fitting. If a duct conveys hot or cold services, it may be desirable to insulate doors and covers, to prevent discomfort to people or damage to materials or finishes outside the duct by conduction or air leakage.

Doors and covers should be hinged or completely removable. Sliding doors should not be used. All doors should open outwards from the duct interior. Hinged hatch covers in floors should open through 180° or be provided with a self-locking device to hold the hatch open. Doors of ducts that are large enough to be entered should be openable from the inside of the duct.

Heavy trench covers do not usually require securing. Other access covers and doors should preferably be secured with budget locks as defined in BS 3827 : Part 1.

Continuous trench covers generally require individual adjustment during installation to ensure accurate align-

ment of the surfaces with adjacent floor surfaces and to eliminate any tendency to rock upon the bearing points. It is, therefore, important that individual sections of trench covers be numbered or marked to ensure that they are placed in correct sequence.

8.7 Security

Special procedures or devices controlling the use of doors and access covers may be needed, particularly if a hazard may arise from unauthorized use.

9 Protection of services in ducts

9.1 Mechanical damage

Services should be protected from accidental and malicious damage by suitable positioning or enclosure.

9.2 Condensation

Condensation should be prevented by suitable choice of insulation, ventilation and heating.

9.3 Corrosion

Corrosion should be minimized by choice of suitable materials and combinations of materials, by keeping ducts and services dry and by application of suitable paint or other protective coatings. Relevant information is given in BS 5493, PD 6484 and DD 24.

9.4 Frost

Services liable to frost damage should be positioned in frost-free places where possible. If this is not possible, they should be protected by insulation and/or heating. The latter should be thermostatically controlled. Particular care should be taken when water services are run in ventilated ducts.

9.5 Thermal expansion

Provision should be made for thermal expansion of services without imposing excessive loads on the structure, fixings or services.

9.6 Differential movement

It is common for services to have to accommodate differential movement, particularly, but not only, at service entry and exit points. Services should therefore be designed so that they can accommodate the expected movement without damage. Advice on how much movement may need to be sought.

9.7 Provision of adequate support

In selecting the method of supporting services, provision should be made for the overall dimensions of the services where these are to be thermally insulated and for the preservation of any moisture-proof layer.

Typical fixings and supports are specified in BS 416, BS 1494, BS 3974 and BS 5572.

10 Drainage of service ducts

10.1 General

Drainage should be provided in ducts to dispose of liquids from leakage or infiltration.

Special consideration should be given to the drainage of flammable, toxic or corrosive liquids.

10.2 Discharge to building drainage system, etc.

Drains from ducts should discharge to the building drainage system, a soakaway or watercourse, etc. if this is acceptable to the water authority. If sufficient fall is not available, a sump with an automatic pump and high level alarm should be provided. A warning pipe or other suitable means should indicate that liquid has escaped within or has entered the duct. Precautions should be taken to maintain trap seals to prevent the entry of rodents, for instance by connecting the discharge from a sanitary appliance to the trap. Precautions should also be taken against back flow from drains into underground ducts.

10.3 Collection in holding tank

If the water authority does not accept discharge to the building drainage system, etc., drains from ducts should discharge to a holding tank. The capacity of the tank should be chosen in relation to the amount of liquid likely to escape from a failed service. Provision should be made for emptying the holding tank to a disposal contractor's vehicle or other suitable recipient. An alarm should indicate that liquid has entered the tank, so that the cause can be established and remedied.

10.4 Retention within the duct

If there is a significant probability of a liquid service leaking and causing damage but it is impractical to provide drainage, the duct should be made watertight and arrangements made for removing and disposing of liquid retained in the duct after a leak. An alarm should indicate that there is liquid in the duct, so that the cause can be established and remedied.

10.5 Watertightness

Ducts below ground level which may be subject to external water pressure should be watertight. (See CP 102.)

11 Ventilation of service ducts

11.1 General

It is recommended that main building service ducts should be ventilated regardless of the services they contain.

Ventilation for persons within ducts is covered in 11.2, for the control of hazardous leaks in 11.3, and for the control of environmental effects, e.g. condensation or overheating, in 11.4. Satisfying the single largest requirement should be satisfactory in all cases.

The provision for ventilation should be so designed as not to decrease the fire safety of the duct.

Ventilation openings provided in accordance with 11.1 to 11.4 should, where necessary, because a fire-resisting division is passed, be fitted with devices, e.g. fire-resisting doors or dampers, that will close automatically in case of fire. Consideration should be given to the provision of indicators to show whether the device is open or closed.

NOTE. Ducts with a cross-sectional area of less than 0.05 m^2 which convey only services in the following list need not be ventilated other than as required in 11.2 or to prevent overheating.

- (a) Ventilation, air conditioning, warm air heating.
- (b) Drainage in houses, offices and shops (except food shops).
- (c) Electric power and telecommunications.
- (d) Substances of groups 4 and 6 (see 6.2.2).
- (e) Vacuum pipelines.

11.2 Ventilation for persons

Work carried out in confined spaces is potentially hazardous and guidance on the precautions to be taken is given in appendix C.

Ventilation for persons within ducts may be achieved by either permanent means or by providing ventilation prior to and during occupation.

The ventilation applied should be capable of providing respirable air for persons whilst working. In some instances additional air may be required to cater for the work being undertaken, e.g. removal of heat or dilution of welding fumes.

BS 5925 provides information on the quantities of air required. (See also Health and Safety Executive Guidance Note EH22 'Ventilation of buildings: fresh air requirements'.)

11.3 Safety ventilation

11.3.1 Ventilation should be provided to dilute any anticipated or reasonably foreseeable leakages of flammable, toxic or corrosive gases to a safe level.

Advice on occupational exposure limits of airborne substances hazardous to health is available in Health and Safety Executive Guidance Note EH40.

For flammable gases/vapours small leaks should be diluted below 25 % of the lower flammable limit (sometimes referred to as LFL or LEL). Where it is not reasonably practicable to satisfy the above, see 11.3.4.

Where oxidizing gases are being distributed, the ventilation air requirement should be such as to limit the concentration of the leaked oxidizing gas in air to less than 1 % by volume.

Natural ventilation is preferred.

Pockets in roofs or floors where lighter-than-air or heavier-than-air gases respectively may accumulate should be avoided.

The ventilation rates should be based upon the sensitivity of pressure testing and maintenance procedures applied for each service.

NOTE 1. The minimum areas for natural ventilation shown in table 1 should be more than adequate for most applications.

NOTE 2. Builders' ducts having a small cross-sectional area and volume (i.e. 10 000 mm² or less and 0.1 m³ or less) may not need the provision of ventilation to the full requirements of table 1 where the duct is contained within one compartment and that compartment has adequate ventilation.

NOTE 3. It is generally not considered necessary to provide ventilation in some small internal structures (e.g. partition walls or ceiling spaces) where medical piped services are installed of all-welded, -brazed or joint-free construction. In such cases the system should be subjected to rigorous soundness testing procedures. Guidance for soundness testing of such services in hospitals is given in Department of Health and Social Security Health Technical Memorandum no. 22.

Table 1. Free area of ventilation opening for dispersal of small leaks	
Cross-sectional area of duct	Minimum free area of each opening
m ²	
Not more than 0.05	Cross-sectional area of duct
More than 0.05 but not more than 7.5	0.05 m ²
More than 7.5	1/150th of area of duct

11.3.2 Duct ventilation openings should lead to safe places, preferably the open air. Ducts contained solely within a room or an occupied space and not containing group 3 services may be ventilated within that room provided that the room is ventilated (see also **11.3.3**).

The free area of such ventilation openings and the distance between them should be based on consideration of the relevant factors which affect air movement, including the location, size and configuration of the duct, on the physical properties including the relative density of the gases or vapours involved and on factors influencing the potential magnitude of any leakages.

Ventilation openings should be located such that air movement can occur within the duct, e.g. at the top and bottom or at each end, and at intervals along long horizontal ducts.

In general, the larger the interval between openings in horizontal ducts, the greater is the need for a vertical component to the duct at one end to generate air movement.

11.3.3 Where there are openings in false or suspended ceilings or floors through which air can pass between the room and the service space, these may be counted as part of the open area required for ventilation of the service space as long as they are unlikely to be blocked.

The equivalent minimum free area of these openings should be calculated from laboratory tests or data provided by the ceiling/flooring manufacturer based on a 1Pa pressure differential across it.

11.3.4 Where it is impracticable to ventilate a duct that conveys flammable or oxidizing gases, flammable liquids or toxic substances, alternative precautions should be taken.

Suggested methods are as follows.

(a) The pipe(s) conveying the gas/liquids to be continuously sleeved through the unventilated duct with the sleeve ventilated at one or both ends into a ventilated area/room/duct.

(b) The unventilated duct to be filled with a crushed inert infill to reduce to a minimum the volume of any gas/liquid that may accumulate. The infill material should be dry, non-absorbent, chemically neutral and non-combustible, e.g. crushed slate chippings or dry washed sand.

NOTE. See note 3 of **11.3.1** for medical services.

11.4 Ventilation for overheating or condensation

In some circumstances ventilation of ducts may be necessary to prevent overheating or condensation. Wherever possible natural ventilation should be used.

12 Fire precautions

12.1 The objects of fire precautions

The objects of fire precautions are:

- to prevent the occurrence of fire;
- to detect a fire in its early stages;
- to provide means of escape for the occupants;
- to prevent the spread of fire and smoke;
- to extinguish the fire.

Unless suitable precautions are taken, service ducts may be:

- a place where fire starts;
- a place where fire grows undetected;
- a place where persons become trapped;
- a route for the spread of fire and smoke;
- a place where fire is difficult to extinguish.

12.2 Prevention of fire

12.2.1 The location and construction of services and ducts within buildings should take into account the fire hazards to the services from fires which can occur in the building or in the duct, and the hazards to the building from a major failure of the services.

In some special cases it may be necessary to provide liquid or gas monitoring or explosion reliefs within the duct.

12.2.2 If combustible materials are considered for use within or as part of a service duct, the extent to which they will increase the fire loading, the necessary provision of cavity barriers and the production of smoke and toxic gases should be carefully assessed. Careful consideration should be given to the potential fire and smoke hazard inherent in combustible insulation. (See BS 5422 and BS 5970.)

12.2.3 Ducts to which access is provided should be designed to be cleanable (see **18.3**). Accumulations of rubbish, dust or grease can easily be ignited. Particular

care should be taken that insulation does not become contaminated by flammable liquids. (See BS 5422 and BS 5970.)

12.2.4 Sources of ignition should be avoided where possible. Smoking should be prohibited in service ducts. Suitable precautions should be taken when operations involving heat, such as soldering and welding, are to be carried out inside ducts (see Health and Safety Executive Booklet HS(G) no. 5. Hotwork). In high fire risk areas, sparks from power or hand tools are dangerous. The Factories Act requires certain precautions to be observed before heat is applied to plant that has contained flammable substances (see also **18.2**).

Consideration should be given to the provision of ample separation between flammable piped services and electrical equipment. Where this is not practicable, the construction of the piped service should be joint free in the vicinity of the electrical equipment or consideration should be given to the need for the application of explosion proof equipment (see BS 4345 and Health and Safety Executive Booklet HS(G) no. 22).

12.2.5 Vertical ducts conveying power cables should be provided with internal barriers as required by the IEE Regulations for Electrical Installations or adequate ventilation should be provided to prevent overheating of cables throughout their length.

12.2.6 If flammable or oxidizing services are to be installed in a ceiling void or floor void, either the services should be enclosed in a separate duct or ducts within the void or the void itself can be considered as the duct enclosing the services.

If toxic or corrosive services are to be installed in a ceiling or floor void they should be enclosed in a duct which is ventilated to a safe position.

If the services are enclosed in a separate duct or ducts within the void, the duct or ducts should be sealed from the void and should be in accordance with this standard. If the services are not enclosed in a separate duct within the void, the void should be in accordance with this standard.

12.2.7 The following factors should be carefully considered when locating services in a separate duct within a void:

- (a) ventilation of the void;
- (b) provision of cavity barriers;
- (c) access to services.

12.3 Detection and alarm of fire

12.3.1 Where ducts are large enough for passage of persons, provision should be made for giving alarm of fire.

12.3.2 If the building has a fire alarm system, the alarm sounders should be audible within such ducts and manual call points should be situated inside, and adjacent, to, each exit from the duct.

12.3.3 If the building has a fire detection system, consideration should be given to such system being extended into service ducts of whatever size.

12.3.4 Any fire alarm or fire detection and alarm system should be in accordance with BS 5839 : Part 1.

12.4 Means of escape

12.4.1 It is essential that adequate provision for means of escape in case of fire be provided from ducts that are large enough for passage of persons. In this connection, consideration should not only be given to the need to escape from any duct in which fire has broken out but also to prevent anyone within a duct being trapped by the outbreak of fire elsewhere in the building.

12.4.2 Exits should be provided in such a number, and be so sited, that any person confronted by an outbreak of fire within the duct, or trapped by fire external to the duct, can make a safe escape. Where any duct (or section) is provided with two or more exits, such exits (unless affording access direct to the external air) should deliver to independent alternative escape routes from the building.

12.4.3 All doors affording escape from and within ducts should open in the direction of escape and should be fitted only with simple fastenings that can be operated from the escape side of the door without the use of a key. However, provision may need to be made to prevent unauthorized entry into the duct.

12.4.4 Doors and openings into and within ducts large enough for the passage of persons should be of such a size as to allow personnel to move through without difficulty. However consideration should be given to their also being large enough to permit the removal of an unconscious person and for their use by anyone wearing breathing apparatus.

12.4.5 All exits should be clearly identified with signs in accordance with BS 5499 : Part 1.

12.4.6 In intricate or extensive ducting consideration should be given to the provision of the following:

- (a) artificial lighting;
- (b) escape lighting in accordance with BS 5266 : Part 1;
- (c) telephones at suitable positions to enable persons trapped to summon help.

12.5 Prevention of spread of fire and smoke

12.5.1 Service ducts and their contents should be designed, constructed and maintained so that they do not impair the building's resistance to fire.

12.5.2 Where a service duct passes from one compartment to another, or through any other fire-resisting division in a building, the fire separation should be maintained by:

- (a) constructing the duct so that it has the fire-resistance recommended in **12.5.4**; or

(b) continuing the fire-resisting division across the duct; or

(c) a combination of (a) and (b).

12.5.3 Where a service duct is contained within, or passes through, a protected escape route, adequate precautions should be taken to ensure the safety of the escape route, e.g. by the use of a fire-resisting duct or the provision of cavity barriers and/or fire-stopping.

12.5.4 A fire-resisting duct should have a fire resistance at least equal to the highest standard required for any of the fire-resisting divisions it crosses.

12.5.5 Any openings provided within the enclosures of fire-resisting ducts should be kept to a minimum and fitted with doors or panels having not less than half the fire resistance required for the duct enclosure, with a minimum of 30 min integrity.

12.5.6 All fire doors should be fitted with a self-closing device (other than rising butt hinges). However, where not required as an exit, such doors or panels may be fitted with means to enable them to be kept locked shut when not in use in lieu of their being self-closing.

All fire doors should be marked, at eye level, with the appropriate fire safety sign in accordance with BS 5499 : Part 1.

12.5.7 Where any pipe penetrates a fire resisting division or enclosure it should either:

(a) be contained within a duct having a fire resistance recommended in **12.5.4** (e.g. a protected shaft); or

(b) be protected by a sealing system which maintains the fire resistance of the element penetrated; or

(c) have a nominal internal diameter not exceeding the relevant dimension given in connection with building regulations;

(d) have nominal size which does not exceed 300 mm, and

(1) is of welded steel construction, with a wall thickness of not less than 6 mm;

(2) the structure is constructed to accommodate such penetration; and

(3) the pipe is enclosed in a sleeve which is sealed to the structure and to the pipe in such a manner as not to reduce the fire resistance of the division.

12.5.8 Where a service passes through a fire-resisting division or enclosure, and the service is not contained within a protected shaft (see **12.5.7(a)**), any opening for the service should be kept as small as possible and should be fire stopped.

12.5.9 Any insulation to services should not penetrate a fire-resisting division or enclosure if this would impair the resistance to fire of the division or enclosure.

12.5.10 Where a duct is contained wholly within one fire compartment, it will not normally require a fire-resisting enclosure since the possibility of fire spread to another

fire compartment via the duct will not exist. There may be a considerable hazard where small areas of high fire risk such as kitchens or stores are included in the same fire compartment as sleeping accommodation. In these cases ducts are normally horizontal and the risk is greater if they are at a high level where they may be subjected to the worst conditions of flame and heat from a fire; in such circumstances consideration should be given to the duct enclosures, including any access or inspection panels in the high fire risk areas, being fire resisting.

A fire resisting suspended ceiling does not necessarily check the spread of fire from the room below to services within the ceiling void or service ducts connected to it.

12.5.11 Cavity barriers/fire-stopping should be provided within any service duct not enclosed within fire-resisting construction:

(a) if a vertical duct, at every floor level (if the duct contains uPVC pipework the duct enclosures should resist smoke penetration);

(b) if horizontal, at approximately 8 m intervals where either:

(1) the duct enclosures are not constructed of materials of limited combustibility; or

(2) substantial amounts of combustible materials are contained within the duct (e.g. as thermal insulation).

Consideration should also be given to providing cavity barriers/fire-stopping at every point where any duct passes the boundary of a room or corridor.

12.5.12 In long ducts provided with means of escape in accordance with **12.4**, provision should be made for preventing the unrestricted spread of fire and smoke between exits.

12.5.13 No means of access to service ducts covered in **12.5.11** should be provided from:

(a) a protected stairway affording the sole means of escape from a building or part of a building;

(b) sleeping accommodation; or

(c) a dwelling, if there is means of access to the same section of duct from an indoor space which is not part of that dwelling.

12.6 Fire fighting

12.6.1 Sufficient and suitable access should be provided to major ducts to enable the fire service to clear the ducts of smoke and to fight a fire inside them.

12.6.2 All doors, ground lights and ventilator shafts designed for fire brigade use should be clearly marked on the exterior as to their function, e.g. 'SMOKE OUTLET FROM SERVICE DUCT'.

The recommendations given in BS 5378 and BS 5499 should be followed.

12.6.3 Major service ducts and important features, such as ventilators and gas isolating valves should be shown on the drawings available to the fire service.

12.6.4 Portable fire extinguishers, hose reels, sprinklers and fire extinguishing gas systems should be provided in service ducts as appropriate.

Any total flooding or automatic fire extinguishers mounted in ducts should be in accordance with BS 5306 and Health and Safety Executive Guidance Note GS16. Particular attention should be paid to the safety of persons within service ducts.

13 Other safety precautions

13.1 General

The safety of the building and all occupants and maintenance personnel should be provided for during the design of service ducts and services.

The nature of the operations to be carried out within the ducts should be assessed in detail, in order to determine the facilities operatives will need in order to work safely.

Special consideration should be given to the safety of personnel required to enter and work inside the ducts in the knowledge of the hazards likely to be encountered (see 18.2) both during construction and use.

13.2 Hazards

As early as possible during the design of a duct, an assessment should be made of the possible dangers to personnel and to the building. Hazards may arise from the arrangement of the ducts or from the services inside them.

For example, personnel may need designed protection against flooding in some ducts, particularly those below ground level, and in such cases a means of drainage will be required. Where flooding is probable, adequate means of rapid escape should be provided for personnel.

Other hazards can be created by the effects of materials such as fluids which may possibly enter a duct. Apart from flooding, such dangers as fumes, explosion, bacteria, physical and chemical processes, including extremes of temperature, pressure and humidity are typical possibilities. These are not likely to be common hazards but if they are possible then expert advice should be obtained very early in the design stage in order to resolve the problems.

Attention is also drawn to the hazards associated with asbestos and the related legal controls, see 4.2.

13.3 Duct interiors

Interiors of ducts should be simple and regular in shape and sudden changes in shape and floor levels should be avoided.

Pipelines or services within the ducts should be suitably insulated and protected to avoid endangering personnel. Step irons and handrails should not be in contact with hot pipes.

Unexpected obstructions or projections by the duct or by the services and equipment within should be limited by careful design and installation.

Services and equipment should be arranged neatly within ducts and should be readily accessible for maintenance.

13.4 Protection against falls

It may be necessary to take special precautions against the possibility of personnel falling within ducts.

No sudden drop should occur over the threshold of an entrance to a duct. If the floor level of the duct is below that of the floor outside, the level of the latter where possible should be continued through the threshold to give a platform of 750 mm by 750 mm minimum.

Where a platform cannot be provided, the entrance should be fitted with a guard rail and sill when a difference in levels occurs over the threshold. Access openings to under-floor ducts should be protected by temporary guard rails when open.

Platforms and staircases within ducts should be fitted with handrailing 1200 mm high with a midrail and toeboard and an entrance to a stair or ladder from a platform should be fitted with a safety bar.

Suitable fixed ladders, stairs, steps or ramps should be provided in vertical ducts or where there is a change in floor level in a horizontal duct. Recommended dimensions for these can be found in the appendices.

Fixed ladders should comply with BS 4211. As an alternative to the provision of safety cages as specified in BS 4211, other suitable means of providing safety on ladders can be employed (e.g. suitable systems for use with safety belts, which help in the release of a person who has collapsed).

In vertical ducts, anchors for attaching the safety line of a harness should be provided on platforms and in the side of the duct at intervals of not more than 2 m. Anchors should comply with BS 5845, and safety belts or harnesses should comply with BS 1397.

13.5 Electrical power

The provision of electrical power within ducts is not normally necessary, however, where specified it is important to consider the problems of high voltages and of trailing leads.

13.6 Lighting

A lighting installation should be provided within ducts large enough to be entered, particularly at access points.

Lights should be controlled by switches placed at a uniform height and at regular intervals. Switches should always be provided at access points.

Consideration should be given to the provision of emergency lighting, which should be actuated automatically when the normal lighting fails, or at least to placing alternate lamps on two different circuits.

Explosion protected or waterproof fittings and switches should be used where appropriate (see BS 5345).