BLUE BOOK

British Standard version

Fire resisting ductwork

tested to BS476 Part 24

3rd Edition

(Volume 1 of 3)

FIRE AND YOUR LEGAL LIABILITY

Fire kills around 300 people and damage claims exceed £1 billion every year in the UK. That's why we must all play our part.

Why is this of relevance to me?

If you are involved in the provision of fire protection, at any level, then you share liability for its usefulness and its operation when it's needed in a fire, and that liability will still be there in the event of a court case.

I place the order; it is not my responsibility to install the works

If it is your responsibility to specify the materials and/or appoint the installation contractor it is also your responsibility to ensure that they can prove competency for the fire protection materials used, or the works to be carried out. It's no longer simply a duty of care or voluntary – it's a legal obligation under sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005. Similar provisions also exist in equivalent legislation in Scotland and Ireland.

If you knowingly ignore advice that leads to a failure in the fire performance of any element of installed fire protection within a building, then you are likely to be found to be just as culpable as the deficient installer.

You also share liability for the provision of information required under Building Regulation 38 (formerly 16B) that tells the user of the building about the fire prevention measures provided in the building. The user needs this to make an effective risk assessment under the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

I'm only installing what I'm contracted to do

If you are installing fire protection, then as with those specifying the materials and/or the contractor, you also have a legal obligation to ensure that the materials you install are adequate under sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

What is expected of me?

In the event of fire, and deaths, a court will want to know how every fire protection system was designed and specified; the basis for selection of the installer; whether adequate time was provided for its installation; and whether there was adequate liaison between the different parties to ensure it was installed correctly. No ifs, no buts – it's all contained in the Construction, Design and Management Regulations 2015.

The CDM 2015 Regulations, enforced by Health and Safety Executive, concentrate on managing the risk, and the health and safety of all those who design, specify and build, those that use the building, those who maintain it and those that demolish it – cradle to grave.

Be aware – the time to consider the above is before the event, not after it!

Association for Specialist Fire Protection (ASFP)

The Association was formed in 1976, and currently represents UK manufacturers and contractors of specialist passive fire protection products, with associate members representing regulatory, certification, testing and consulting bodies. It seeks to increase awareness and understanding of the nature of fire and the various forms, functions and benefits provided by passive fire protection. It is willing to make available its specialist knowledge on all aspects of fire protection and can assist specifiers and main contractors in identifying products suitable for specific requirements, both in the UK and related overseas markets. The Association encourages experimental work related to passive fire protection and promotes consideration and discussion of all issues affecting the fire protection of buildings

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Building and Engineering Services Association

BESA is the UK's leading trade association for building engineering services contractors – representing the interests of firms active in the design, installation, commissioning, maintenance, control and management of engineering systems and services in buildings. Founded in 1904, it adds value to members' businesses by providing quality services, promoting excellence and shaping the commercial environment through representation and leadership.

137-143 Hammersmith Road London W14 0QL
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National Association of Air Duct-Cleaners UK (NAADUK)

National Association of Air Duct cleaners UK is the UK's trade association representing contractors who provide cleaning services for HVAC ducts and other equipment. All NAADUK operators have agreed to meet stringent criteria to become a member and are trained, qualified and certified equivalent to TR/19 and BSEN 15780 standards.

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The Fire Test Study Group (UK) Ltd (FTSG)

FTSG is a forum for technical discussions and liaisons between consulting fire test laboratories involved in producing test and assessment information for the purposes of building control.

The member laboratories are all UKAS Accredited for testing and the primary objective of the group is to ensure common technical interpretations of the fire test standards and a common approach to technical appraisals or assessments of products which may be made by the members within the terms of Approved Document B and national equivalents in Scotland and Ireland.

FTSG members support the publication of this edition of the “Blue Book” as it provides specifiers and regulatory bodies with an independently validated comprehensive and concise guide to the performance of fire resisting ducts when tested against British Standards.

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Amendment sheet

DATE	SECTION	AMENDMENT SUMMARY
19/10/10	3.5	Revisions to clause
19/10/10	3.6	New clause
19/10/10	Front	Inclusion of Fire and Your Legal Liability and Amendment pages
October 2016	All	New 3rd edition comprehensively updates to reflect updated codes, standards and current practice

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Fire resisting ductwork – tested to BS 476 Part 24 - 3rd Edition

Published by the Association for Specialist Fire Protection

Foreword

As Convenor of ASFP Task Group 6 (Ducts and Dampers), I am pleased to introduce this 3rd Edition of 'Fire Resisting Ductwork' from the Association for Specialist Fire Protection.

The prevention of fire spread through ducted systems is of critical importance, as evidenced by serious and increasing fire losses in recent years. This document provides details and new recommendations not previously covered in other standards or codes of practice and should make a significant contribution to improved fire safety. It contains sections on the different types of system and their function; information on all the relevant legislation, standards and codes of practice as well as notes on penetration seals and support systems.

The 3rd Edition continues to include Data Sheets which provide details of fire tested duct systems that have been suitably fire tested & assessed by UKAS, or equivalent accredited fire test laboratories. A requirement for all passive fire protection products listed in ASFP colour books is that they are either CE marked or are third party certificated. The ASFP believes that third party certification of passive fire protection products and installers is the best way to instil confidence in the use of passive fire protection.

In this latest edition of the 'Blue Book' the product data sheets are being simplified and these will be hyperlinked back to the relevant certification body website where a comprehensive certificate can be downloaded. In this way, end users can be sure that they can get the most up to date information on the product backed up with the authority of the certification body concerned. In the meantime, until the new Summary Data Sheets are produced, the existing product data sheets of third party certificated products are published separately in Volume 2 of this publication so that end users have a list of third party certificated fire resisting ducts to choose from.

This document is cited in Approved Document B – the statutory guidance to the England and Wales Building Regulations.

Darren Webster
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ASFP TG6 Ducts and dampers
Firesafe Ductwork Ltd

Contents

SCOPE

This publication aims to assist the reader in understanding the essential factors relating to the design and installation of fire resisting ductwork (which includes smoke outlet/extraction ductwork) in accordance with UK legislation. It references the relevant Building Regulations, British Standards and Codes of Practice which apply to these specific types of duct.

Detailed information on current British Standard fire resistance and reaction to fire tests is provided, together with recommended methods for appraisal systems for both direct and extended fields of application. Guidance is also given in respect of the fire resisting requirements for duct systems incorporating penetration seals, support systems and ancillary items, with a section relating to limitations.

Drawings of typical BS 476: Part 24 test constructions are reproduced (by kind permission of the British Standards Institution) and diagrams of types and functions of various fire resisting ductwork systems are included. These are for guidance purposes only.

The guidance given in this publication specifically refers to fire resisting ductwork tested to BS 476 Part 24 1987 and does not, therefore, include advice on conventional non-fire rated ventilation ductwork systems, or ducts containing services such as water pipes and cables.

This book does not include guidance arising from European fire tests and classifications for smoke control and fire resisting ductwork. These are dealt with in the ASFP publication Fire resisting ductwork: classified according to BS EN 13501 Parts 3 and 4 European version – 1st Edition, the Blue Book EN. End users should satisfy themselves that such products do not have to be CE marked in accordance with the Construction Products Regulation for this document, in which case the Blue Book EN to be applicable.

Cautionary note to all ductwork designers, manufacturers and installers

General purpose DW/144 ventilation/air conditioning ductwork cannot be utilised as, or converted into, a fire resisting ductwork system unless the construction/materials of the whole system are proven by test or assessment in accordance with the requirements of BS 476: Part 24.

Under the Construction Products Regulations, where there is a harmonised European Product Standard (hEN) for a particular product it is necessary for a manufacturer to comply with it and CE mark the product. At the time of writing, the only published standard relevant to fire resisting ductwork is BS EN 12101-7, Smoke and heat control systems, Part 7: Smoke duct sections. Note, currently size restrictions also apply to CE marked ducts.

Limitations

This list sets out the principal limitations in the scope of the guidance given in this publication and is not intended to be exhaustive.

a) The term ‘fire resisting ductwork’ is deemed to refer to a system as tested or assessed in accordance with BS 476 Part 24. As the vast majority of tests on steel ducts are conducted with rigid ducts it is not appropriate to extrapolate this data for flexible steel ducts. Therefore, unless the flexible steel duct system has been tested in accordance with BS 476 Part 24, this guidance cannot be assumed to apply.

b) Service ducts are not included within this guidance.

c) Fire resisting ductwork systems shall be deemed to include all the components as tested or assessed, including supporting systems and penetration seals. Reference is made to the Field of Application section within this guidance.

d) The element of building construction to which the support systems are attached must have a fire rating of at least that specified for the duct and be able to support the weight of the duct under fire conditions.

e) It is essential when choosing a fire rated duct system that it is fit for the purpose to which it is being applied. Considerations other than the successful completion of a BS 476 Part 24 fire test on a sample

section of ductwork may need to be given when assessing the suitability of a fire rated duct for a particular application. Reference may be made to the footnotes to the Table in Explanatory Note A8 within the Annex to BS 476 Part 24.

f) During any defined non-fire operating conditions, fire resisting ductwork must be capable of both performing and being tested to the ductwork classification and the air leakage limits of the designated ductwork specification, e.g. DW /144.

g) In general, the air flow characteristics of ductwork and its associated components such as bends, branches and changes of section must all be in accordance with DW /144.

h) In the case of an **existing metal or a newly constructed duct**, where application of a fire insulation cladding material to provide fire resistance is considered, it is imperative that the construction standard of the metal duct is checked for conformity with the appropriate fire test report. Metal gauge, spacing & size of flanges and stiffeners, bolting centres, use of steel / aluminium rivets, sealants, spacing of hanger supports and fixing method to the soffit should all be checked for compliance with the fire tested construction. It is not sufficient to rely on a DW/144 construction classification for fitness for purpose in this regard.

i) For the purposes of independent assessment, laboratories accredited by UKAS, or equivalent for conducting the relevant test and some suitably qualified fire consultants might be expected to have the necessary expertise.

j) It is recommended that the installed fire rated duct system be verified by the use of a quality system, based upon the ISO 9000 Series. This will enable the supplier/installer to provide documentary evidence of the conformity of the installed system and its components. Verification will be required including research, checking or test of existing ductwork installations which are being modified and / or over-cladding to provide a fire rated system.

k) Light gauge specifications such as DW/144 recognise many machine forming techniques for ancillary items, such as air turning vanes and the increased gauges, associated with fire resisting ductwork systems may not only preclude the use of such techniques but may also, out of necessity, introduce a geometric change that may require the approval of the HVAC designer in terms of a component's air flow characteristics.

l) A fire rated duct tested to BS 476 Part 24 (Ventilation duct fire resistance test) which meets criteria of stability, integrity and insulation may not be suitable for kitchen extract application or smoke extract application unless proven by additional test criteria, as outlined in the Explanatory Notes Annex to the Standard (A.1(c) & A.8).

m) For the field of direct application, any penetration seal must be the same as that used in the original BS 476 Part 24 test, see section 9.1

n) Where fire dampers are connected to a fire rated duct it is assumed by this guidance note that the combined installation is adequate for the required fire resistance. However it is incumbent upon the designers and providers of such damper installations to verify that they have been appropriately tested adopting the procedures and criteria of BS EN 1366-2.

o) This guidance does not address the complex and detailed issue of fire and/or smoke dampers or any other fire resisting components or elements of structure with which the fire resisting ductwork system interfaces, save for their assumed levels of adequacy. Responsibility is therefore deemed to end with the interface.

p) Special care must be taken with in-line items of equipment such as fans, volume control dampers, attenuators etc. Where such items are within a fire resisting ductwork run, the item of equipment must maintain the full fire performance of the duct into which it is fitted or it must be installed within its own fire rated enclosure (same performance as the duct). Access provisions to the ductwork for cleaning and maintenance should also maintain the fire performance of the duct to which they are fitted.

q) The expansion of the ductwork could cause excessive forces on an associated wall or floor construction and penetration seals, which, could result in their failure under fire conditions. The ductwork route should either be reconsidered, to lessen the effect of expansion on the penetration seals, or fire resisting expansion devices/compensators should be included within the ductwork.

1. INTRODUCTION

This publication aims to assist those involved in the specification, installation, inspection and verification of fire resisting ductwork tested to BS 476 Part 24 and to ensure that minimum performance standards are maintained which will contribute to ensuring that fire compartmentation systems are not breached prematurely.

1.1 What is fire resisting ductwork?

Fire resisting ductwork being installed

Fire resisting ductwork is ductwork that has been successfully tested or assessed to BS 476 Part 24. It may be provided either by specialist companies producing proprietary systems or by insulating satisfactorily constructed and supported steel ductwork. Care must be taken when choosing a fire resisting ductwork system and checks should be made to ensure that the ductwork fire performance meets with the requirements of the relevant application.

1.2 What is fire resisting ductwork required to do?

Fire resisting ductwork usually needs to pass through compartment walls or floors that will have a prescribed fire resistance period in terms of the load-bearing capacity, integrity and insulation criteria, for durations of 30 to 240 minutes. It is a requirement that where these compartment walls/floors are penetrated by ducts or other building services, the fire performance criteria for the penetrated wall or floor are maintained, such that fire in one compartment may not spread to other areas. So the fire resisting duct needs to maintain i.e. not compromise the fire resistance of the wall or floor through which it penetrates. The performance of a fire resisting duct which penetrates a fire resisting/separating element requires careful consideration by specifiers and controlling authorities. **The standard periods of stability and integrity should in all cases be at least equal to those required for the penetrated element of construction.**

In certain circumstances, fire engineers may argue for and/or controlling authorities may waive the insulation requirement or allow a reduced period of insulation, for example, in some car parks, where enforcers have considered that there was not a possibility of combustible materials being in close proximity of the ductwork.

National Statutory Guidance documents such as Approved Document B (and its equivalents in Scotland, Northern Ireland and Ireland) refer to BS 5588: Part 9/BS 9999 for alternative ways in which the integrity of compartments may be maintained where ductwork penetrates fire separating elements.

1.3 Maintaining the fire resistance of walls & floors penetrated by ventilation ducts

Most ventilation ductwork systems offer little or no protection against fire spread. When ventilation ductwork penetrates building compartmentation, regulatory requirements and the guidance of BS 9999 should be followed:

Method 1	Protection using fire dampers;
Method 2	Protection using fire resisting enclosures;
Method 3	Protection using fire resisting ductwork.

Statutory regulations and design codes provide the designer with prescribed periods of fire resistance to elements of construction, which give a safe period for evacuation of people, a safe period for fire fighting and can also provide for property protection. It is vitally important for life safety that the fire resistance of the element of construction is not reduced when ductwork is routed through it.

Good practice dictates that fire dampers should not be installed within certain ductwork systems in buildings (e.g. kitchen extraction, staircase and lobby pressurisation, lift shaft ventilation, fresh air make up provision, etc.) and therefore either Method 2 or Method 3 of BS 9999 should be used.

Steel ductwork systems for air movements around buildings are generally constructed to the BESA guide DW/144 which covers a wide range of construction standards in the manufacture of sheet metal ductwork for use in low, medium or high pressure applications and includes various methods of jointing, stiffening and support for the ductwork.

BS 5588: Part 9 paragraph 7.5.1 acknowledges that steel ductwork **'**if satisfactorily constructed and supported will be able to provide a high degree of resistance to the passage of smoke and decomposition products. However, rapid transfer of heat through the steel regardless of its thickness prevents the ductwork achieving any degree of fire resistance without supplementary insulation'. **A satisfactorily constructed and supported fire rated steel duct is only one proven by test and/or assessment to BS 476: Part 24.**

An alternative to steel ductwork systems is self-supporting ductwork such as that constructed from rigid boards. Supplementary insulation may also have to be considered for these systems.

The fire test for evaluating the fire resistance of ducts, BS 476 Part 24 was introduced in 1987. The document includes an explanatory Annex giving guidance on the fire performance criteria required for kitchen extract and smoke outlet/extraction applications, which differ from the requirements for ventilation ducts. It is important that the evaluation and suitability of any proposed system of fire resisting ductwork matches the requirements for the application; (e.g. a smoke outlet/extraction duct to maintain a minimum 75% of the original cross section when tested to BS 476: Part 24).

1.4 Other characteristics

It is essential to give due consideration to other factors that may be required when evaluating the suitability of a proposed system of fire resisting ductwork. These may include:

- Seismic qualification of ductwork, support system and penetration sealing method
- Pressure / air carrying capacity
- Materials sensitive to thermal shock
- Materials susceptible to physical damage
- Acoustic performance requirement of the system
- Thermal performance requirement of the system
- Resistance to air flow.
- The suitability for cleaning, if a kitchen duct system
- Any need for a smooth internal surface, for high pressure ducts.

2. DEFINITIONS

For the purpose of this document the following definitions apply.

2.1 Duct/ductwork terms

Access doors
A closure of an inspection opening within the duct.

Compensator
A device that is used to prevent damage from the forces generated by expansion.

Duct/Ductwork
A system of enclosures of any cross sectional shape for the distribution or extraction of air.

Duct/Ductwork - Fire Rated
Ductwork that conforms to one or more of the definitions of (types) of fire resisting duct/ductwork listed below. Note: the term fire rated, while widely used is deprecated because it can refer to a reaction to fire requirement rather than any for fire resistance or smoke control.

Duct/Ductwork - Fire Resisting
A duct or ductwork used for the distribution or extraction of air, designed and tested to satisfy the criteria defined in BS 476: Part 24.

Duct/Ductwork - Fire Resisting Smoke Outlet/extraction
A fire resisting smoke outlet/extraction duct, for the extraction of products of combustion, designed and tested to satisfy the criteria defined in BS 476: Part 24. A smoke outlet/extraction duct must retain at least 75% of its cross-sectional area throughout the test.

Duct/Ductwork - Fire Resisting Kitchen Extract
A duct or ductwork that is installed entirely independent of any other duct or ductwork within the building and which serves as an extract for non-domestic kitchens see clause 33.4.3.1 d) of BS 9999: 2008) (see clause 9.5 of BS 5588: Part 9), designed and tested to satisfy the criteria defined in BS 476: Part 24.

Duct/Ductwork - Self supporting
Self-supporting fire rated ducts are those that are formed with fire protection boards, and possibly framework, without a steel duct.

Shunt System
A duct or ductwork used solely for extraction in flats and maisonettes which may be used to avoid the need to provide fire dampers in extract ductwork from bathrooms and WC's. (See clauses 6.1, 6.2 and 9.6 of BS 5588: Part 9 and 3.9.8 and 33.4.4.3 of BS 9999: 2008).

Support System
The components used for supporting a duct or ductwork from, and fixing to, a fire resisting element of construction.

2.2 Dampers

Damper, fire
A device for use in heating, ventilation and air-conditioning (HVAC) systems at fire separating elements to maintain compartments (E classification). Note: not all fire separating elements are compartment walls.

Damper, fire & smoke
A device for use in heating, ventilation and air-conditioning (HVAC) systems at fire separating elements to maintain compartments and reduce smoke leakage to protect escape routes (ES classification). Note: not all fire separating elements are compartment walls.

Damper, smoke control
A device, automatically or manually activated, which may be open or closed in its operational position, to control the flow of smoke and hot gases into, from or within a duct, and may assist fire fighting procedures. (ES classification).

2.3 General terms

Compartment
A building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building. A roof space above the top storey of a compartment is included in that compartment.

Depressurisation
Smoke control using pressure differentials where the air pressure in the fire zone or adjacent spaces is reduced below that in the protected zone

Fire Resistance
The ability of a component or construction to satisfy, for a stated period of time, the appropriate criteria specified in the relevant part of BS 476. The following criteria are applied to fire resisting ductwork.

Stability

The ability of a duct, ductwork and the support system to remain intact and fulfil their intended function for a specified period of time, when tested to BS 476: Part 24

Integrity

The ability of a duct or ductwork to remain free of cracks, holes or openings outside the compartment in which the fire is present for a specified period of time, when tested to BS 476: Part 24

Insulation

The ability of a duct or ductwork to maintain its integrity without developing temperatures on its external surface, outside the compartment in which the fire is present, which exceed:

i. 140°C as an average value above ambient and/or

ii. 180°C as a maximum value above ambient at any one point

When tested for a specified period of time to the requirements of BS 476: Part 24. For kitchen extract ductwork (duct A) these limitations also apply to the internal surface of the duct within the compartment in which the fire is present.

Fire Separating Elements
Floors, walls, fire protected shafts (multi-service or dedicated) and other separating elements of construction having a period of fire resistance as determined in accordance with BS 476: Parts 20, 21 or 22. Note: not all fire separating elements are compartment walls.

Penetration
An aperture through a fire separating element for the passage of a duct or ductwork, or building services, that reduces the fire performance of the fire separating element

Penetration sealing system
The system used to maintain the fire resistance of the fire separating element, in accordance with BS 476: Part 24, at the position where there is provision for a duct or ductwork to pass through the element.

Note: penetration sealing systems tested with e.g. cables and pipes to BSEN 1366-3 or BSEN 1366-4 cannot be used with fire resisting ducts. See ASFP Advisory note on Mixed Penetration Seals (in course of preparation). The seal used must be the same as that when the duct was tested to BS 476: Part 24. No other seal type can be used without an assessment or consultation with the manufacturer.

Pressurisation
Smoke control using pressure differentials, where the air pressure in the spaces being protected is raised above that in the fire zone

Protected shaft
A shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed with fire-resisting construction.

3. DUCTWORK TYPES & FUNCTIONS

This document does not apply to ducts containing services such as water pipes or electrical cables. It covers only ductwork that is part of the following systems for handling air, fumes or products of combustion. Typical examples are illustrated in figures 2-10.

If a product is subject to a harmonised product standard it is a legal requirement under the Construction Products Regulation that it is supplied in accordance with this and CE marked accordingly. This applies to smoke control ducts to BS EN 12101-7, Smoke and heat control systems, Part 7: Smoke duct sections. In such cases, designers should refer to the ASFP Blue Book (EN). Note currently size restrictions also apply to CE marked ducts.

3.1 Mechanical ventilation systems

Mechanical ventilation systems are used to extract vitiated or polluted air from a building and to supply replacement fresh or conditioned air. The necessary fans and conditioning equipment are generally located in separate plant rooms, often in a basement or on the roof. The distribution of the air involves ductwork which may be very large, extend throughout the building, penetrate compartment walls and/or floors and have openings in every space through which it passes.

Without suitable fire precautions, therefore, ventilation ductwork can provide a route by which fire, smoke and toxic gases are enabled to spread rapidly through a building.

3.2 Smoke extraction systems

Smoke extraction is the evacuation from a building of products of combustion, such as smoke and toxic gases, which could otherwise reduce visibility and impair human functions. This facilitates the escape of the building occupants and assists fire fighters in locating the seat of the fire and extinguishing it.

In situations where smoke clearance by natural ventilation through windows or other openings may be difficult (e.g. in large or deep basements or in high rise buildings without operable windows) ductwork is required to conduct the smoke to a suitable outlet from the building. In cases where the natural buoyancy of the combustion products is not adequate to ensure the required smoke extraction rate through the ductwork, fan assisted systems are used. It may also be necessary to install ducted air inlets as part of the smoke extraction scheme, in order to provide the replacement air.

If the ductwork incorporated in a smoke extraction system is wholly contained within the fire compartment, it must at least be capable of resisting the anticipated smoke temperatures generated during the development of a fire. These will generally be lower than the temperatures specified in BS 476: Part 24, which are intended to represent a fully developed fire. However, if the ductwork penetrates a fire resisting barrier, it must also be capable of providing the relevant fire resistance in a test to Part 24. Further clarification of the fire testing requirements for these two different situations is provided in Section 6 of this document 'Standard Fire Tests'. In view of the importance of maintaining the design extraction rates during a fire, BS 476: Part 24 also imposes an additional requirement on smoke outlet/extraction ductwork (i.e. the retention of at least 75% of its original cross sectional area during the test). Figures 6, 8 and 9 show examples of smoke extraction systems.

Under the Construction Products Regulation, where there is a harmonised European Products Standard for a particular product it is necessary for a manufacturer to comply with it and CE mark the product. At the time of writing, the only published standard relevant to fire-resisting ductwork is BS EN 12101-7, Smoke and heat control systems, Part 7: Smoke duct sections. Note currently size restrictions also apply to CE marked ducts and not all fire resisting smoke extract systems fall within the scope of this product standard.

3.3 Dual ventilation /smoke extraction systems

These systems serve as a conventional ventilation system under normal conditions, but are converted to a smoke extraction system in the event of fire, thus providing an economical dual system. See figures 6, 8 & 9.

3.4 Pressurisation systems

Pressurisation is a method of restricting the penetration of smoke into certain critical areas of a building, by maintaining the air within the critical areas at pressures higher or lower than those in adjacent areas. It applies particularly to protected stairways, lobbies and corridors, as smoke within these areas would inhibit escape, and also to fire fighting shafts serving deep basements, because of the difficulties in clearing smoke from basements.

A pressurisation system is a special form of mechanical ventilation system. However, as the air supply creating the pressurisation must be maintained for the duration of a fire, fire dampers cannot be used within the ductwork to prevent the spread of fire. Any duct penetrating fire resisting barriers must be fire resisting.

BS 9999 Annex B.6 gives guidance on the use of pressurisation in buildings for the purpose of smoke control.

An example of a pressurisation system is given in figure 10.

3.5 Means of escape

There are three options for safeguarding protected means of escape routes commonly in use:-

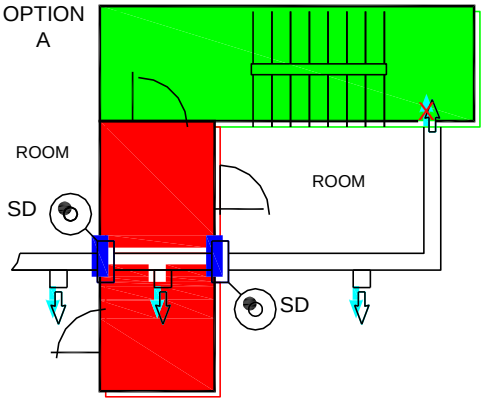
A. ES fire/smoke dampers (As described in Approved Document B Volume 2)
B. Fire resisting enclosure of ductwork systems (known as Method 2 in BS 5588-9 and BS 9999)
C. The use of fire resisting ductwork (known as Method 3 in BS 5588-9 and BS 9999)

Options B and C use fire resisting ductwork (or ductwork) enclosed with fire resisting construction.

These are shown in figure 1 below.

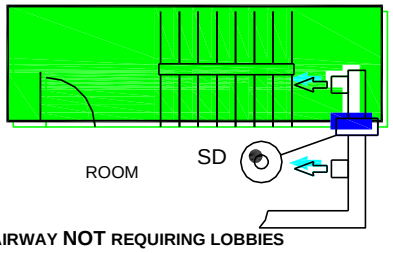
FIGURE 1

OPTION A



VENTILATION OUTLETS SHOULD NOT SERVE A STAIRWAY REQUIRING LOBBY PROTECTION (GENERALLY SINGLE STAIRWAYS ABOVE TWO STOREY AND MULTI STAIRWAYS OVER 18m ETC).

IF DUCTWORK NEEDS TO PASS THROUGH SUCH STAIRWAYS METHOD 2 OR 3 PROTECTION IS REQUIRED AS OPTION B OR C



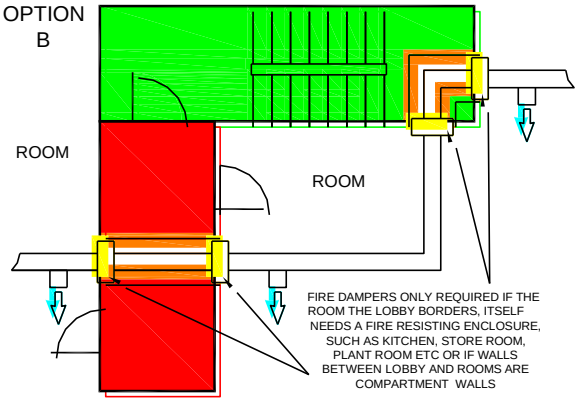
STAIRWAY NOT REQUIRING LOBBIES
GENERALLY SINGLE STAIRS SERVING ONLY TWO STORIES OR MULTI STAIRS NOT EXCEEDING 18m.

STAIRWAY REQUIRING LOBBIES

ES CLASSIFIED FIRE/SMOKE DAMPER SOLUTION; METHOD 1
DUCKWORK PASSING THROUGH PROTECTED ROUTES IS ABLE TO SERVE THE PROTECTED ROUTES (APPROVED DOCUMENT B, VOL 2: 5.48)

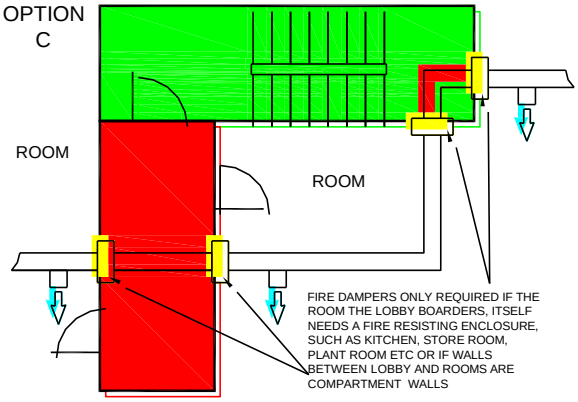
WHILST THIS BS VERSION OF THE BLUE BOOK IS SPECIFICALLY RELATED TO THE USE OF BRITISH STANDARD TEST METHODS, OPTION A HAS BEEN INCLUDED TO INFORM READERS THAT USING ES CLASSIFIED FIRE/SMOKE DAMPERS WHICH SATISFY EN STANDARDS ARE A FURTHER OPTION AND MAY ALLOW MORE FLEXIBILITY DEPENDING ON THE DUCTWORK CONFIGURATION

OPTION B



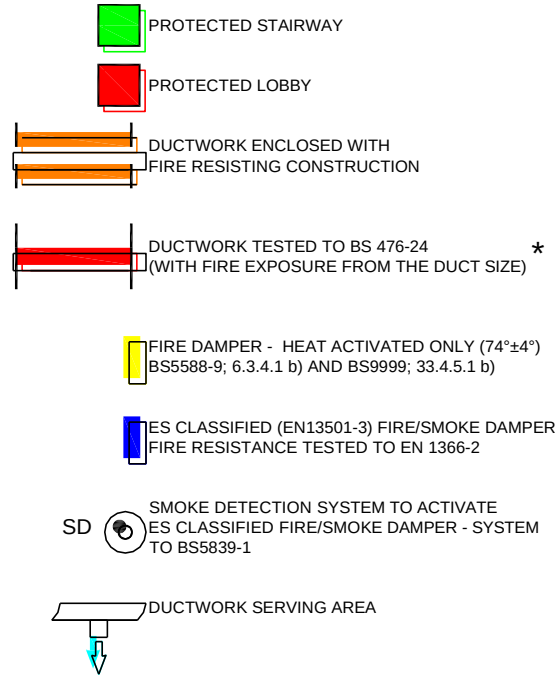
PROTECTED DUCTWORK SOLUTION; METHOD 2
DUCKWORK PASSING THROUGH PROTECTED ROUTES WITHOUT SERVING THE ROUTE (METHOD 2 IN BS5588-9; 6.4.3 AND BS9999; 33.4.2)

OPTION C



PROTECTED DUCTWORK SOLUTION; METHOD 3
DUCKWORK PASSING THROUGH PROTECTED ROUTES WITHOUT SERVING THE ROUTE (METHOD 3 IN BS5588-9; 6.4.3 AND BS9999; 33.4.2)

KEY



* WHERE THE DUCT IS REQUIRED TO PERFORM AS A SMOKE VENTILATION DUCT, THE DUCT ITSELF MAY STILL NEED TO HAVE FIRE RESISTING PROPERTIES AND THEREFORE METHOD 2 OR 3 MAYBE MORE APPROPRIATE. WHERE THE DUCT IS REQUIRED TO PERFORM AS A SMOKE VENTILATION DUCT, OTHER PARTS OF EN-1366 MAY APPLY.

3.6 Kitchen extract systems

Kitchen extraction ductwork presents a particular hazard, in that combustible deposits such as grease are likely to accumulate on its internal surfaces, and may spread fire if ignited. A fire in a kitchen may spread to other areas of the building by way of the kitchen extract ductwork and may also prejudice escape routes See figure 7.

Figure 7 references a room 1. It is important when assessing the risk for fire to consider the potential of a fire breaking out in room 1 and igniting the grease within the kitchen extract duct passing through the room. Therefore insulation is essential and the testing must have included for the thermocouples on a duct A within the furnace. There are various considerations to be taken into account for kitchen extraction systems and we recommend that reference is made to BESA DW 172 to ensure full compliance with these requirements (see 3.6.2).

Guidance for the installations for kitchen extract ducts is provided in various documents. Whilst paragraphs (a) to (g) may not be exhaustive, they attempt to list the common requirements with reference to the regulatory guidance in Approved Document B 2006 where applicable. Similar requirements are given in the statutory guidance documents in Wales, Scotland and Ireland.

3.6.1 Provisions for means of escape in relation to kitchen extraction systems (AD-B)

a) *Approved Document B: 2006, Paragraph 5.50*
Non-domestic kitchens are required to have separate and independent extraction systems, because of the polluted nature of the extracted air. The extracted air should not be re-circulated.

b) Any kitchen extract duct or ductwork penetrating fire resisting barriers must be fire resisting between the kitchen and the external weathering cowl.

The fire resistance requirement is normally 30 minutes, unless the duct also penetrates a compartment separation wall/floor where the fire resistance period and criteria should meet any higher requirement of the compartment wall/floor.

c) *British Standards*
Although Approved Document B 2006 does not provide guidance on kitchens other than in small premises and residential care homes, the AD-B states in paragraph 0.22 that supplementary guidance is given in British standards, and AD-B paragraph 5.53 references BS 5720. (The ASFP considers that paragraph 2.5.2.3 applies)

BS 5720 paragraph 2.5.2.3
States that kitchen extract ductwork should be enclosed with fire resisting construction where passing through other floors between the kitchen and the external weathering cowl. See figure 7 The canopy, ducting and insulation forming the kitchen extract duct should be made from non-combustible material.

d) *Guidance for Hospitals is given in HTM 05-02.*
In most cases, unless a suitable automatic extinguishing arrangement is provided, kitchens are required to be enclosed with fire resisting construction. Consequently the extract ductwork also needs to be enclosed with fire resisting construction where passing outside the kitchen enclosure up to its discharge to external air. The required fire resistance is to be achieved from inside the duct, to prevent a fire from inside the duct breaking out and spreading to other areas in the building.

NOTE: ASFP emphasises that regular internal cleaning of kitchen extract ducts is an essential part of all fire risk assessments and planned maintenance programmes in accordance with BESA publication DW/172, TR 19 and BS 9999 Annex W1. See also 9.5.

3.6.2 Provisions for compartmentation in relation to kitchen extract systems (AD-B)

a) *Approved Document B 2006, Paragraph 10.9 and 10.10*
Where a kitchen extract duct (an air handling duct) passes through fire separating elements the

integrity of those elements should be maintained. Fire dampers (known as Method 1) are not suitable for extract ductwork serving kitchens. This is due to the likely build-up of grease within the duct, which can adversely affect the effectiveness of any dampers. Therefore a fire resisting enclosure (known as Method 2) or fire resisting duct (known as Method 3) is recommended.

b) *BS ISO 6944-2: 2009*
The specifier may select a system which has been tested to BS ISO 6944-2: 2009 which has been developed specifically for kitchen extract ducts.

NOTE: Regardless of the publication of BS ISO 6944-2: 2009 the UK regulators may choose not to adopt all published standards in regulatory documents. Specific regulatory information is available in Approved Document B as guidance to building regulations.

c) *BESA DW 172 Specification for kitchen ventilations systems*

This specification contains useful information for designers, consultants and contractors as follows:

I. "15.12 All interior surfaces of the ductwork shall be accessible for cleaning and inspection purposes. In the absence of a detailed specification/method, access doors shall be installed at 3m centres."

II. "D6 No fire dampers are to be installed in the extract ductwork"

III. "D9 It is essential that the installed system complies with BS476, Fire inside (Type B) is rated for stability, integrity and insulation for the same period as the compartment through which the duct passes."

3.7 Car park extract systems

Car parks are required to have separate and independent extraction systems because of the polluted nature of the extracted air. It is recommended that fire dampers should not be installed in extraction ductwork serving car parks. Any duct or ductwork penetrating fire resisting barriers must be fire resisting. See Figure 8. See also section 4.5 for recommendations regarding car park extract systems.

3.8 Sound and thermal insulation used on and in ductwork systems

This item relates not to 'insulation' in relation to fire resistance but to where 'insulation materials' commonly known as 'ductwrap', although sometimes in the form of slab based materials, are to be applied to the outer or inner surface of ductwork systems to improve the sound and thermal insulation properties of ductwork systems. It is important that supports are adequately sized to take account of the additional weight'

These standards are described in BS 5588-9:1999; 10.2, and 7.5 and BS 9999; 2008; 33.4.13.1, 33.4.13.1, 33.4.13.2, 33.4.3.3, and are summarised below. There are three occasions where this may arise:-

3.8.1 Internal linings to ductwork

These should be class O (Euroclass B-s3, d2) and either be non-combustible (Euroclass A1) or a material of limited combustibility (Euroclass A2).

3.8.2 External insulation ductwork

a. Insulation within 500mm of a fire damper should be should be class O (Euroclass B-s3, d2) and either be non-combustible (Euroclass A1) or a material of limited combustibility (Euroclass A2). Otherwise insulation should not be within 500mm of a fire damper.

b. Insulation situated within a fire resisting ductwork enclosure should either:-

i) Have a class O (Euroclass B-s3, d2) surface
OR

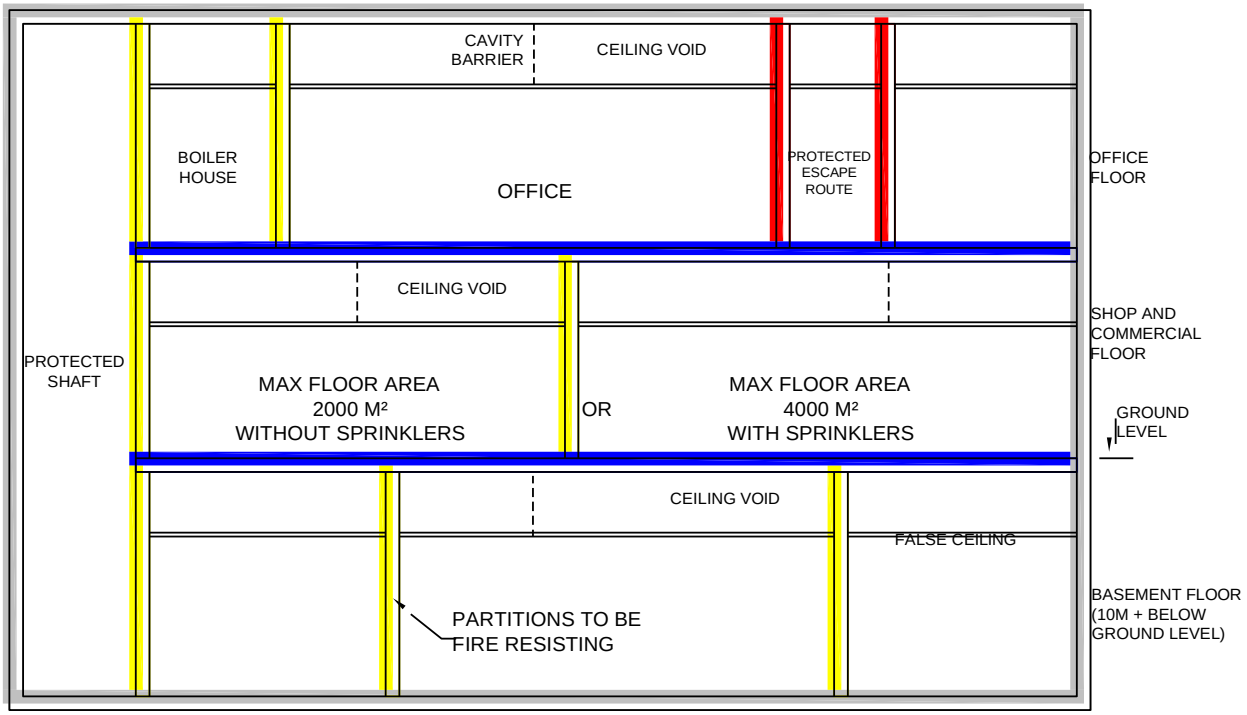
ii) If in a riser shaft between floors in a building needing compartment separation have been provided with a fire resisting subdivision between floors in the riser to the same standard as the compartment fire time.

c. Insulation not situated in a fire resisting enclosure should have a Reaction to fire classification (Euroclass) the same as the surface of the room or ensure where it passes through.

3.8.3 Insulation in riser shafts where Method 2 is used (not fire resisting ductwork enclosed in a fire resisting enclosure).

The enclosure of the Method 2 protection should be to the fire time of the compartment through which it passes, however the fire time/fire exposure side of the enclosure can be reduced if non-combustible (Euroclass A1) materials such as insulation are provided and floor fire stopping is included, See BS 5588-9; 7.5.2 a and b a full description of this solution. This solution is also mentioned in BS 9999:2008; 33.4.3.3.

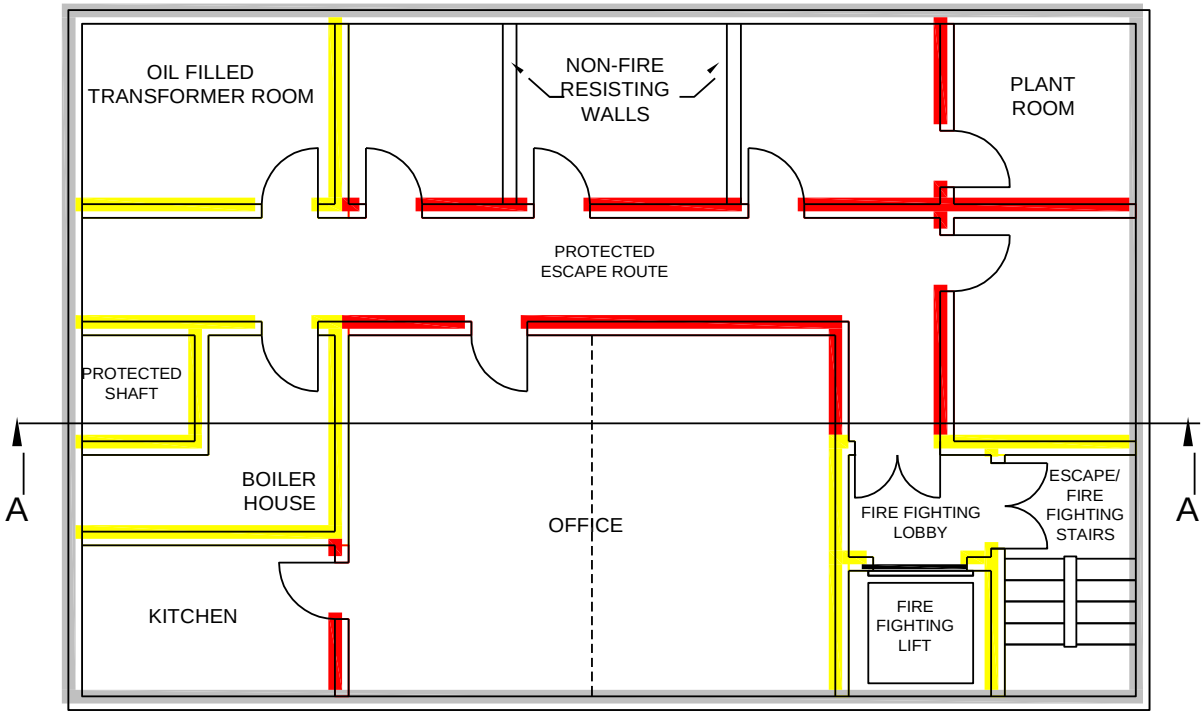
FIGURE 2
BRITISH STANDARD VERSION
FIRE RESISTING SEPARATION
FOR COMPARTMENTATION AND MEANS OF ESCAPE PURPOSES
IN LINE WITH APPROVED DOCUMENT 'B' OF THE BUILDING REGULATIONS



SECTION A-A

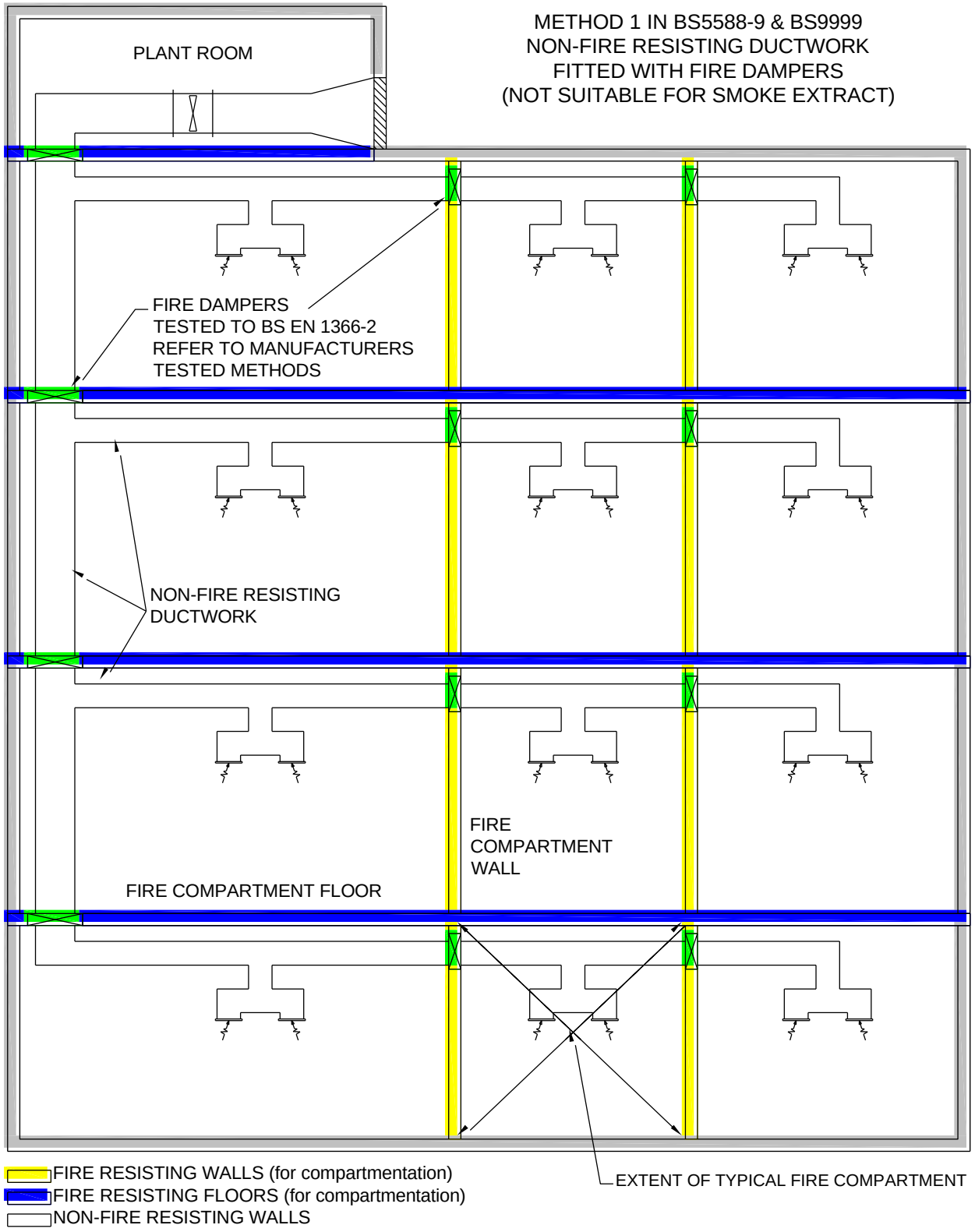
FIRE RESISTING WALLS (for compartmentation)
FIRE RESISTING FLOORS (for compartmentation)
FIRE RESISTING WALLS (for means of escape purposes only)
NON-FIRE RESISTING WALLS

Note: Some walls need to be fire resisting for means of escape and compartmentation reasons such as the stairway and special fire risk areas such as the boiler house.
In such cases the higher fire time is illustrated in colour.



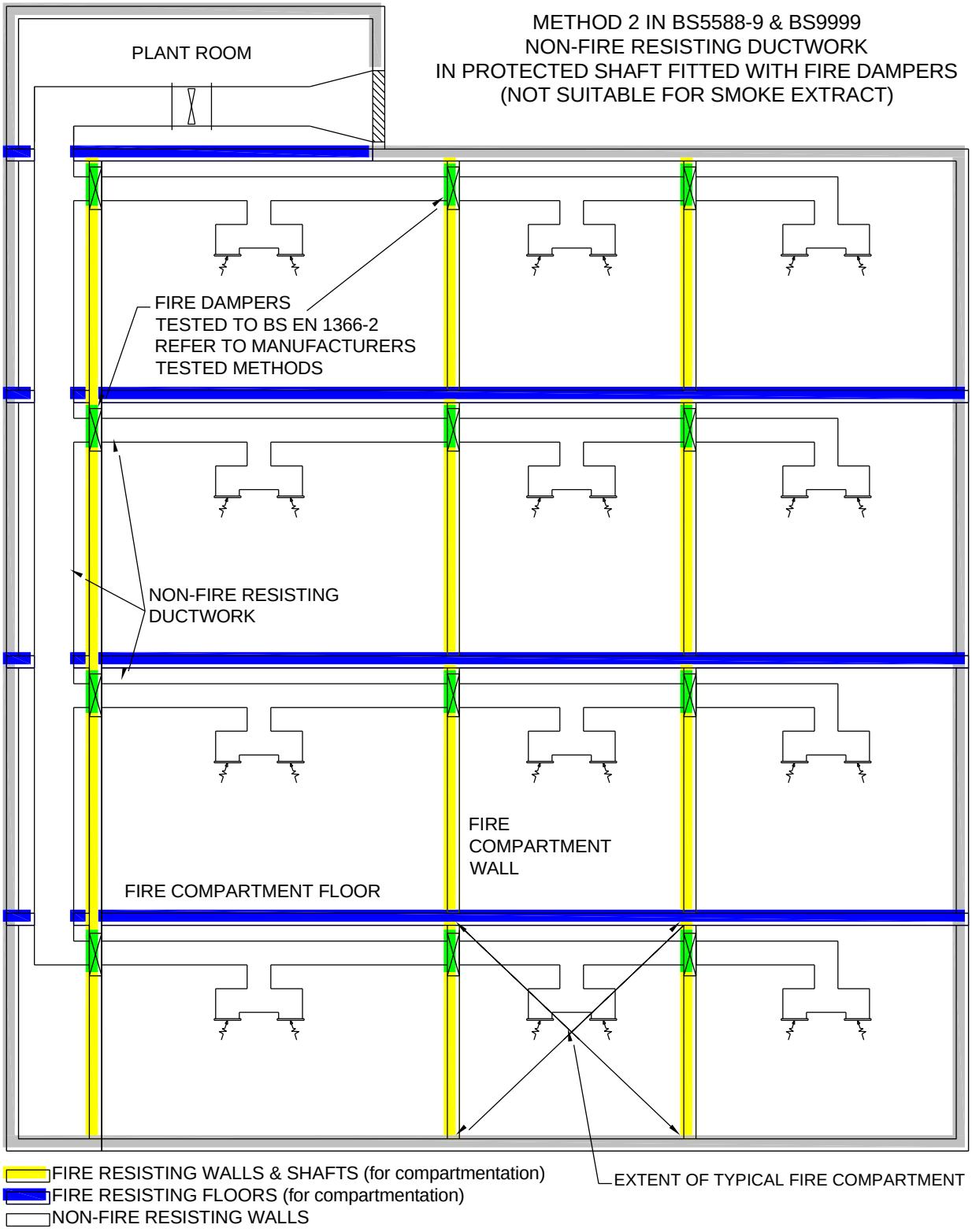
PLAN

FIGURE 3
BRITISH STANDARD VERSION
MECHANICAL VENTILATION SYSTEMS FOR COMPARTMENTATION ONLY



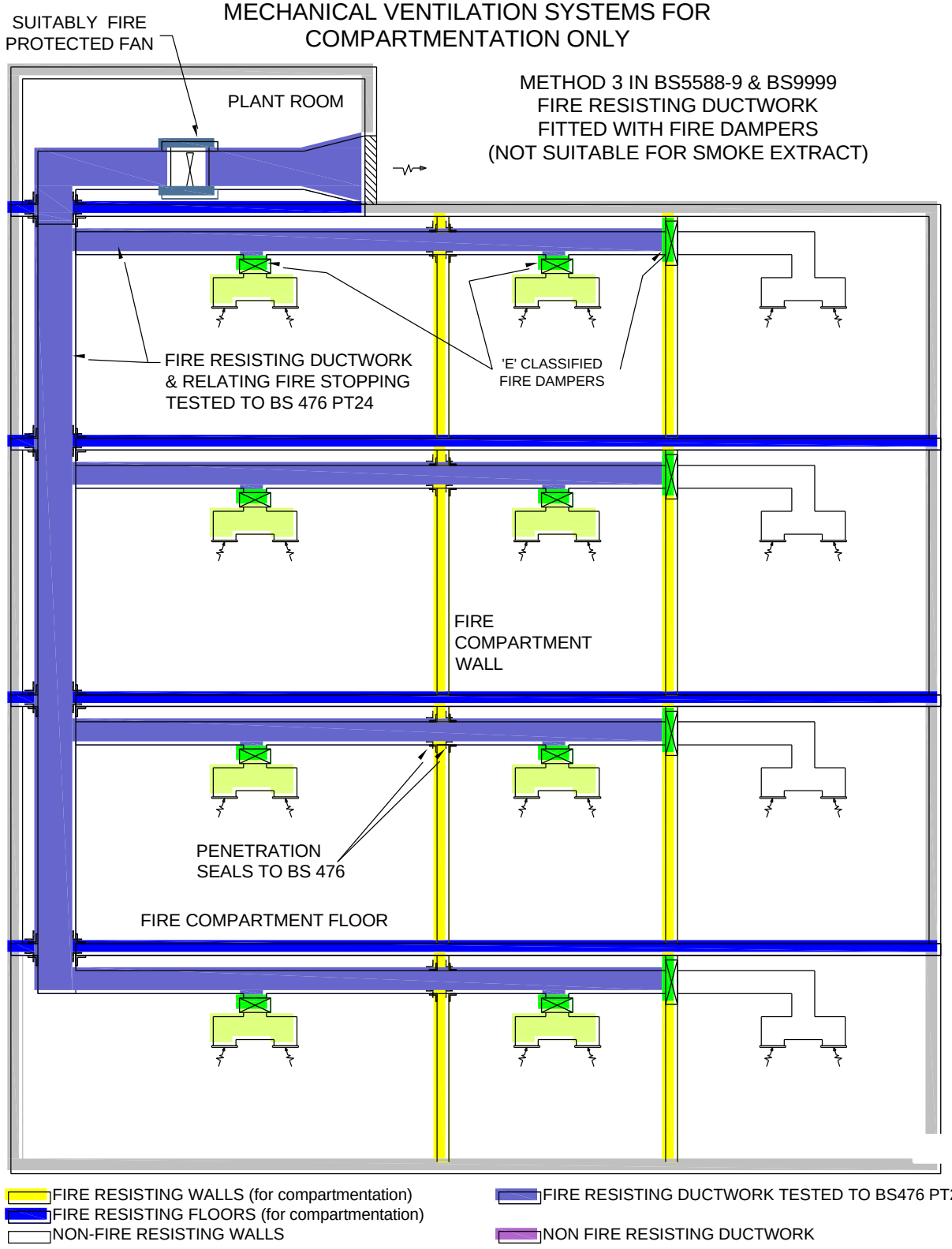
ELEVATION

FIGURE 4
BRITISH STANDARD VERSION
MECHANICAL VENTILATION SYSTEMS FOR COMPARTMENTATION ONLY



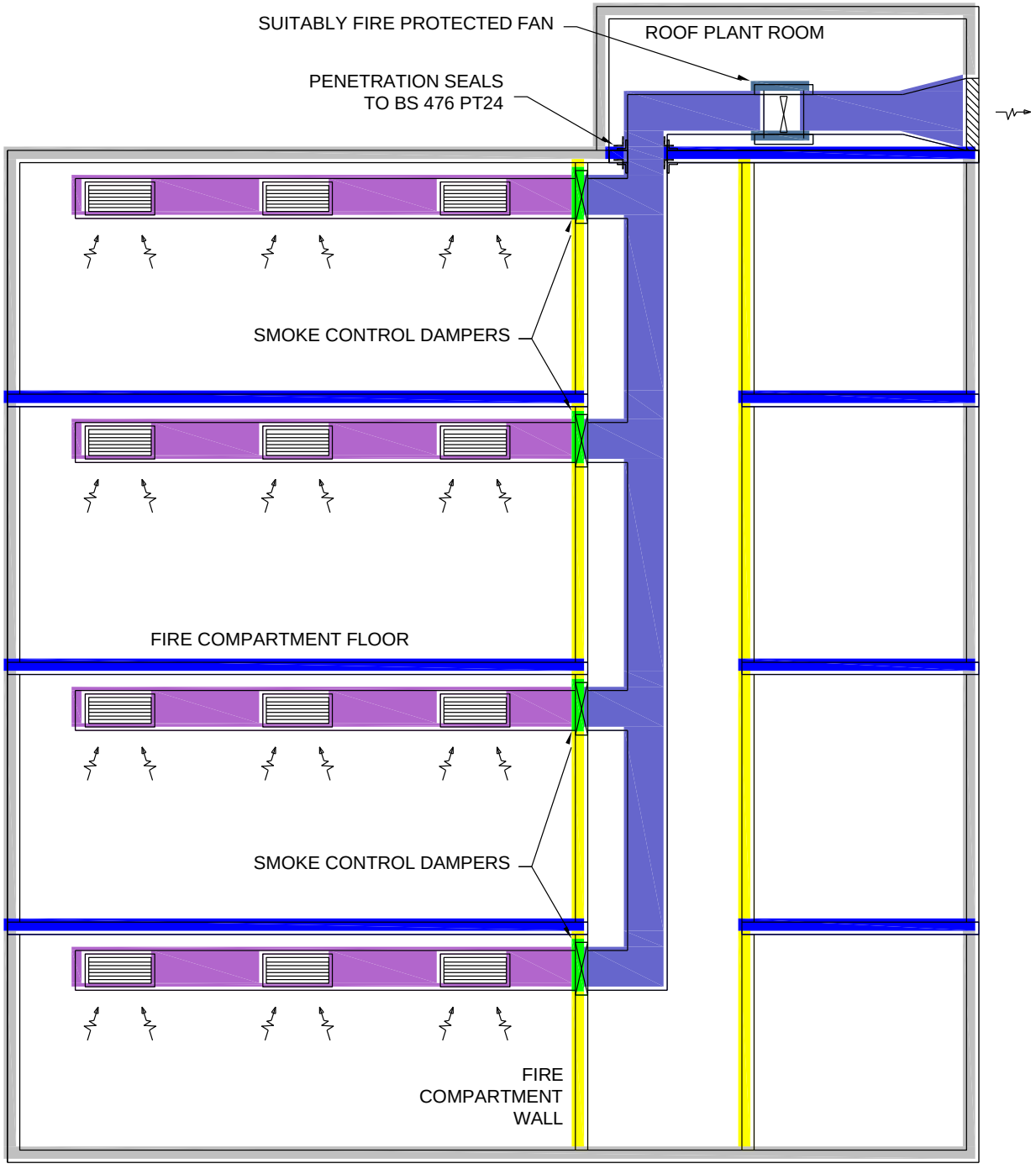
ELEVATION

FIGURE 5
BRITISH STANDARD VERSION
MECHANICAL VENTILATION SYSTEMS FOR COMPARTMENTATION ONLY



ELEVATION

FIGURE 6
BRITISH STANDARD VERSION
TYPICAL SMOKE OUTLET DUCTWORK SYSTEM



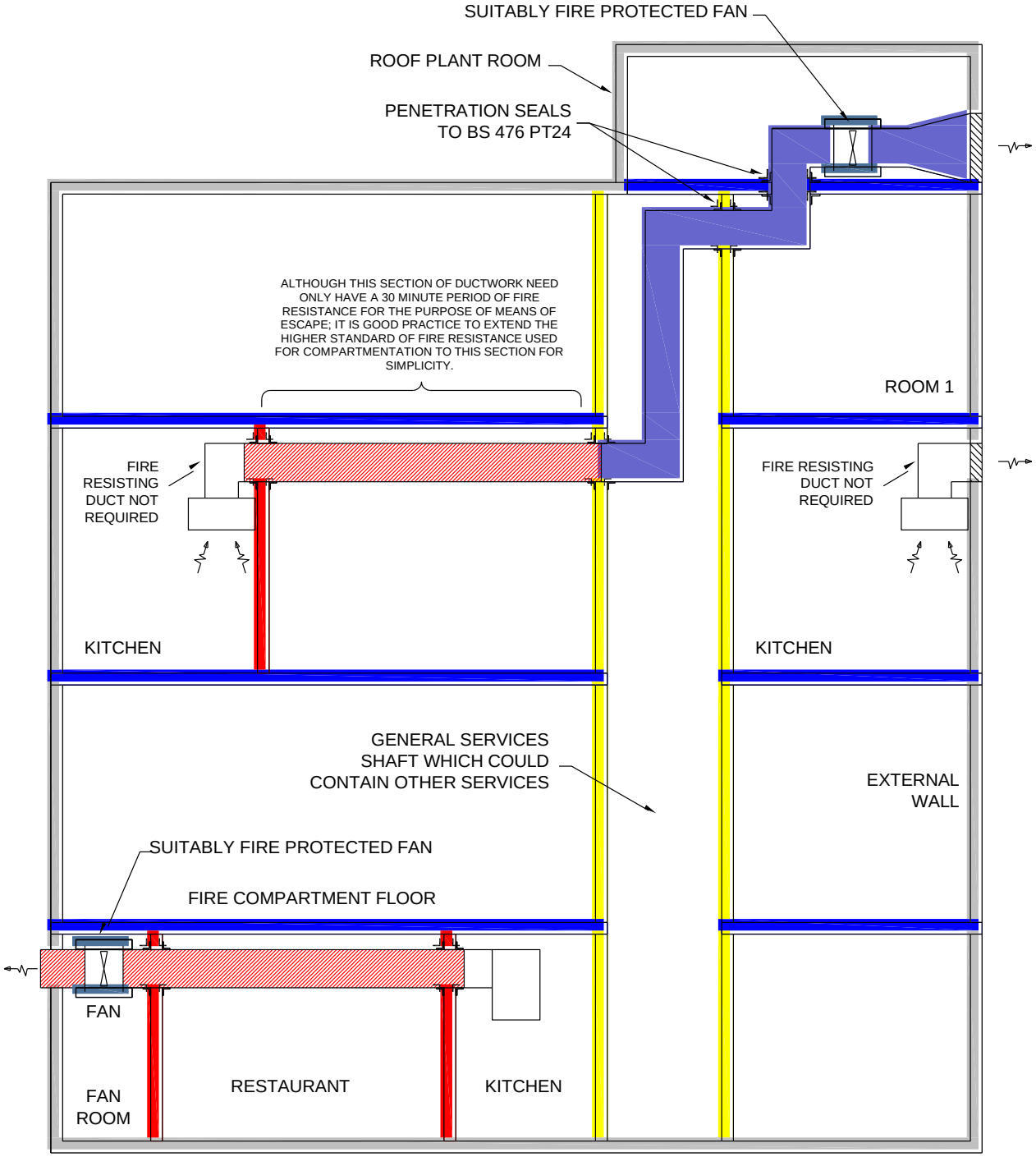
FIRE RESISTING WALLS (for compartmentation)
FIRE RESISTING FLOORS (for compartmentation)
NON-FIRE RESISTING WALLS

FIRE RESISTING SMOKE OUTLET DUCTWORK, RETAINING CROSS SECTIONAL AREA OF MORE THAN 75% OF DUCT. STABILITY, INTEGRITY & INSULATION RATING EQUAL TO COMPARTMENT WALLS, UNLESS SHAFT IS DEDICATED, THEN STABILITY & INTEGRITY ONLY IS REQUIRED

DUCTWORK SUITABLE FOR CLEARING SMOKE.
OFTEN 1 HOUR INTEGRITY TO BS 476 PT 24 - ISO 6944
RETAINING A CROSS SECTIONAL AREA OF MORE THAN 75%.

ELEVATION

FIGURE 7
BRITISH STANDARD VERSION
TYPICAL NON-DOMESTIC KITCHEN EXTRACT SYSTEM



NOTE: THERE SHOULD BE NO FIRE DAMPERS WITHIN NON DOMESTIC KITCHEN EXTRACT SYSTEMS

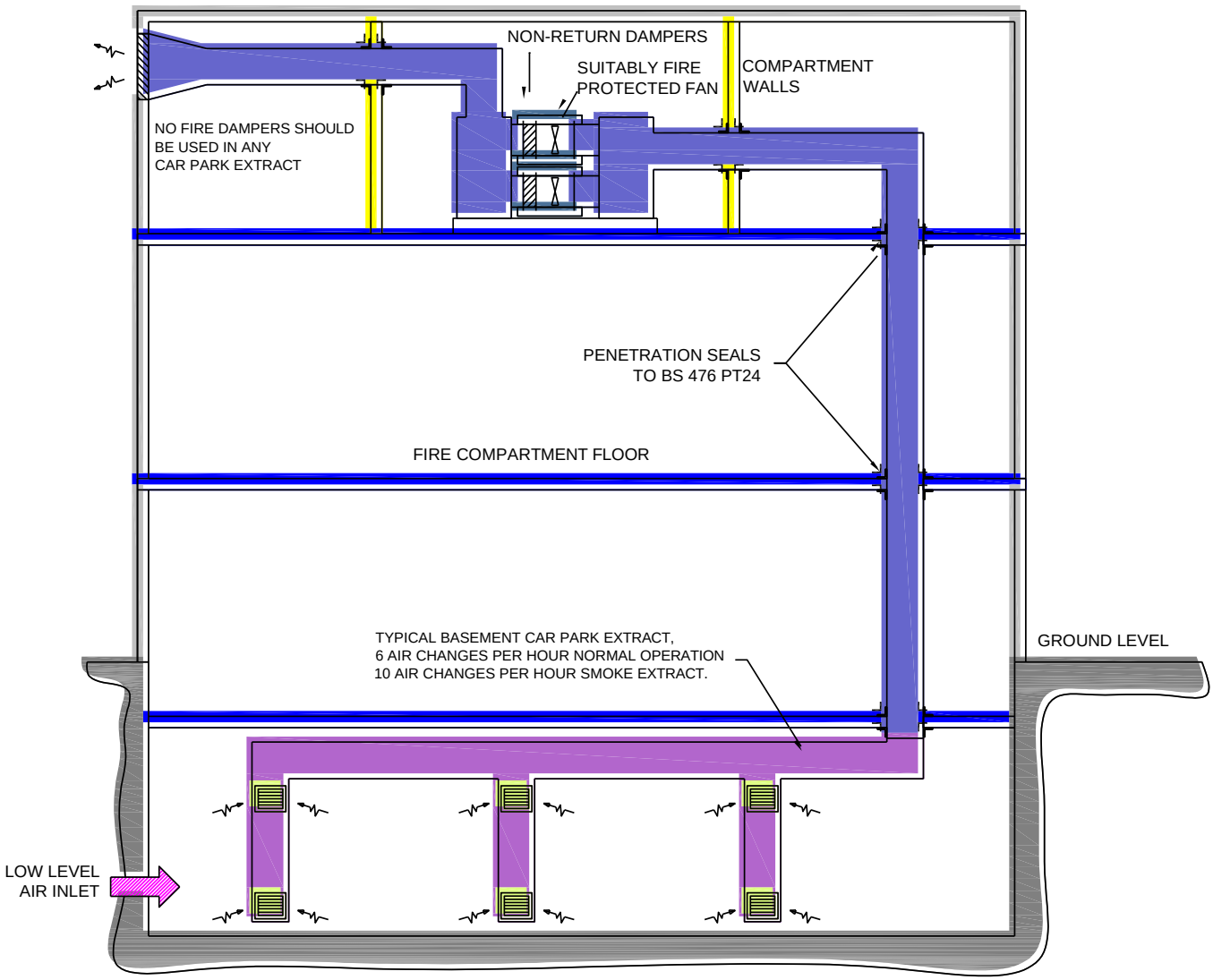
- FIRE RESISTING WALLS (for compartmentation)
- FIRE RESISTING FLOORS (for compartmentation)
- FIRE RESISTING WALLS (for means of escape purposes only)
- NON-FIRE RESISTING WALLS
- FIRE RESISTING KITCHEN EXTRACT DUCT, STABILITY, INTEGRITY AND INSULATION RATING EQUAL TO COMPARTMENT WALL
- 30 MINUTE FIRE RESISTING KITCHEN EXTRACT DUCT, STABILITY, INTEGRITY AND INSULATION RATING FOR MEANS OF ESCAPE PURPOSES

Note: Some walls need to be fire resisting for means of escape and compartmentation reasons such as the stairway and special fire risk areas such as the boiler house. In such cases the higher fire time is illustrated in colour.

ELEVATION

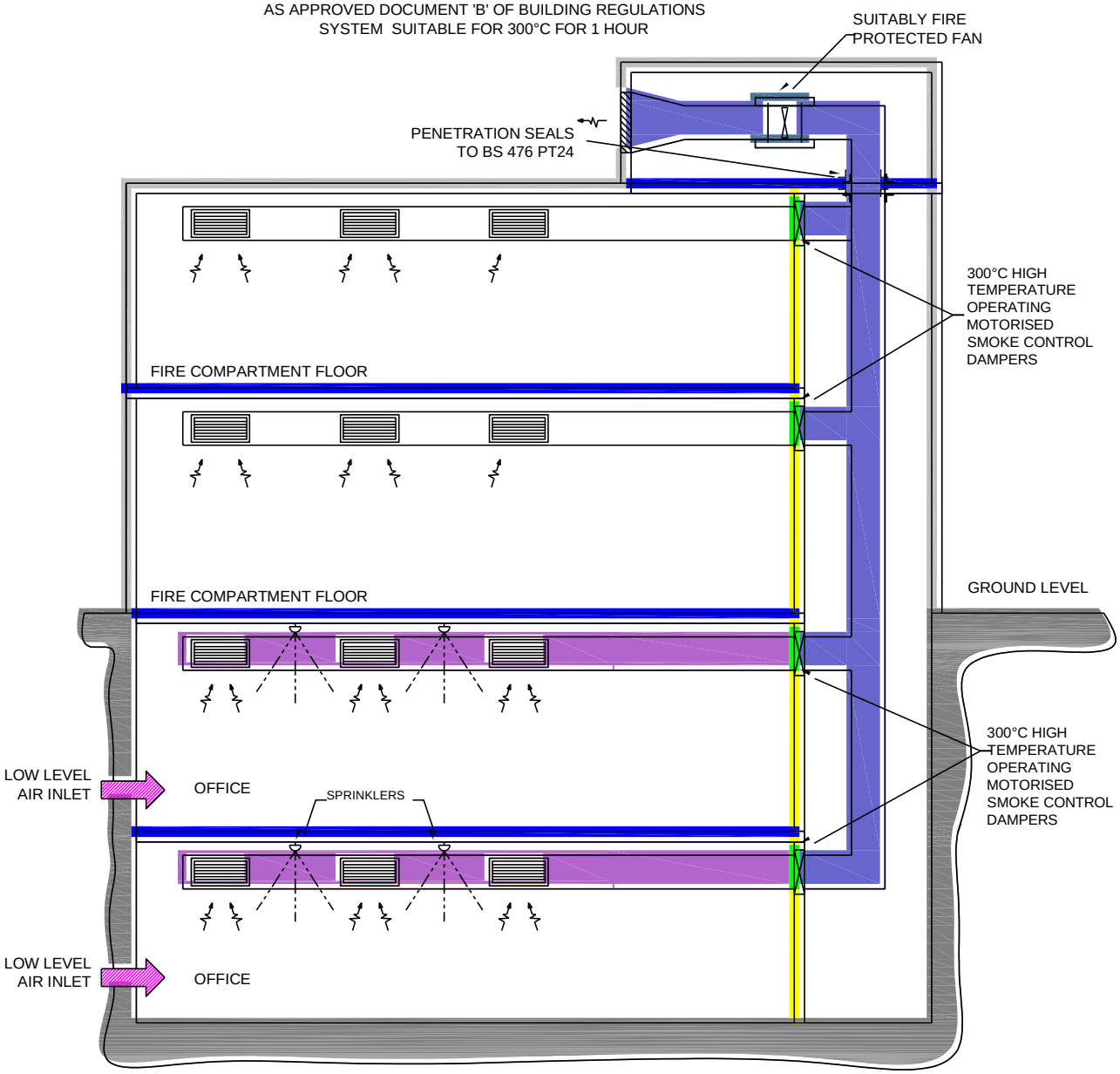
FIGURE 8
BRITISH STANDARD VERSION
TYPICAL CAR PARK EXTRACT SYSTEM

AS APPROVED DOCUMENT 'B' OF BUILDING REGULATIONS
FANS DESIGNED TO OPERATE AT 400°C FOR 1 HOUR, EACH FAN DESIGNED TO RUN AT 50% OF THE NORMAL AND SMOKE VOLUMES, AND DESIGNED SO THAT EACH FAN CAN OPERATE SINGULARLY AND SIMULTANEOUSLY.



ELEVATION

FIGURE 9
BRITISH STANDARD VERSION
TYPICAL BASEMENT SMOKE/DUAL EXTRACT SYSTEM
AS APPROVED DOCUMENT 'B' OF BUILDING REGULATIONS
SYSTEM SUITABLE FOR 300°C FOR 1 HOUR



FIRE RESISTING WALLS (for compartmentation)
FIRE RESISTING FLOORS (for compartmentation)
FIRE RESISTING WALLS (for means of escape purposes only)

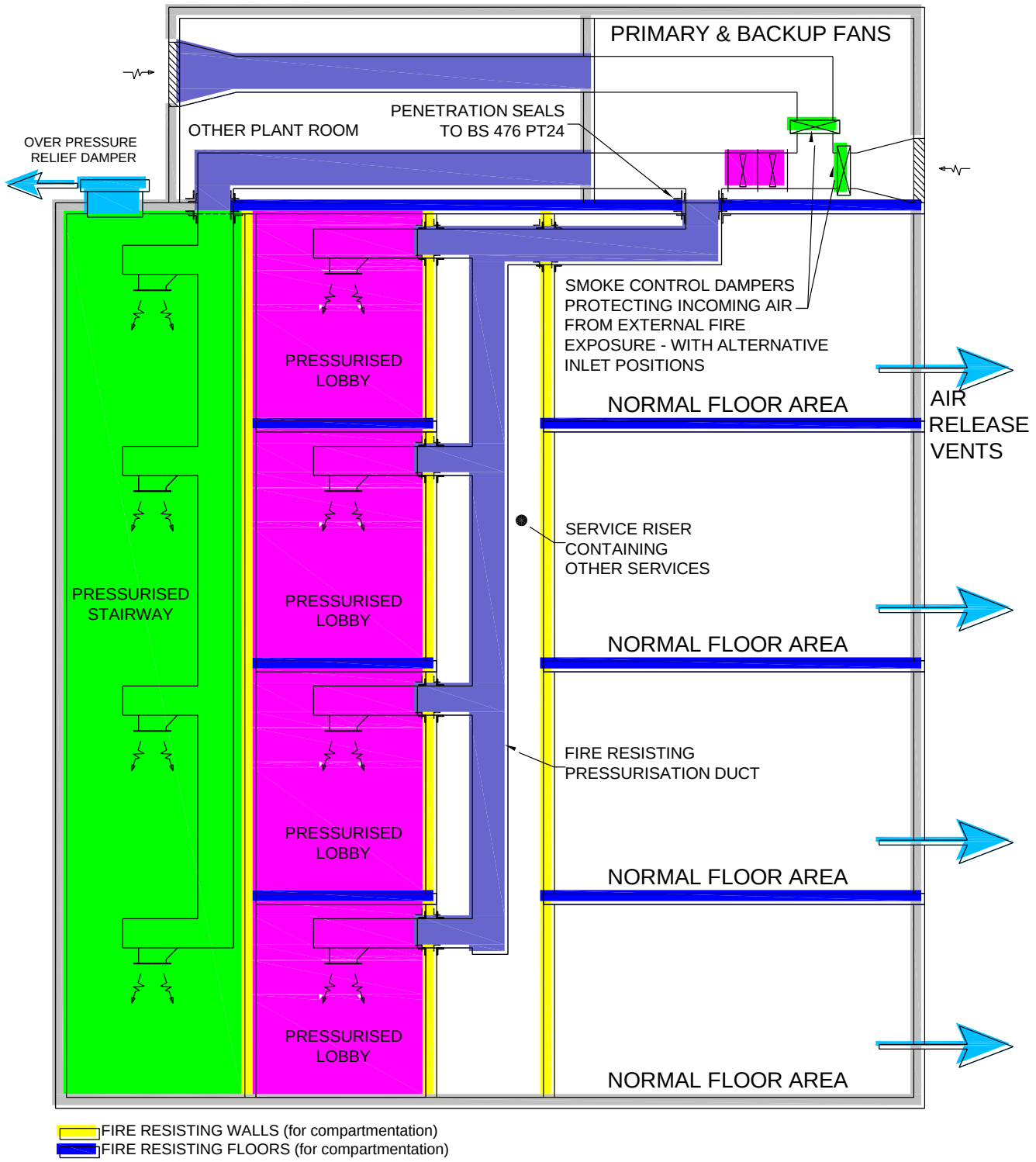
Note: Some walls need to be fire resisting for means of escape and compartmentation reasons such as the stairway and special fire risk areas such as the boiler house. In such cases the higher fire time is illustrated in colour.

FIRE RESISTING SMOKE OUTLET DUCTWORK, RETAINING CROSS SECTIONAL AREA OF AT LEAST 75% OF DUCT. STABILITY, INTEGRITY & INSULATION RATING EQUAL TO COMPARTMENT WALLS, UNLESS SHAFT IS DEDICATED, THEN STABILITY & INTEGRITY ONLY IS REQUIRED

EXTRACT SYSTEM SHOULD GIVE AT LEAST 10 AIR CHANGES PER HOUR AND SHOULD BE CAPABLE OF HANDLING GAS TEMPERATURES OF 300°C FOR NOT LESS THAN 1 HOUR. IT SHOULD COME INTO OPERATION AUTOMATICALLY ON ACTIVATION OF THE SPRINKLER SYSTEM; ALTERNATIVELY ACTIVATION MAY BE BY AN AUTOMATIC FIRE DETECTION SYSTEM WHICH CONFORMS TO BS5839-1:2002

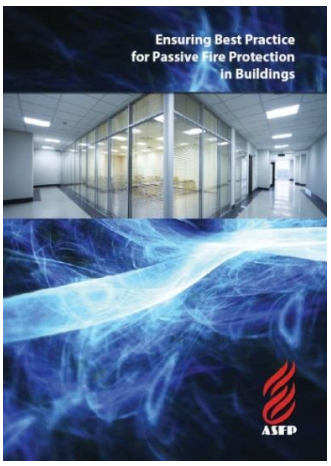
ELEVATION

FIGURE 10
BRITISH STANDARD VERSION
TYPICAL PRESSURISATION DUCTWORK SYSTEM
DIAGRAM BASED ON THE PRINCIPLE OF EN12101-6 (FIGURE 8B)



ELEVATION

4 BEST PRACTICE



This section gives some general guidance on the best practice to be employed when designing, specifying, installing and maintaining fire resisting ducts in buildings.

The ASFP publication *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2 describes in detail best practice to be followed from a project's inception through design, build and commissioning to providing information for maintenance and for facilities managers. It was written specifically to encourage a 'cradle to grave' approach in the provision of passive fire protection in buildings. The guide includes essential recommendations to be followed and has dedicated sections on fire resisting ducts.

It can be downloaded from http://is.gd/t9V42f.

4.1 Recommendation on design of fire resisting ductwork installations

4.1.1 General

The design of HVAC systems requires special attention from the designer because it is frequently hidden once installed and is therefore difficult to inspect after installation, handover and subsequently through the life of the building. However, it is sometimes not considered early enough, often as a result of a 'design and build' type approach; with the result that layout of the compartmentation with respect to services is not considered properly until it is too late. This results in services and their associated firestopping and supports being installed in the wrong place, too close to each other, too close to adjacent walls/floors and in locations where correct firestopping is almost impossible e.g. because of limited access. If adequate provision was given to the design of the division earlier on in the construction process, these problems would be avoided.

The ASFP publication *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2 gives guidance on when the design of all passive fire protection products should be considered in the construction process and on who is responsible for it.

4.1.2 Mixed penetrations

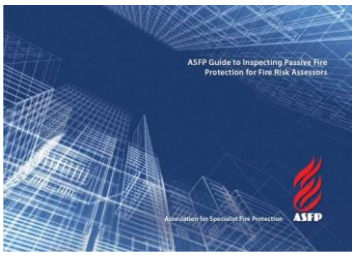
One reason why design is so important to consider at an early stage is to avoid situations where designers put all the services e.g. HVAC equipment, cables and pipes through one opening. Such 'mixed penetrations' should be avoided because the heat from a duct penetration and movement due to expansion will adversely affect the fire resistance of other penetration seals. The method of fire testing for ductwork is different to that for other service penetrations. Therefore a mixed penetration cannot be validated by test in the strict sense of the term. In the event of a mixed penetration, advice and design of a suitable seal should be sought from a fire engineer with experience of mixed penetrations.

4.2 Recommendations on who can install fire resisting ducts

Recommendations on the provisions for fire resisting ducts and on the competence of those installing it are given in Approved document B. The ASFP recommends that such installations should only be undertaken by contractors holding the relevant third party certification. See also clause 7.

Further information on the installation and inspection of fire resisting ducts can be found in ASFP TGD 18 Code of practice for the installation and inspection of fire resisting duct systems in buildings http://is.gd/FCjaV1**.**

4.3 Recommendations for the building owner



Modern commercial and public buildings are dynamic environments in which change is frequent and this can affect the installed fire protection systems. In particular building services are the principal cause of breaches in fire barriers. These breaches in fire resisting elements in the event of a fire may give rise to uncontrolled spread of fire.

Building owners (and their agents) and/or the Responsible Person under the Regulatory Reform (Fire Safety) Order 2005 (and national equivalents in

Scotland, Wales and Ireland) are responsible for the maintenance of fire-stopping systems within the building and this should form part of the risk assessment carried out under these regulations. Similar provisions apply in Scotland and Ireland. The ASFP publication: *Guide to inspecting passive fire protection for fire risk assessors* gives detailed information on how to inspect passive fire protection to be able to adequately undertake a risk assessment under those regulations. http://is.gd/eUAABM

4.4 Recommendations on Inspection,

Product manufacturers are required to provide information for inspection, maintenance and repair of their products in accordance with the requirements of Building Regulation 38 – see Appendix G Approved Document B – Fire Safety.


ASFP Technical Guidance Document – TGD 18

Code of practice for the installation & inspection of fire resisting duct systems

In particular, it is good practice to inspect frequently to ensure that inappropriate unauthorised modifications have not been made e.g. the addition of access doors for cleaning kitchen extract ducts which may not be fire resisting; or their fire resistance performance with the particular duct in which they are installed cannot be verified. In such cases, appropriate measures will need to be undertaken e.g. remedial work to maintain the fire resistance performance of the duct system.

Further information on the installation and inspection of fire resisting ducts can be found in ASFP TGD 18 *Code of practice for the installation and inspection of fire resisting duct systems in buildings* http://is.gd/FCjaV1**.**

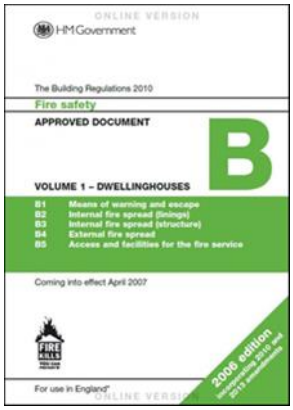
4.5 Recommendations for car park extraction ducts

Figure 8 shows the provisions for car park extraction ductwork as taken from Approved Document B (England and Wales versions). The provision is for ductwork made of metal with a melting point not less than 800^{O}C including other elements such as rivets, supports and fixing bolts. The ASFP recommends that to ensure proven reliability of such ductwork in the event of a fire, that it has been successfully tested in accordance with BS 476: Part 24: 1987. The ASFP believes that only a fully tested system can guarantee the performance required. In addition, as with all passive fire protection products, the ASFP recommends that the ducting is third party certificated and is installed by contractors holding third party certification for the installation of fire resisting ductwork.

5. REGULATIONS, CODES AND STANDARDS

5.1 Introduction

The documents listed in this section are most of the publications relevant to the performance requirements of ductwork in the event of a fire.



5.2 Building regulations

Building regulations in the UK and the Republic of Ireland are applicable to most building work that is undertaken. The Regulations for England and Wales are functional and deal with life safety standards for design and building work in the construction of domestic, commercial and industrial buildings. The regulatory systems in Scotland Northern Ireland and the Republic of Ireland differ from those in England and Wales.

A summary of the applicable legislation and appropriate statutory guidance documents for fire safety is given in table 1 below.

Country	England	Wales	Scotland	N Ireland	Ireland
Building Regulations	Building Regulations 2010	Building Regulations 2010	Building (Scotland) Regulations 2006	Building Regulations (N Ireland) 2000	Building Control Regulations 1991, 1997 – 2011. Building Control (Amendment) Regulations 2014
Statutory or Supporting Guidance docs	Approved Document – B 2007 http://is.gd/BVG4MS	Approved Document – B 2007 (including 2010 & 2016 amendments) http://is.gd/DjxxNx	Technical Handbook 2013 http://is.gd/k9dVVq	Technical Booklet E 2012 http://is.gd/8RCBtB	Technical Guidance Document B 2006 (new TGD-B expected 2016)
Building Regulation 38 equivalent	Yes	Yes	No*	No	Fire Services Acts 1981 and 2003
CDM regulations or equivalent	2015	2015	2015	2007	No

*although Scottish Building Standards Officers can apply 'continuing requirements' and fire safety design documents are part of those. In addition the Scottish Executive is considering an equivalent to Regulation 38.

Table 1: Summary of the applicable Building Regulations in the UK and Ireland.

5.3 Building Regulation 38 (formerly Regulation 16b) - England & Wales only

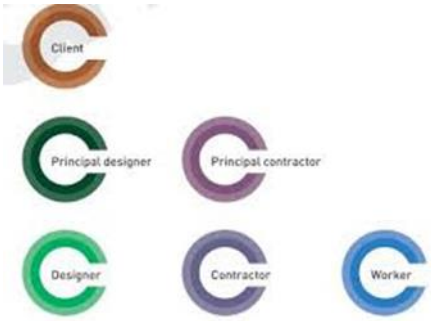
If a building was constructed after April 2007, Regulation 38 (formerly 16b) of the Building Regulations applies in England and Wales. This requires that sufficient fire safety information be provided for persons to operate and maintain the building in reasonable safety. An overview of what information is required in terms of PFP measures is provided in the Annex G of Approved Document B Volume 2: Fire Safety (English and Welsh versions). The information, which should have been passed on by the main contractor in compliance with Regulation 38 is vital to ensure that an appropriate and effective Fire Risk Assessment under the Regulatory Reform (Fire Safety) Order can be undertaken (see 5.4.2).

Such information, whether arising from the CDM Regulations or Regulation 38 will include details of fire-resisting construction on escape routes, fire compartmentation and other PFP information specified to satisfy AD-B and should include the fire test and assessment reports and any third party certification.

5.4 Other Regulations

5.4.1 Construction (Design and Management) Regulations 2015

The Construction (Design and Management) Regulations 2007 were revised in 2015. Whilst mainly aimed at clients, designers and contractors, manufacturers of construction products also have obligations under these Regulations:



Manufacturers supplying standardised products for use in any construction project are not designers; however, the person who selects the product is a designer and must take account of health and safety issues arising from the installation and use of those products. In a situation where a product is required to be purpose built (bespoke), then the person who prepares the specification or drawings is a designer and so is the manufacturer if he develops the specification into a detailed design. The connection is that the designer's decisions can affect the health and safety of workers and others who will construct, maintain, repair, clean, refurbish and eventually demolish the building or structure, as well as those who will use it as a completed workplace.

Further information can be obtained from *CDM2015 Principles in Practice, Industry Guidance for Designers* published by CITB which can be downloaded *here*. Note that this is still draft guidance which is subject to change. Further Industry Guidance publications include guidance for Contractors (download *here*), Principal Contractors (download *here*), Workers (download *here*) and the new role of Principal Designers (download *here*). The existing role of CDM Co-ordinator is not taken forward with the new Regulations.

In addition to the above guidance the HSE has published *Draft Guidance on The Construction (Design and Management) Regulations 2015* which provides draft Legal (L) Series guidance on the legal requirements of the Regulation. A copy of this publication can be downloaded *here*.

For the first time, all the above will now apply to domestic client projects, although the client duties will normally be transferred to the contractor or principal contractor, or if the client wishes to make a specific appointment, the designer.

The ASFP will be producing a short guide to the 2015 CDM regulations.

5.4.2 Risk based fire safety legislation

The move within regulatory guidance from prescriptive rules to performance-based designs and risk assessment during occupation puts greater responsibility for safety onto building owners or occupiers. The establishment of the 'Responsible Person' under the RR(FS)O (and national equivalents in Scotland and Ireland) means that those who are responsible for the operation of a business within a building need to be aware of their responsibilities which include the installation and maintenance of passive fire protection systems.

> *The Responsible Person is the employer, where there is one, and where there is not it will be the person responsible for the activity undertaken on the premises which might give rise to a risk to those present. It includes;*
>
> *a) the employer in relation to any workplace which is to any extent under his control;*
>
> *b) in relation to any premises where there is no employer:*
>
> *i the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or*

ii where there is no one with overall management responsibility, the occupier of the premises; or
iii where neither (i) or (ii) apply, the owner of the premises

A brief summary of the appropriate legislation is given in table 2 below.

Country	England & Wales	Scotland	N Ireland	Ireland
Relevant Act	Regulatory Reform (Fire Safety) Order (FSO)	Fire Safety (Scotland) Regulations & Fire Scotland Act	Fire and Rescue Services (Northern Ireland) Order 2006	General Application Regulations 2007 under the Safety, Health and Welfare at Work Act 2005. Fire Services Acts 1981 & 2003
Person responsible	Responsible Person	Duty holder	Appropriate Person	Responsible Person (Employer/landlord)
Person to do risk assessment	Responsible or Competent person	Responsible or Competent person	Responsible or Competent Person	Responsible or Competent person
People affected in building	Relevant persons	Relevant Persons	Relevant Persons	Employees and persons connected with the workplace

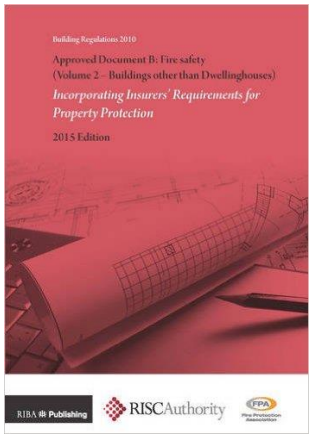
Table 2: Summary of the applicable legislation pertaining to fire risk assessments in the UK and Ireland.

5.4 Supporting Documents for risk based fire safety legislation

The following supporting documents may be useful, but is not an exhaustive list:

The Department for Communities and Local Government (CLG) has published a series of guides which introduce employers, managers, occupiers and owners to the new fire safety regime as it affects a variety of types of premises, under the generic title 'Fire safety risk assessment'. Documents can be downloaded from: http://is.gd/hB1U1h.

5.5 Insurers' requirements



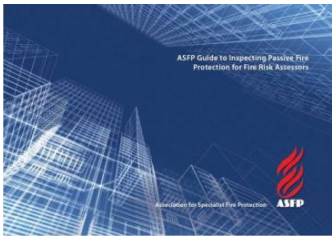
Insurers' requirements for the protection of property may be higher than those required for life safety. Business continuity is also a consideration which can lead to higher specification of passive fire protection.

Useful information can be found at www.riscauthority.co.uk including free downloads of relevant documentation including:

- Insurers' version of England Approved Document B http://is.gd/wm9XjE
- BDM2 - Fire protection of buildings - Core Document – Compartmentation http://is.gd/dxDsaL
- BDM6 - Fire protection of buildings - Core Document - Protection of openings and service penetrations from fire http://is.gd/HutrbG

a) 'Essential principles'
b) 'Design Guide for the protection of buildings - Protection of openings and service penetrations from fire'

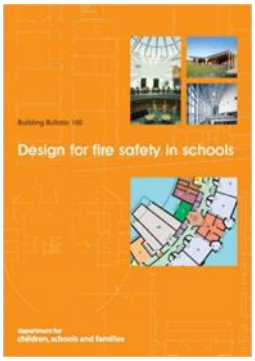
5.6 ASFP documents



Building owners (and their agents) and/or the Responsible Person under the Regulatory Reform (Fire Safety) Order 2005 (and national equivalents in Scotland, Wales and Ireland) are responsible for the maintenance of fire-stopping systems within the building and this should form part of the risk assessment carried out under these regulations. Similar provisions apply in Scotland and Ireland. The ASFP publication: *Guide to inspecting passive fire protection for fire risk assessors* gives detailed information on how to inspect passive fire protection to be able to adequately undertake a risk assessment under those regulations. http://is.gd/eUAABM

5.7 Codes of practice

- The Department for Children, Schools and Families have published Building Bulletin 100 – *Designing &managing against the risk of fire in schools*. http://is.gd/EHwYC9



- Department of Health HTM 05 Series, available from http://is.gd/nQ2PAe:
  - HTM_05-01 Managing healthcare fire safety
  - HTM_05-02_2015 Guidance in support of (Fire safety in the design of healthcare premises)
  - HTM_05-03_Part_A_Final General fire safety
  - HTM_05-03_Part_J Guidance on fire engineering of healthcare
  - HTM_05-03_Part_M_Final Guidance on the fire safety of atria

- BS 9999: 2008 Code of practice for fire safety in the design, management and use of buildings
- BS 9991: 2015 Fire safety in the design, management and use of residential buildings. Code of practice
- Fire Protection Association Design Guide for the Fire Protection of Buildings – Essential principles, http://is.gd/C75CwC
- Fire Protection Association Design Guide for the Fire Protection of Buildings – Essential principles, http://is.gd/C75CwC
- University Health and Safety Association Guidance on the Preparation of a Generic Fire Design Guide. http://is.gd/QLE7Fr

5.8 British standards

BS 476: Fire Tests on Building Materials and Structures

Part 4: 1970	Non-combustibility test for materials
Part 6: 1989 + A1	2009 Method of test for the fire propagation for products
	Part 7: 1997 Method of test to determine the classification of the surface spread of flame of products
Part 11: 1982	Method for assessing the heat emission from building materials
Part 20: 1987	Method for determination of the fire resistance of elements of construction (general principles)
Part 24: 1987	Method for determination of the fire resistance of ventilation ducts

BS 5588: Fire Precautions in the Design, Construction and Use of Buildings Part 9: 1999 Code of practice for ventilation and air conditioning ductwork.

Other British Standards

BS EN 12101-3 Specification for powered smoke and heat control ventilators (Fans)

BS EN 12101-7 Smoke and heat control systems. Smoke duct sections

BS 9999: 2008 Code of practice for fire safety in the design, management and use of buildings

BS ISO 10294 Fire Resistance tests - Fire dampers for air distribution systems
Part 1: 1996 - Test method.
Part 2: 1999 – Classification, criteria & field of application of test results
Part 3: 1999 – Guidance on the test method
Part 4: 2001 – Test of thermal release mechanism
Part 5: 2005 – Intumescent fire dampers

5.9 International standards (ISO)

ISO 834-1:1999	Fire resistance tests – Elements of building construction: Part 1 General requirements
ISO 6944: 1985	Fire Resistance Tests – Elements of building construction: Part 1 Ventilation ducts
ISO 6944-2:2009	Fire resistance tests – Elements of building construction: Part 2 Kitchen extract ducts

5.10 BESA Documents

DW/143: 2013	Good practice guide to ductwork leakage testing
DW/144: 2013	Specification for Sheet Metal Ductwork Low, medium and high pressure/velocity air systems
DW/145: 2010	Guide to good practice for the installation of fire and smoke dampers
DW/172: 2005	Specification for kitchen ventilation systems
TR/19: 2013	Guide to good practice – Internal cleanliness of ventilation systems

5.11 Standard method of measurement of building works

RICS NRM2 – Detailed Measurement for Building Works

The measurement of fire resisting ductwork should follow the guidelines of Table38 of NRM2

6. STANDARD FIRE TESTS

The fire performance of passive fire protection products is evaluated primarily by fire tests undertaken to British and European standards. Manufacturers undertake tests at specialist fire test laboratories to satisfy the requirements of building regulations, but also for a variety of other reasons including obtaining market advantage, developing new products, in support of CE marking and for third party certification. This section explains the various processes from fire testing, through assessment (expert judgement), classification, CE marking through to third party certification.

6.1 The stages of a fire, 'reaction to fire' and 'fire resistance'

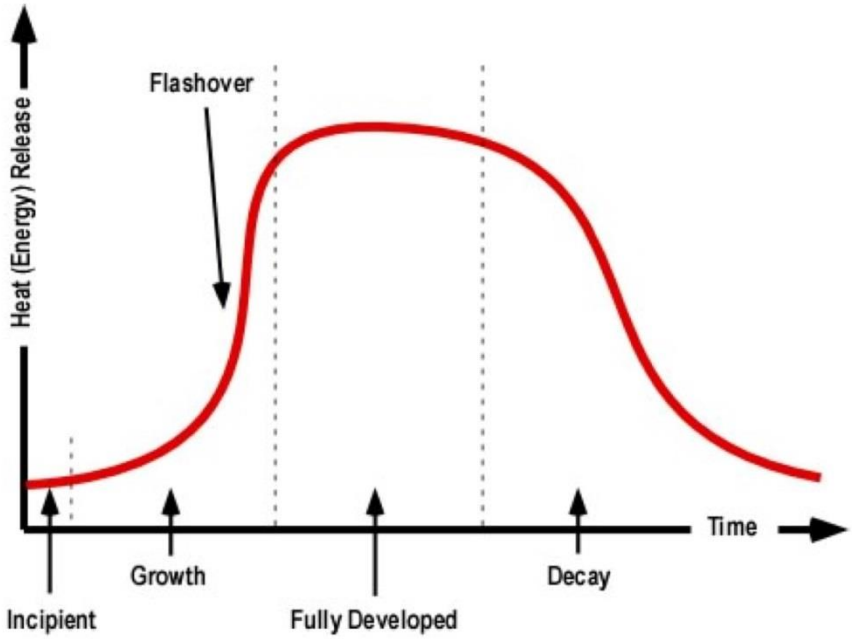


Figure 11: Stages of development of fire in a compartment

Fire occurs when a combustible material is ignited in the presence of oxygen/air which supports the combustion and allows the fire to grow. The stages of a fire in a compartment are shown in figure 11 above.

The rate of fire growth will depend on the combustibility of the item first ignited and the other materials in contact with, or in the vicinity of, the ignited material, such that fire spread could occur through conductivity of heat, convection of heat, or radiation of heat. This is the growth phase.

When the temperature of the enclosure containing the ignited contents in a small room reaches around 600˚C, the condition known as flashover will occur, sometimes suddenly, such that all other combustibles in the enclosure will also ignite and release energy through combustion along with smoke and the toxic products of combustion. This is accompanied by a rapid increase in temperature.

The fire temperature will grow further if further combustible material is available in a ventilated space. Otherwise the fire will peak in the fully developed phase and then die back, usually due to lack of fuel. If the oxygen required for combustion is inadequate then combustion will reduce to smouldering level and finally cease.

The duration of any fire is dependent of the amount of combustible organic material available to burn.

6.2 Reaction to fire

Reaction to fire is the term used to describe the behaviour of materials and products during the incipient and growth stages of a fire. The reaction to fire characteristics of a material can be measured using a variety of fire tests. These include:

- Ignitability
- Spread of flame over its surface,
- Amount and rate of heat released,
- Amount of smoke produced
- Amount and toxicity of effluent gasses emitted.

Because such fire exposures (tests) are intended to model the ignition and growth stages of a fire they are described as 'pre-flashover' condition. There are British and European standard tests for Reaction to fire; both are given visible recognition in the statutory guidance documents to UK Building Regulations such as Approved Document B.

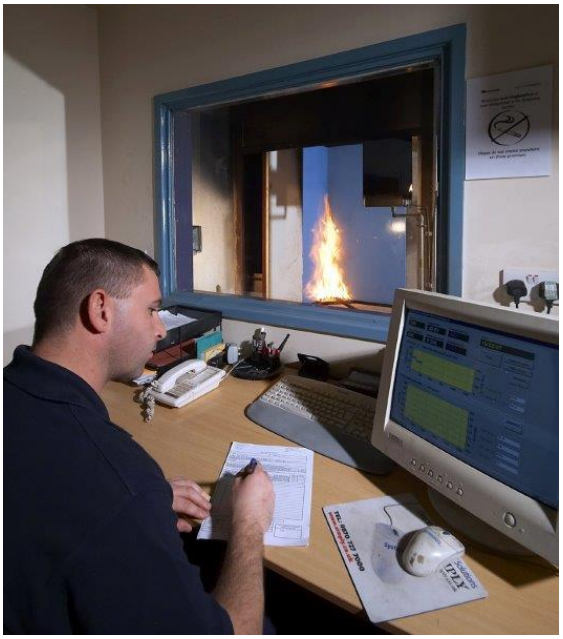


Figure 12: EN 13823 SBI test

However, if the material under consideration is CE marked, then only the European test can be used to create the resulting 'Euroclass'

Reaction to fire tests which are used to demonstrate compliance are:

6.2.1 British Standard Reaction to Fire Tests

6.2.1.1 BS 476: Part 7

BS 476: Part 7: *Method of test to determine the classification of the surface spread of flame of products* measures the rate at which flame is able to spread over the surface of a lining material. The material or product is classified 1, 2, 3 or 4 with Class 1 being the highest classification (least flame spread).

6.2.1.2 BS 476: Part 6

BS 476: Part 6: *Method of test for fire propagation for products* measures the rate of heat release from a product or material. From this test, indices of performance are calculated. Index of performance (I) relates to the overall test performance, whereas sub-index (i_1) is derived from the first three minutes of test. The maximum acceptable 'fire propagation' indices are specified in the statutory guidance documents to the Building Regulations.

6.2.1.3 BS 476: Part 11

BS 476: Part 11: *Method for assessing the heat emission from building materials* and BS 476: Part 4: *Non-combustibility test for materials* are similar and are used to determine the heat emission from a product or material. Materials of limited combustibility are defined in the national Building Regulations by reference to the method of test specified in Part 11. Non-combustible materials are also defined in the national Building Regulations either as listed products or in terms of performance when tested to Part 4 or Part 11. Non-combustible materials may be used whenever there is a requirement for materials of limited combustibility.

6.2.1.4 Class 0

An additional product performance classification for lining materials is defined in the national Building Regulations as Class 0. This is achieved if a material or the surface of a composite product is either:

- composed throughout of materials of limited combustibility, or
- a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i_1) of not more than 6.

Class 0 is not a classification identified in any British Standard test.

6.2.2 European Standard Reaction to Fire Tests

Although this publication refers to ducts evaluated by British Standards, it may well be the case that a British Standards duct is lined or wrapped with an insulation conforming to the European classes for reaction to fire.

The classification system has seven levels of performance from A1 (best level of performance) to F (no performance determined). There are supplementary classifications for the production of smoke and flaming droplets, but they do not concern us here. The relevant test standards and performance levels for each classification are set out in the classification standard itself. The relevant tests are:

EN ISO 1182 *Non-Combustibility test*

EN ISO 1716 *Determination of the heat of combustion* [bomb calorimeter test]

EN 13823 *Single burning item [SBI] test*

EN ISO 11926 – 2 *Ignitability with direct impingement of flames* [Small flame test].

6.2.2.1 EN ISO 1182

EN ISO 1182 *Non-combustibility test* is used to determine the heat emission from a product or material. It is almost identical to BS 476: Parts 4 and 11 (see above). The EN ISO 1182 test method is used for the classification of European classes A1 and A2, together with EN ISO 1716.

6.2.2.2 EN ISO 1716

EN ISO 1716 Test to determine calorific value. In this test, a powdered specimen of specified mass is burned under standardised conditions at constant volume, in an atmosphere of oxygen, in a bomb calorimeter. The calorific value is calculated on the basis of observed temperature rise. This test determines an absolute value for a product of the total amount of heat it can potentially generate which will be greater than that which it would generate under real fire conditions. The BS EN ISO 1716 test method is used for the classification of European classes A1 and A2, together with EN ISO 1182.

6.2.2.3 EN 13823 Single burning item test

The Single Burning Item test is an intermediate scale open corner method for measuring lateral flame spread, total and rate of heat release, propensity for the production of flaming drips and total and rate of smoke production. The test specimens comprise two vertically oriented walls, arranged to form a 90˚ corner. It provides data suitable for comparing the performance of materials, composites or assemblies that are used primarily as the exposed surfaces of walls and ceilings. The test procedure simulates the performance of these products when fixed to the walls/ceilings of small rooms under end-use conditions where the ignition source is a nominal 30kW single burning item such as a waste-paper basket in a corner of the room. The SBI test method is used for the classification of European class A2, together with EN ISO 1716; and European classes B, C and D with EN ISO 11925-2.

6.2.2.4 EN ISO 11925-2 Ignitability test

This test determines the ignitability of vertically mounted test specimens when a small flame is directly applied to its surface, edge and possible vertical edge. No other heat source is used. The ignition source consists of a small match size flame mounted at an angle of 45˚ applied in one fluid movement for either 15 or 30 seconds dependant on the classification sought. The test method is used for the classification of European classes B, C and D, together with other test methods and E and F as a direct result of this test.

6.3 Fire resistance tests on ducts

Figure 13: fire resisting duct under test

Standard British fire resistance tests on ventilation ducts are carried out in accordance with BS 476: Part 24 (ISO 6944-1: 1985 – but not later versions). This standard specifies a method of test and criteria for the determination of the fire resistance of vertical and horizontal ventilation ducts under standardised fire conditions. The general purpose of the test is to measure the ability of a representative duct or duct assembly to resist the spread of fire from one compartment to another.

The test is conducted without the involvement of fire dampers. It is applicable to vertical and horizontal ducts, with or without branches, taking into account joints, air supply and exhaust openings, as well as suspension devices and penetration seals. The performance of the duct assembly is measured in terms of its ability to withstand exposure to high temperatures by setting criteria by which the resistance to collapse - ensuring the duct is able to fulfil its intended function - (stability), the fire containment (integrity) and the thermal transmittance (insulation) functions can be judged. The standard temperature/time fire exposure specified in BS 476: Part 20 is representative of only one possible fire exposure condition at the fully developed fire stage.

The method of test does not quantify the behaviour of a duct for a precise period of time in a real fire situation but can be used directly to show compliance with fire resistance requirements in regulations or other safety specifications, and enables comparisons to be made between constructions.

The specimen which is subjected to the fire test must be designed and constructed to be representative of how it would be constructed on site. Two ducts are tested, one with fire outside only (duct A) and one with fire on the inside (duct B). Both ducts may be tested in either a horizontal or vertical orientation. See Figures 14 to 17. The minimum length of the specimen duct required by the test standard is 3.0m in the furnace and 2.5m outside the furnace for horizontal ducts; and 2.0m in the furnace and 2.0m outside the furnace for vertical ducts. Horizontal duct A is fitted with a branch duct within the furnace. The recommended cross section of duct for test is 1.0m x 0.25m internally. A fan is connected to the end of horizontal duct A outside the furnace which induces an under-pressure of 300Pa inside the duct. A fan is connected to the end of horizontal and vertical ducts B outside the furnace which induces air velocity of 3m/s within the ducts at ambient temperature, drawn through an opening in the side wall of the duct within the furnace. The settings of the fan are not altered during the test. Every 30 minutes of the test the fans are switched off for five minutes to evaluate the integrity of the ducts in the 'fan off' situation.

The test specimen is subjected to fire on all four sides. The standard temperature/time fire exposure is followed. The furnace pressure is measured 100mm below horizontal ducts, and 100mm below the top of the furnace for vertical ducts. It is controlled after the first five minutes of the test to be positive by 10 ± 2Pa compared to that of the laboratory. Thermocouples are applied to the non-fire face of the duct outside the furnace as required by the standard and extra thermocouples are included within the duct to gain additional data on the fire performance. These additional thermocouples enable assessments to be carried out on the duct system when used as a kitchen extract duct. Observations must also be made during the test regarding the retention of the cross-sectional area of the duct so that assessments can be made on the duct system when used as a smoke outlet/extraction duct. A smoke outlet/extraction duct should retain at least 75% of its cross-sectional area.

The tested duct assembly is judged against three performance criteria. These are:

Stability

Stability failure shall be deemed to have occurred in duct A within the furnace and in ducts A and B outside the furnace when the duct collapses in such a manner that the duct no longer fulfils its intended function. Included in this is the ability of a smoke outlet/extraction duct to retain at least 75% of its cross-sectional area.

Integrity

The presence and formation in the test specimen of cracks, holes or other openings outside the furnace through which flames or hot gases can pass shall constitute integrity failure. Integrity failure shall also be deemed to have occurred when the cotton pad referred to in ISO 834 is ignited or when sustained flaming, of duration at least 10s, appears on the unexposed face of the test specimen outside the furnace.

In order to interpret the presence and formation in the test specimen of cracks, holes or other openings outside the furnace through which flames or hot gases can pass, the following modes of failure under the integrity criterion of BS 476: Part 20 are adopted:

Failure is deemed to occur:

i. when a 6mm diameter gap gauge can penetrate through a gap and can be moved in the gap for a distance of at least 150mm;

ii. when a 25mm diameter gap gauge can penetrate through a gap.

Insulation

Insulation failure shall be deemed to have occurred when the temperature rise above initial ambient temperature in the laboratory on the unexposed surface of the test specimen outside the furnace exceeds either

i. 140°C as an average value; or

ii. 180°C as a maximum value read by any surface thermocouple.

For kitchen extract duct A, these temperature rise limits also apply to the inside surface of the duct within the furnace.

Non-standard tests are carried out to the principles of BS 476: Part 24, but at reduced furnace temperatures, for applications such as smoke extraction systems where the maximum exhaust temperatures are specified and the ductwork does not penetrate fire separating elements. The results from similar tests can also be utilised for installations where a fire engineering analysis has been carried out on the building and the maximum temperature to which the duct would be exposed in a fire situation has been calculated. An example of such an installation is in an atrium of a multi-storey building where the ducts are designed to extract smoke and hot gases in the event of a fire and to prevent flash-over occurring.

Figure 14: Test arrangement for vertical ducts
Typical test arrangement to BS 476: Part 24:1987

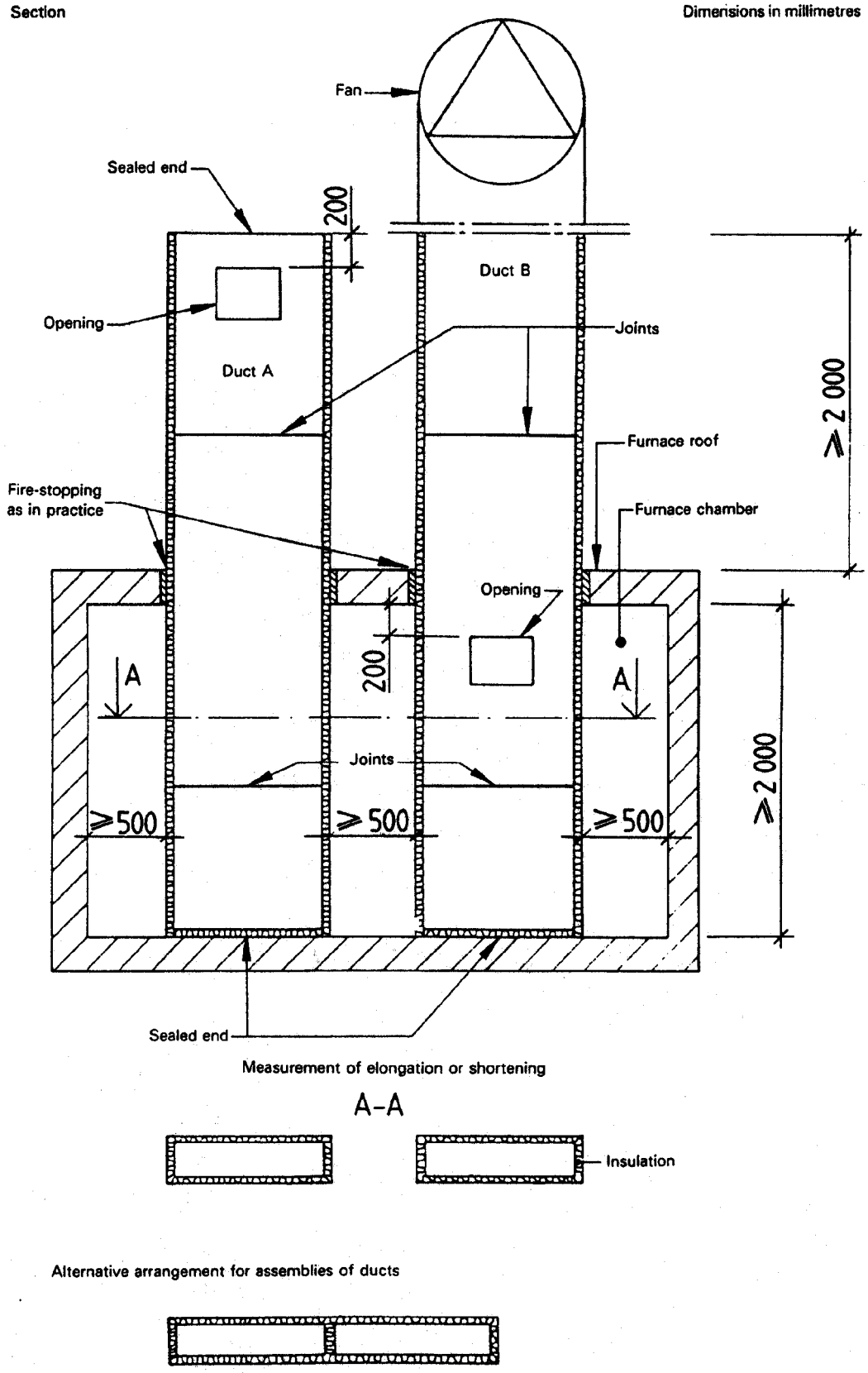
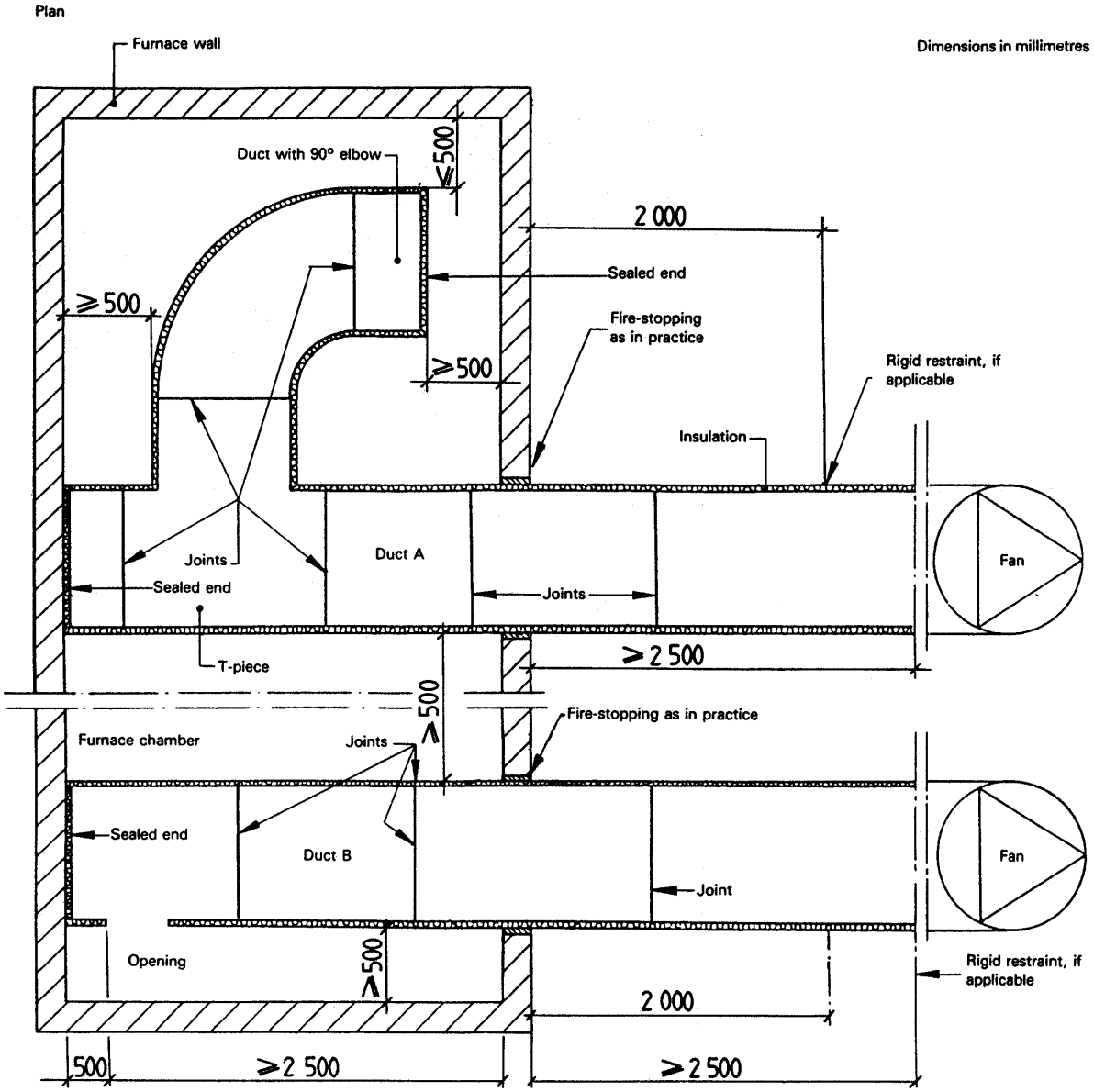


Figure 15: Test arrangement for horizontal ducts
Typical test arrangement to BS 476: Part 24:1987



NOTE: The sealed end shall be independent of the furnace wall

Figure 16: Location of thermocouples on vertical ducts outside the furnace

Typical test arrangement to BS 476: Part 24: 1987

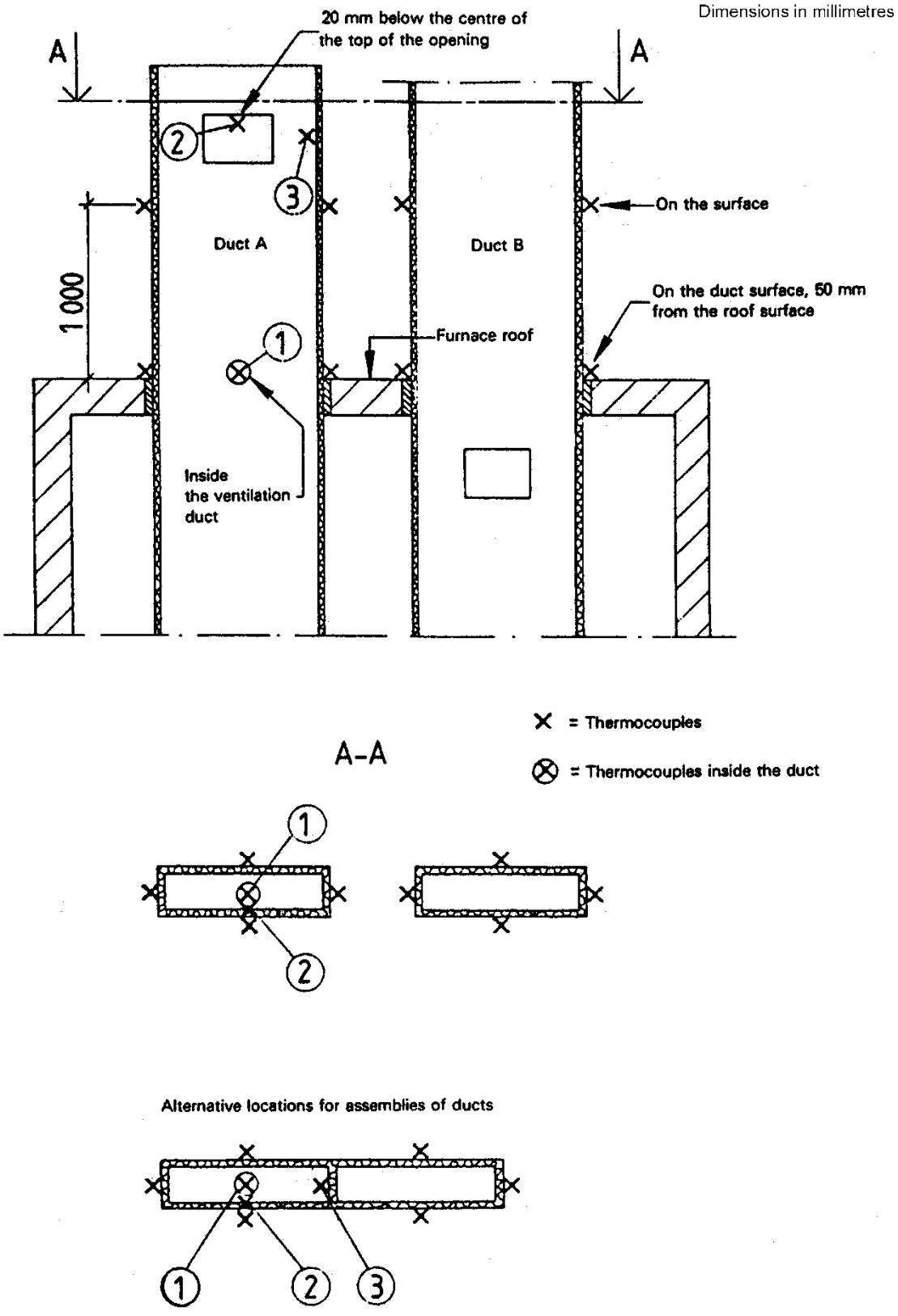
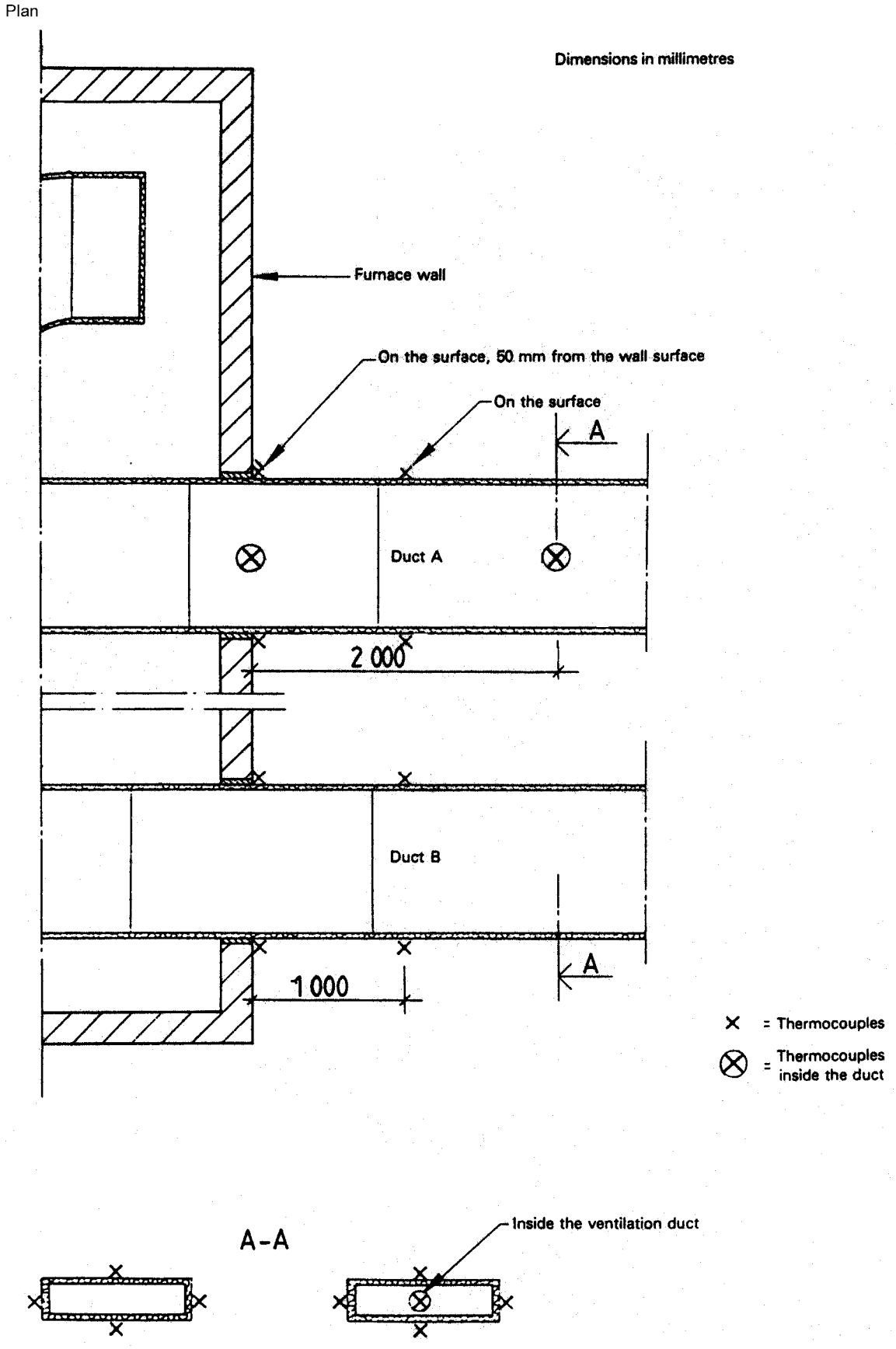


Figure 17 Location of thermocouples on horizontal ducts outside the furnace - typical test arrangement to BS 476: Part 24: 1987



7. ASSESSMENTS OR 'ENGINEERING JUDGMENTS'

7.1 General to increase scope of a product's range

The sheer range of products and sizes and configurations of passive fire protection products means that it is almost impossible to test every single variant. It would also be uneconomic to do so and fire resisting ducts are no exception. Consequently, assessments or 'engineering judgments' are used following the generation of fire test evidence to expand the scope of the applicability of the tested product/system. Assessments are normally the view of a recognised expert in a particular fire test, and the performance of products in that test, that may be used for the purpose of interpreting or applying results in connection with National Regulations.

Assessments have been used in this way, in the UK, for many years and have been accepted as having a similar status to a test report. It is normal for UKAS, or equivalent accredited test laboratories to conduct the assessments, although this is by no means mandatory. Some fire consultants and suitably qualified/experienced fire engineers would also be expected to have the appropriate knowledge

ASFP recommends that such assessments are conducted in accordance with the *PFPF Guide for Assessments In Lieu Of Fire Resistance Tests*. Assessments, which follow the guidance within the PFPF Guide, will provide the end user with confidence that the evaluation has been carried out with the necessary care and expertise and is appropriate to the intended use. The guide can be downloaded from here: http://ftsg.co.uk/pubs.html

Previous versions of this book contained rules for assessments or engineering judgements to increase the scope of products for which manufacturers could claim a fire performance. These rules are also used in in part or completely by some of the certification bodies for the third party certification of fire resisting ducts.

It has agreed to remove these rules partly because they might encourage lay persons without an experienced background in the testing and approval of fire resisting ducts to attempt to assess products. This should be left to UKAS, or equivalent, accredited test laboratories, suitably qualified fire consultants and the certification bodies. The rules will be kept and maintained by ASFP for use by appropriate parties.

7.2 Site-specific assessments

Just as all the combinations of permutations of fire-stopping cannot all be tested, so the total range of end-use (on-site) applications cannot be tested either. Special conditions will arise from site to site which may mean that the manufacturer's instructions and tested installation method cannot be followed. In such circumstances, an evaluation of likely performance needs to be undertaken. This is normally conducted via a site specific 'assessment' or 'engineering judgment' report as per 7.1 above. The report should address the on-site condition and the required amendments to the construction and provide justification that the proposed changes are acceptable. Typical areas where site specific assessments may be required are:

a) 'one-off' projects or applications, where the cost of testing would otherwise make the application uneconomic

c) Where, for various reasons (e.g. size or configuration) it is not possible to subject a construction or a product to a fire test.

8 THIRD PARTY CERTIFICATION

8.1 Product certification

Voluntary third party product certification schemes vary according to the terms of individual schemes, but essentially include verification of the test evidence and scope of application or use of the product, and a regular audit of the factory quality assurance (QA) system to ensure that the product as supplied to the contractor is to the same design or formulation as the original test samples. Third party certification specifically involves:

- **Independent selection of samples for test**
- **Evaluation of manufacturer's factory production control system**
- **Initial inspection of the factory**
- **Undertaking, or organising, the testing of the product at an independent laboratory**
  In addition to fire testing, these will include other characteristics that are relevant to the performance of the product as considered under the individual scheme. Unlike CE marking, which stipulates which characteristics are required to evaluated in the European Technical Specification, Third Party Schemes are free to be tailored to a specific product type. Usually, such schemes evaluate fitness for purpose, but concentrate on those product characteristics important to the fire performance of the product.
- **An appraisal of all the test and assessment evidence to be able to define a scope of certification**
  Again this is another area where third party certification schemes differ from CE marking. CE marking is quite rigid over the extent to which products variations are catered for. The limits being contained within EXAP standards (see 7.5). Voluntary third party certification schemes are not so constrained and can use expert judgment to significantly extend the scope of certificated products. Again, the schemes will differ and manufacturers should compare the 'technical schedules' of the schemes to find the most suitable scheme. These are publicly available on the certification body websites.
- **Undertaking audit testing/procedures** including regular retesting or other regular quality checks
- **Issuing a certificate**
- **Traceable labelling of product**

It should be noted that CE Marking is not a 'quality mark' but uses harmonised European classification and fire testing procedures. Voluntary third party product certification schemes are 'product quality' schemes and invariably include more checking procedures than are required for CE Marking.

Figure 18: Certification bodies offering third party product certification

The ASFP strongly supports third party certification of all passive fire protection products including fire resisting ducts. It is a condition that manufacturers who wish to have products listed in this publication must have third party certification for the product. In this way, end-users can use this book as a source of products whose fire performance has been comprehensively evaluated by an independent third party certification body.

8.2 Installer certification

Third party certification for installers is a process whereby the contracting company employs appropriately trained, competent staff to install the required passive fire protection system. Their work is independently audited by site inspections from the third party organisation and a full record system is required as part of the scheme. Installer certification specifically involves:

- **Auditing of offices to check**
  - **that written procedures are in place to account for the correct use of staff**
  - **records for the correct purchase of appropriate materials/products are present**
- **Use of staff whose competency has been evaluated**
- **Use of proven e.g. CE marked or third party certificated fire-stopping products or systems**
- **Certificate of completion of works lodged with certification body**
- **Independent inspection of works by certification body**

As with third party product certification schemes, installer schemes vary slightly and it is useful to compare the requirements of each scheme.

The ASFP recommends that all passive fire protection is installed by third party certificated installers. In the case of fire resisting ducts this is particularly important as they are often covered up and inaccessible after installation, so it is important to get it right.

It is a condition of membership of the ASFP that contractors must have third party certification for installation. End-users can be confidant that an ASFP contractor will have had their installation capability comprehensively evaluated by an independent third party certification body.

Figure 19: Certification bodies/schemes offering third party installer certification

8.3 Reference to third party certification in Statutory Guidance documents

The use of third party certification schemes is recognised in the Building Regulations, Approved Document B (Use of Guidance; Independent certification schemes).

In the section dealing 'Use of Guidance; Materials and Workmanship – Independent certification schemes*:* Approved Document B 2006 includes the following text:-

> *"There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognized document, which is appropriate to the purpose for which the material is to be used. Materials, which are not so certified, may still conform to a relevant standard.*
>
> *"Many certification bodies which approve such schemes are accredited by UKAS.*
>
> *"Since the fire performance of a product, component or structure is dependent upon satisfactory site installation and maintenance, independent schemes of certification and registration of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.*
>
> *"Building control may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, Building Control Bodies may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. A Building Control Body will wish to establish in advance of the work that any such scheme is adequate for the purposes of the Building Regulations."*

9. NOTES ON PENETRATION SEALS, SUPPORTS & ANCILLARY ITEMS

9.1 Penetration seals

Where ductwork passes through a compartment wall or floor it must be ensured that the fire separation of the wall or floor is maintained. This is usually achieved in one of two ways:

i. For fire resisting ductwork a penetration seal is fitted between the duct and the wall or floor. The penetration seal and the ductwork are considered as one integral system and for the field of direct application must be the same as that tested or assessed in accordance with BS 476: Part 24.

ii. For non-fire resisting ductwork a fire damper must be fitted in the plane of the wall or floor. The damper and associated penetration seal must be installed to a procedure substantiated by test or assessment. Note that the damper must be mounted in the wall or floor and must be supported/ restrained independently of the ductwork.

Where fire resisting ductwork adjoins a damper fitted in a wall or floor the penetration seal to the wall or floor must be installed as (ii) above.

The primary reason for providing fire-resisting ductwork systems is to maintain the fire resistance of a compartment wall or floor of a building. It is therefore critical that the correct method of sealing any gaps around the ductwork is used as it passes through any compartment wall or floor. This detail is one of the most common reasons for the failure of the ductwork system in a fire resistance test.

The fire resistance test for ducts (BS 476: Part 24) is designed to evaluate the fire performance of the duct penetration seal system through a wall or floor construction (the fire separating element), as well as the fire performance of the duct system itself. The purpose of the penetration seal system is to seal the gap between the duct walls and the surrounding wall or floor. In a fire situation, an integrity failure of the penetration seal system is often caused by the movement or distortion of the duct. Therefore it is not possible to separate the fire performance of the penetration seal from the construction of the duct.

A successful test on a penetration seal fitted around one type of duct construction does not mean that the penetration seal is suitable for use with a different type of duct construction. Similar comments apply for duct sizes other than that tested.

Usually the penetration seal will be suitable for duct sizes smaller than that tested, but the construction of the duct may have to be modified or the duct locally strengthened at the penetration, for duct sizes larger than that tested.

Most of the fire tests on duct penetration seal systems have been carried out through concrete floors or masonry/concrete walls. If the fire separating element is of a different type of construction from that tested, for example a timber floor or a fire rated partition system, then an indicative fire test and an assessment should be carried out to ensure that the duct penetration seal system and/or any damper restraint system is compatible with the different fire separating element for the required fire rating.

The BS 476 Part 24 fire tests on ducts are carried out on specimens in the horizontal orientation and in the vertical orientation. The fire performance of the penetration seal system must be demonstrated for the orientation in which the duct is being used, or have been assessed as being suitable. If the penetration seal system fails to satisfy the test criteria during the test then the duct or damper system is also deemed to have failed.

The performance of the system will depend on several factors as follows:

9.1.1 Thermal expansion or shrinkage of ductwork system

Systems based on steel ductwork will expand in fire, and self-supporting systems may shrink. This movement may dislodge the seal.

9.1.2 Deformation of ductwork

The sides of any ductwork system are likely to deform in fire conditions. In particular, the top horizontal face of horizontal ducts will tend to sag, causing gaps to form at the seal. The extent of any deformation will depend on a) the size of the duct, b) the materials used to form the ductwork, c) the location of any

joints or stiffeners in the system within, or close to, the wall or floor, d) the location of any internal stiffeners within, or close to, the wall or floor, e) the size of any stiffeners and f) the position and size of the hangers on both sides of the wall.

9.1.3 Gap size

The size of the gap between the duct and the wall or the floor will affect the performance of the seal. Generally, the bigger the gap, the more likely a failure is to occur. However, if gaps have been sealed with intumescent materials, a reduction in the gap size may have an adverse effect, as the amount of intumescent material in the gap may be inadequate to allow effective expansion, or to seal any increase in the gap size during a fire.

9.1.4 Collars

Several ductwork systems employ collars fitted around the ductwork on each side of the wall or floor as part of the penetration sealing system. The collars used in the fire test may have been fixed to the ductwork, or to the wall or floor, or to both. The collars should be fixed as tested. The size of the collar should be adequate to overlap the wall, partition, or floor to at least the same extent as tested. Generally, it is not advisable to fix the collar to both the ductwork and a non-load bearing partition as the thermal movement of the ductwork may have an adverse effect on the performance of the partition.

9.1.5 Surrounding construction

The performance of the seal will depend on the type and depth of the wall, partition, or floor. Generally, the surrounding construction must have at least the same fire resistance as the construction used in the test, and can be thicker, denser, or have more layers of board, as appropriate. The performance of the seal may vary depending on the type of surrounding construction it is passing through. For example, if the ductwork has been tested passing through a concrete wall, its performance may be different when passing through a lightweight partition system.

9.1.6 Specification of seal

The specification of the seal fitted to the duct at the penetrations through fire compartment walls and floors should be the same as the tested system.

9.2 Support systems

The support systems used for fire resisting ductwork must be capable of bearing the load of the ductwork under fire conditions. The support system consists of the hangers and bearers, the fixings and brackets. Attention must be given to the spacing of the supports and the size of the support components in accordance with the manufacturer's test data and recommendations. For the required fire rating, do not exceed –

- The maximum allowable span of the duct between supports
- the maximum distance of the hangers from the side of the duct
- the maximum allowable stress within the components of the supports

The fixings should be carefully selected for the substrate and loading. They should be non-combustible and/or shown by test to be suitable for the fire rating conditions

Stresses within the support components can be reduced by increasing the size of the components, or reducing the spacing of the supports, or applying fire protection to the support systems.

- If supports were positioned at all duct joints within the furnace in the fire test then the supports must be located at all duct joints in practice.
- The element of building construction to which the support systems are attached must have a fire rating of at least that specified for the duct and be able to support the weight of the duct under fire conditions.

9.3 Ancillary items / in-line equipment

A fire rated duct will often adjoin a component or structure which does not form part of the tested ductwork system, and could have in-line equipment and control devices such as balancing dampers, filters, attenuators, fans, etc. The performance characteristics of the fire-rated duct must be continued through these ancillary items of equipment to ensure the fire resistance of the system is maintained.

Fire Dampers

It is not recommended for fire resisting ductwork to be *randomly* used to rectify **incorrect** installation or positioning of dampers (e.g. in situations where a damper tested only for installation in the plane of a wall or floor has been installed remote from a wall or floor). It may be possible to protect the duct on both sides of the wall – up to the damper – to ensure that fire compartment is maintained, and that the fire damper can operate as intended, provided that a positive independent site- specific assessment has been carried out.

9.4 Interface between fire resisting ductwork & elements of construction

Responsibility for the satisfactory performance of each element of building construction (e.g. walls, floors, cavity barriers, etc.) lies with the installer of each particular element. The 'change over' of responsibility occurs at the interface between the fire resisting ductwork and the elements. It is imperative that the interface detail does not compromise the fire performance of either the element of building construction or the fire rated duct.

The building designer, mechanical services designer and the installer all have a responsibility to pay due care to this detail and ensure it is in accordance with test evidence of a ductwork penetration.

9.5 Duct cleaning

Insurers are increasingly requiring cleaning of fire resisting kitchen extract ducts; there is also an implicit legal requirement for cleaning arising from food preparation related legislation. Duct cleaning companies can sometimes use highly caustic aggressive chemicals that are needed to shift dirt and especially grease. ASFP, BESA and National Association of Air Duct cleaners UK (NAADUK) are addressing concerns that these might be damaging some of the materials e.g. intumescent used in some fire resisting ducts. Manufacturers are recommended to include information on cleaning requirements for their products so that these can be included with the information they submit as part of the building O & M file. Duct cleaners should consult this information or the manufacturer if the information is not available.

9.6 Access doors

It is sometimes the case that kitchen extract ductwork systems are installed with insufficient numbers of access doors (one every 3m) to facilitate cleaning. Due to more rigorous insurers' requirements for cleaning fire resisting kitchen extract ducts (see 8.5), ASFP and BESA members are increasingly being asked to fit access doors to pre-existing fire kitchen extract ducts. In some cases, there is fire test evidence for the access door, but not in conjunction with the duct it is to be fitted to. In light of the fact that such modifications to the fire resisting duct will require building regulations approval, installers and building owners should ensure that they have test or assessment evidence to ensure that the access doors are fire resisting and that fitting them to the existing fire resisting duct will not compromise the fire resistance performance.

9.7 Labelling of fire resisting ducts

Some manufacturers of fire resisting ducts do not label their ducts so that they can clearly be distinguished from non-fire resisting types. Consequently, duct cleaning companies and other follow on trades are unaware that they must not compromise the fire resistance e.g. by fitting access doors (see 9.6). It is recommended that all installed fire resisting duct systems are clearly labelled so that the risk of their fire resistance being compromised by modification by other parties is lessened. ASFP is working with the relevant trade associations to develop a joint labelling scheme.

10. STANDARD SPECIFICATION

In order to ensure fire resisting ductwork is correctly specified prior to the commencement of work, several factors should be carefully considered and defined.

The Specification should therefore:

1) Define the type of ductwork, as - Smoke / Ventilation / Kitchen / Pressurisation

2) State the required fire classification to BS 476: Part 24 in minutes for:

   i. Stability

   ii. Integrity

   iii. Insulation

3) Define if the system is Duct Type A (fire outside) or Duct B (fire inside) or requirement for both 'fire inside' and 'fire outside'.

4) Define Static Pressure Limits –

Pressure / velocity	Class	Pressure level range	
		Positive pressure	Negative pressure
Low	Class A	Up to + 500 Pa	Down to - 500 Pa
Medium	Class B	Up to + 1000 Pa	Down to - 750 Pa
High	Class C	Up to + 2000 Pa	Down to - 750 Pa
High	Class D	Up to + 2500 Pa	Down to - 750 Pa
NOTE that these classifications are to DW /144 requirements			

5) The fire duct manufacturer should define the friction resistant coefficients of all bends and tapers, etc. which are to be used if they differ from those for galvanised sheet steel.

6) It is recommended that the manufacturer/installer is working to a Quality Assurance System based upon the ISO 9001 series.

With reference to the above factors, the standard Specification should read:

'The ___(**1**)___ Ductwork should be constructed in accordance with the *ASFP Guide to Fire Resisting Ductwork* to provide __(2)**i**)__ minutes stability, __(2)**ii**)__ minutes integrity, and __(2)**iii**)__ minutes insulation when tested to the requirements of BS 476: Part 24 by a UKAS, or equivalent approved laboratory. The ductwork should be capable of providing Type ___(3)___ fire containment and, under normal non-fire operating conditions, should conform to the ___(**4**)___ pressure classification of the current HVCA DW/144 Specification for Sheet Metal Ductwork.'

11. STANDARD METHOD OF MEASUREMENT OF BUILDING WORKS

The measurement of fire resisting ductwork should follow the guidelines of RICS NRM2 – *Detailed Measurement for Building Works* Table 38.

It is essential that any bill of quantities description for fire resisting ductwork includes ALL of the following. This is a minimum list for fire assessments to be reliably made.

- Duct function – ventilating, smoke extract or kitchen extract
- Duct type – self supporting construction, factory made fire resisting duct, or fire protection cladding added to specified steel ducts
- Duct orientation – horizontal or vertical
- Duct size – longer side or diameter
- Thickness of steel, board and/or coating
- Duct shape
- Any stiffening of the duct panel
- Any stiffening of the duct , the type and maximum spacing
- Any use of internal duct stiffeners or tie rods
- Maximum duct section length
- Type, shape and size of cross joints
- Maximum spacing for hangers and bearers
- Any required fire protection layers or insulation – with material, thickness and fixings
- Fire resistance requirement - e.g., 60 minutes stability, 60 minutes integrity and 60 minutes insulation when tested in accordance with BS 476: Part 24)
- The detail of the seal at any service penetration through compartment walls, floors or fire resisting division.

NOTE that fire resisting ductwork must be measured as a complete item in linear metres with ancillaries and fittings described and measured separately.

12. DATA SHEETS

12.1 Summary data sheets

As this document is referred to in several of the statutory guidance documents to Building Regulations in the UK and Ireland, manufacturers may wish to list products to demonstrate that fitness for purpose and independent evaluation with respect to claims for fire performance. The rules for inclusion of data sheets are as follows:

- All products must be third party certificated before they can be included
- The product entry must be submitted on a basic Summary Data Sheet examples of which are given in section 13. Note: these are subject to development and modification
- Each Summary Data Sheet will include a hyperlink back to the website of the certification body to the third party certificate
- The completed Summary Data Sheet will be sent to the ASFP Technical Officer for checking and inclusion into this publication
- A fee will be applicable

12.2 Existing product data sheets

In the interim period while the Summary Data Sheets are being developed, the existing product data sheets from the previous version of the Blue Book (BS) are included in Volume 2 so that end users have a list of third party certificated fire resisting ducts to choose from.

12.3 Assessment rules

Previous versions of this book contained rules for assessments or engineering judgements to increase the scope of products that manufacturers could claim a fire performance. These rules are also used in in part or completely by some of the certification bodies for the third party certification of fire resisting ducts.

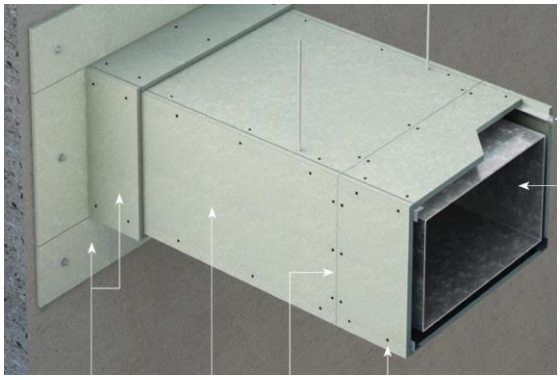
It has agreed to remove these rules partly because they might encourage lay persons without an experienced background in the testing and approval of fire resisting ducts to attempt to assess products. This should be left to UKAS, or equivalent accredited test laboratories, suitably qualified fire consultants and the certification bodies. The rules will be kept and maintained by ASFP for use by appropriate parties.

13. SUMMARY DATA SHEET EXAMPLES

ABC FIRE RESISTING DUCT CO LTD		
Manufacturer/ Supplier	*ABC fire resisting duct co*	
Product type	*Coated Wrap*	
Product Name	*ABC Insulated Wrap*	
Manufacturers address:		
Telephone & Fax	Tel:	
Web site		
e-mail address		

Test method used as a basis of the product claims	*BS 476: Part 24: 1987*	Stability	*120 minutes*
		Integrity	*120 minutes*
		Insulation	*120 minutes*
Type of ductwork system	*Ventilation/smoke extract/kitchen extract*	Max cross section dimensions	*750mm x 750mm*
Cross sectional shape	*Rectangular/circular/flat oval/other*	3rd Party Certification Number & Body	*CF3050 / Certifire*

Product description	*ABC insulated wrap provides a comprehensive range of systems tested to BS 476: Part 24 and to ISO 6944 for insulation of kitchen extraction and ventilation ducts. The systems comprise bio-soluble Blanket, a high-temperature insulation made from calcium, magnesia, silica chemistry designed to enhance bio-solubility completely encapsulated in an aluminium foil, fibreglass-reinforced scrim covering. This scrim provides additional handling strength as well as protection from tearing and moisture absorption. The thin and lightweight wrap systems are easy and clean to install around all geometries and orientations of pre-formed metal ducting and can provide fire protection for up to 120 minutes depending upon the system and application.*
Intended Use	*The intended use of ABC Insulated wrap is to provide fire resistance to steel ducts used in buildings*
Installation Method	*Consult manufacturer*

ABC FIRE RESISTING DUCT CO LTD		
Manufacturer/ Supplier	*ABC fire resisting duct co*	
Product type	*Fire resisting board*	
Product Name	*ABC Fire resisting board*	
Manufacturers address:		
Telephone & Fax	Tel:	
Web site		
e-mail address		

Test method used as a basis of the product claims	*BS 476: Part 24: 1987*	Stability	*240 minutes*
		Integrity	*240 minutes*
		Insulation	*240 minutes*
Type of ductwork system	*Ventilation/smoke extract/kitchen extract*	Max cross section dimensions	*750mm x 750mm*
Cross sectional shape	*Rectangular*	3rd Party Certification Number & Body	*CF3060 / Certifire*

Product description	*ABC Fire resisting board is a high quality laminated calcium silicate board. It does not contain asbestos or other inorganic fibres and is free from formaldehyde. It is a strong and lightweight, non-combustible building board for use in many fire resisting applications up to 240 minutes fire rating performance to international standards including BS, EN, GB, and ISO. ABC Fire resisting board is made of special fire resistant minerals materials and has undergone a sophisticated process. It is simple to work with and fix, easy to decorate, resistant to the effects of moisture and will not rot and decay. ABC Fire resisting board is manufactured to ISO 9001 quality management system and ISO14001 environmental management system, and has obtained the Green Product Label Award issued by National Environment Protection Bureau.*
Intended Use	*The intended use of ABC Fire resisting board is to provide fire resistance to steel ducts used in buildings*
Installation Method	*Consult manufacturer*