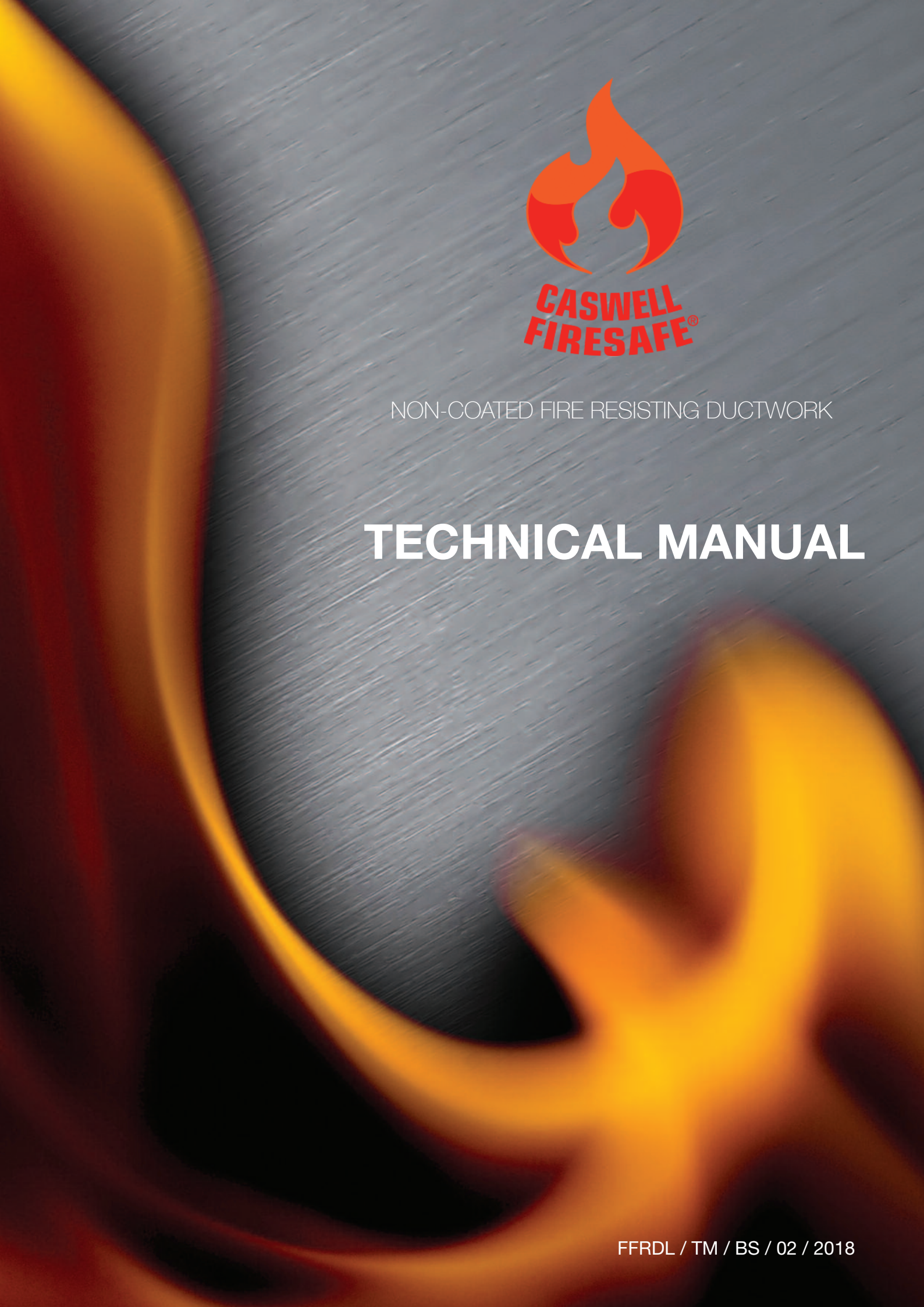


NON-COATED FIRE RESISTING DUCTWORK

TECHNICAL MANUAL

FFRDL / TM / BS / 02 / 2018

Contents

1 Introducing CASWELL FIRESAFE®

Firesafe Fire Rated Ductwork Limited (FFRDL) is a member of Caswell Holdings Limited, a group which also contains C.Caswell Engineering Services Limited - commonly known as Caswell - and Konvekta Limited.

Caswell is an established HVAC company that has been manufacturing and installing ventilation systems since 1969. Specialising in niche markets, we place great emphasis on meeting our customers' needs and developing new products to satisfy the ever-changing market. As part of an on-going product development programme it was recognised that large commercial, leisure and retail developments had a growing requirement for fire resisting ductwork systems and that this sector of the industry was poorly served.
So Caswell embarked on developing a range to fully meet these needs.

In February 2003 CASWELL FIRESAFE® fire rated ductwork was successfully tested to BS 476: Part 24 (1987) (ISO 6944:1985), attaining a rating of up to 4 hours for Stability, Integrity and Insulation under this standard. In collaboration with insulation market leader Rockwool® Ltd, we were able to combine test data to support a full range. This offering was officially launched in the UK in August the same year.

In 2006, a separate company was needed to dedicate resource to the ever-increasing demand for CASWELL FIRESAFE® products. FFRDL was therefore formed and tasked with the future development of the range, licensed partner programme and all technical, quality management and training aspects.
Our group is in the vanguard of innovation in the HVAC industry. Caswell are an active member of the Building Engineering Services Association (BESA) with representation on the BESA Ductwork Executive Committee.

FFRDL is a full and active member of the Association for Specialist Fire Protection (ASFP), with experienced staff in the ASFP Ducts & Dampers Technical Group (TG6). We are also heavily involved with UK-based ADCAS (Association of Ductwork Contractors & Allied Services), U.S. focused SMACNA (Sheet Metal & Air-Conditioning Contractors' Association) and global certification stalwarts, UL® (Underwriters Laboratories).

The success of our global business strategy to actively seek licensed manufacturing partners means CASWELL FIRESAFE® systems are now manufactured and installed under licence in many territories worldwide.

2 Regulations, Codes and Standards

Approved Document B1 (Means of Escape) and B3 (Internal Fire Spread Structure) of the Building Regulations 2000 for England and Wales details alternative ways in which the integrity of compartments may be maintained where ductwork penetrates fire separating elements.

Similar details are contained in Technical Standards Parts D & E (Scotland) and Technical Booklet E (Northern Ireland). The Regulatory Reform (Fire Safety) Order 2005 replaced most fire related legislation in England & Wales on the 1st October 2006.

Other useful documentation relating to the fire protection of buildings includes:

- Department of Health HTM 05 Series including:
  HTM 05-01 Managing Healthcare Fire Safety
  HTM 05-02A Guidance in Support of Functional Requirements
  HTM 05-03 Operational Provisions

- DFES Building Bulletin 100 - Design for Fire Safety in Schools
- London District Surveyors Association Fire Safety Guides including Fire Safety Guide No 1 - Section 20 Building: 1997
- Fire Prevention Association (FPA) Design Guide for the Fire Protection of Buildings

The most detailed and informative guides specifically related to fire resisting ductwork are the ASFP (Association for Specialist Fire Protection) Blue Books - British Standard & European versions.

BS 9999:2017 Code of Practice for Fire Safety in the Design Management and use of Buildings details the four principle methods of protection as follows:

Method 1	Protection using Fire Dampers (thermally actuated)
Method 2	Protection using Fire Resisting Enclosures
Method 3	Protection using Fire Resisting Ductwork
Method 4	Protection using Fire and Smoke Dampers (automatically actuated via smoke detectors)

There are a number of Standards related to the testing of products suitable for use as fire resisting duct systems as follows:

British Standards

BS 476 Pt24:1987	Method for the determination of the fire resistance of ventilation ducts

European Standards

BS EN 1366-1:2014	Fire resistance tests for service installation - Ventilation ducts
BS EN 1366-8:2004	Fire resistance tests for service installation - Smoke extraction ducts
BS EN 1366-9:2008	Fire resistance tests for service installations - Single compartment smoke extraction ducts
BS EN 12101	Part 3: Specification for powered smoke and heat exhaust ventilators

International Standards

ISO6944-1:2008	Fire resistance tests - Ventilation ducts
ISO6944-2:2009	Fire resistance tests - Kitchen extract ducts

This Technical Manual relates to products specific to BS 476:Pt 24 (1987) testing which are widely specified and used outside the European Economic Area. For products covered by EN 1366-1 & 8 test standards, refer to our Technical Manual **FIRESAFE / TM / 01 / EN / 2018**

3 Testing Requirements

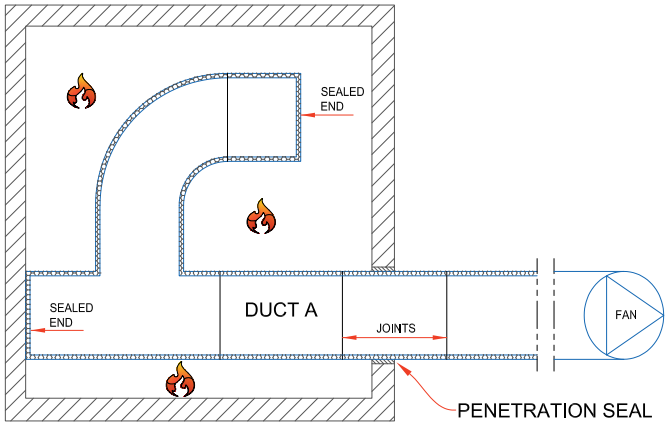
Standard ductwork systems (manufactured to DW144 or DW172 for kitchen extract systems) cannot be used where fire resisting ductwork is specified. The BS 476:Pt 24 (1987) tests are designed to simulate a fire in a compartment and the ability of a duct penetrating the compartment wall / floor to resist the spread of fire from one compartment to another

without the use of fire dampers. The tests include a fully assembled system attached to a fan and as such all aspects of the system are subjected to the test conditions; including the joints, supports and the penetration seal within the compartment wall / floor.

There are two test types as follows:

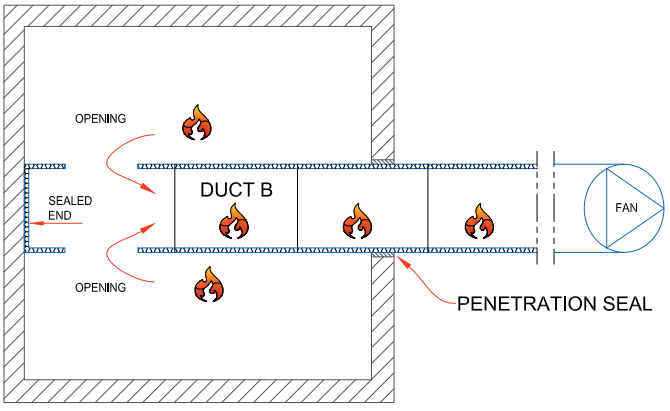
Duct A **Fire Outside**
Demonstrates the ability of the duct to withstand a fire breaking into the duct from outside and hence being able to travel down the duct into another compartment

HORIZONTAL DUCT `A' TEST ARRANGEMENT (FIRE ATTACK FROM OUTSIDE) SEALED DUCT PUT UNDER NEGATIVE PRESSURE DURING TEST



Duct B **Fire Inside**
Demonstrates the ability of the duct to withstand a fire breaking out of a duct and into another compartment.
These are particularly relevant to Kitchen Extract systems where the ignition source is often at the canopy / cooking appliances.

HORIZONTAL DUCT `B' TEST ARRANGEMENT (FIRE ATTACK FROM INSIDE & OUTSIDE) DUCT WITH OPENINGS INSIDE FURNACE WITH HOT FLAMES & GASES DRAWN THROUGH DUCT BY FAN AT 3 m /s VELOCITY



Typical test arrangement for horizontal ducts to BS 476:Pt24 (1987)

Fire resistance of ductwork is expressed in minutes duration of exposure for Stability, Integrity and Insulation. The criteria for failure is stated under BS 476:Pt 24 (1987).

Failure shall be deemed to have occurred as follows:

Stability: If the duct collapses either in the furnace (Type 'A' test) or on either side of the furnace (Type 'B' test) in such a manner that the duct no longer fulfills its purpose.

An additional criteria added for Smoke Extract systems is that the duct must retain at least 75% of its cross-sectional area to be functional.

Integrity: The formation on the unexposed side (i.e. outside the furnace) of holes, cracks or openings that allow flames or hot gases to escape. The method used to determine this is the ignition of a cotton pad and / or sustained visible flaming of at least 10 seconds.

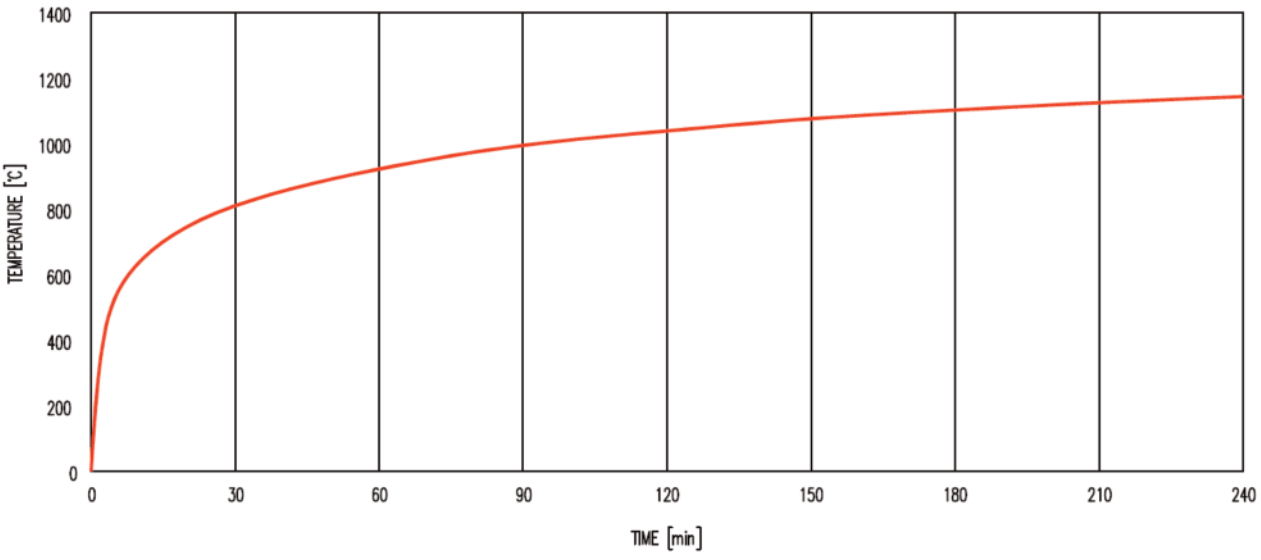
Failure is also deemed to have occurred if it is possible to insert a 6mm diameter gap gauge and move it 150mm in the opening and / or when a 25mm gap gauge can be inserted through the opening.

Insulation: Failure is deemed to have occurred when the temperature rise (above ambient) on the unexposed side of the furnace exceeds 140°C on average or 180°C as a maximum. Temperature is measured by attaching thermocouples to the ductwork.

In respect of Kitchen Extract ducts, there is an additional requirement on Type 'A' test that the temperature rise inside the duct within the furnace shall not exceed the above limits.

The Time vs Temperature curve below demonstrates the severe climb in temperature within the furnace. In the first 20 minutes of the test the temperature climbs from ambient to approx 750°C and reaches over 1100°C after 4 hours.

ISO 834 (E) Fire Resistance Test. Standard Time - Temperature Curve



Plotting temperature rise as a function of time for all BS 476:Pt24 (1987) & ISO 6944 (1985) fire tests

Test Reports & Assessments

The CASWELL FIRESAFE® fire resisting ductwork system has been tested and assessed as suitable for use either horizontally or vertically in the following system types and materials.

Systems: Ventilation, Pressurisation, Smoke Extract, Kitchen Extract
Materials: Galvanised Mild Steel, Stainless Steel, Fully Welded Mild Steel

Test Report		BS476:Pt 24 (1987) Type A Fire Outside
Test Report		BS476:Pt 24 (1987) Type B Fire Inside
Test Report		Impact Test to BS 5669: Pt 1 1989
Assessment		All duct specifications up to 3m x 3m 1, 2 & 3 sided ducts Panel design for ducts up to 8m x 6m VCD / Silencer design
Assessment	**R38800**	UL® Certificate of compliance CDXN

International Recognition

CASWELL FIRESAFE® has been reviewed and approved for use by prestigious Fire & Safety organisations who work closely with our international partners around the globe.

Hong Kong Fire Services Department

Dubai Civil Defence Authority

Fire and Rescue Department of Malaysia (aka 'Bomba')

Singapore Civil Defence Force

In addition, CASWELL FIRESAFE® is accredited by CERTIFIRE, an independent third party certification scheme that assures performance, quality, reliability and traceability of fire protection products and is recognised by regulatory authorities worldwide.

The company is also a Silver member of SMACNA (Sheet Metal and Air-Conditioning Contractors' National Association), an international trade association boasting over 1800 members throughout, among others, the United States, Canada & Australia.

4 Fire Resisting System Applications

Fire resisting ductwork is classed as Passive Fire Protection. Other examples of construction products that would be classed as passive fire protection are fire-resisting walls, floors, cavity barriers, doors, windows, shafts / stairwells and cladding to structural steel.

On the other hand, Active Fire Protection includes fire alarm systems, heat / smoke detectors, sprinkler systems, fire suppression systems and smoke control systems. The standard method adopted in general supply and extract ventilation systems to prevent fire and smoke spreading from one compartment to another is to install tested fire or fire / smoke dampers within the ductwork.

Limitations to the use of Fire Dampers

It is impractical and inadvisable to use fire dampers in Smoke Extract, Pressurisation or Commercial Kitchen Extract systems.

Fire dampers that incorporate a fusible link (thermal device) are designed to close when triggered by the elevated temperatures within a duct in the event of fire. This precludes their use in Smoke Extract or Pressurisation systems as the dampers, once activated, would prevent these systems from fulfilling their intended function.

Commercial Kitchen Extract systems are by nature prone to becoming laden with grease and carbonated deposits. Even though a thorough cleaning regime is recommended, it is possible over time that the damper blades and / or mechanism become saturated or encrusted to the point that they are inoperable, leading to a serious system failure.

Thermal fusible links are available in various ratings but the most commonly used are designed to fail at c. 72ºC (162ºF) so the high temperatures generated under normal cooking conditions could easily trigger them. If this happens there would be no extraction and so no further cooking would be possible until the dampers were reset. This is clearly not a viable option for commercial caterers.

In all these cases, the use of dedicated fire resisting ductwork is essential to maintain the integrity of the fire compartment through which the duct travels. Fire resisting ductwork is most frequently used in the following systems:

Smoke Extract / Car Park Extract
Dual Return Air / Smoke Extract
Pressurisation
Kitchen Extract

Once the system type has been chosen, the fire rating to BS 476:Part24 (1987) for Stability, Integrity and Insulation (in minutes duration) must be stated. The required operating pressure limits of the ductwork, as defined by HVCA specification DW144, need to be defined as one of the following classes:

Low - Class A - Up to 500Pa positive or 500Pa negative
Medium - Class B - Up to 1000Pa positive or 750Pa negative
High - Class C - Up to 2000Pa positive or 750Pa negative)
High - Class D - Up to 2000Pa positive or 750Pa negative / Very Low Leakage

Finally, accounting for the correct quantity of Access Doors to allow maintenance and cleaning to the required TR/19 PDI level forms the core ductwork specification.

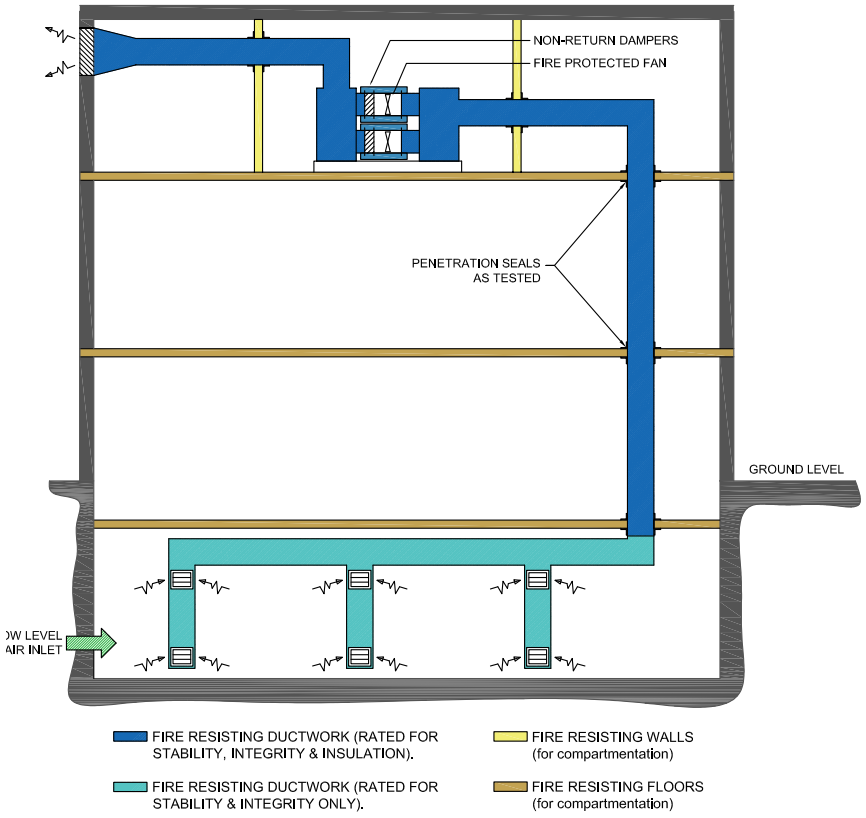
Smoke Extraction / Car Park Extract Systems

Smoke extraction involves the evacuation of products of combustion, such as smoke and toxic VOC gases, which could reduce visibility and impair human functions. This may impede the efforts of emergency services in finding the seat of the fire and so increase the time it takes to extinguish it.

As previously stated, installing thermally activated fire dampers in these systems would prevent the system from fulfilling its function; therefore the system, from the point it first passes through a compartment wall, must be fire resisting.

The diagram below illustrates a typical Smoke Extraction system.

ENCLOSED CAR PARK / BASEMENT EXTRACT



ELEVATION

Even if the system is self-contained within its own compartment it must be capable of maintaining its ability to operate and clear smoke at the elevated temperatures in the development phase of a fire.

Car parks requiring mechanical ventilation must have separate and totally independent extract systems due to the polluted nature of the air. Fire dampers should not be installed in car park extract systems and as such the systems should be fire resisting and treated as a dedicated smoke extract function; with the requirement to maintain 75% of their original cross-sectional area under fire conditions.

Dual Return Air / Smoke Extract Systems

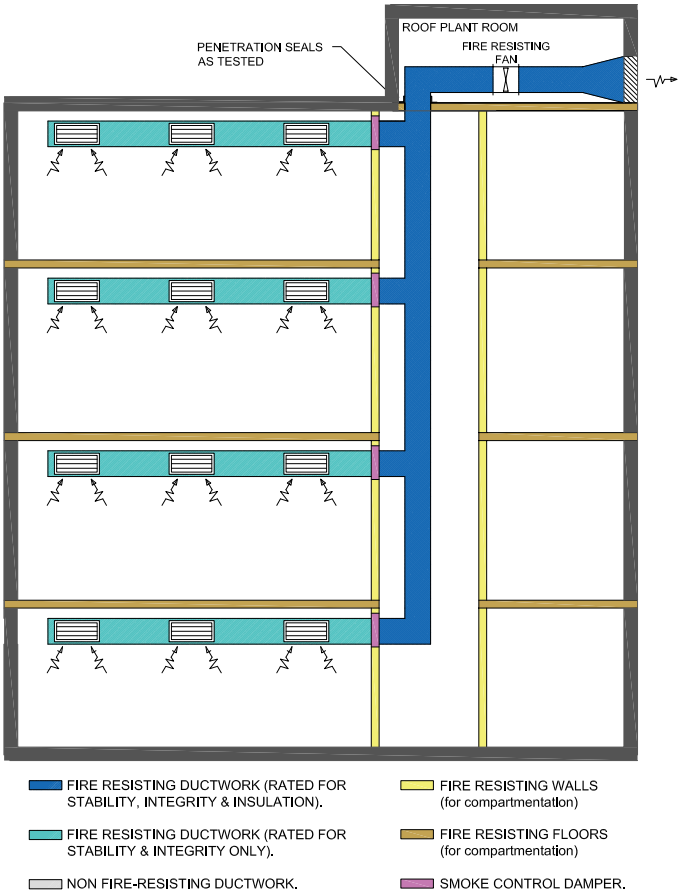
In difference to car park and kitchen extract systems, there will be situations where a dedicated extract system is not required. It is possible to incorporate a fire resisting smoke extract or clearance system as part of the general ventilation extract or recirculation system.

In normal operating conditions the system works with return air going back through the air handling unit, however, in the event the fire fighting services wish to remove smoke from the affected area, a switch is provided which closes the fire / smoke damper on the recirculation branch and opens a fire / smoke damper on a separate branch attached to a high temperature smoke extract fan. This fan is switched on automatically once the damper on the smoke extract branch has opened.

The ductwork is fire resisting from the point the fire compartment is breached and remains fire resisting through to the point of discharge.

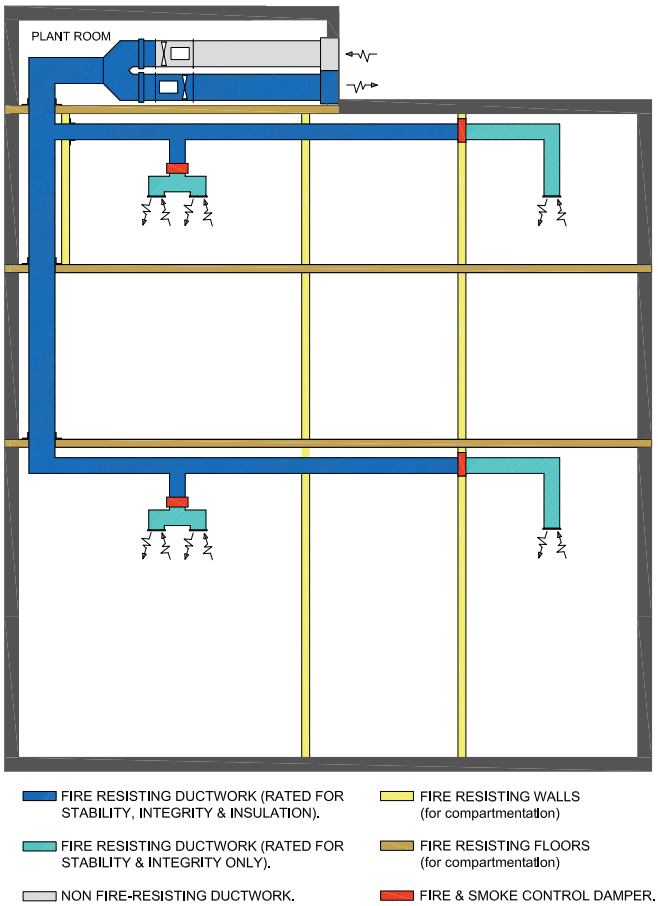
These systems are frequently used in shopping malls or large buildings with open spaces such as concourses or atria. They are an effective and economical method of providing emergency smoke extract in the event of fire.

SMOKE CONTROL : STAND-ALONE



ELEVATION

SMOKE CONTROL : DUAL PURPOSE



ELEVATION

Pressurisation System

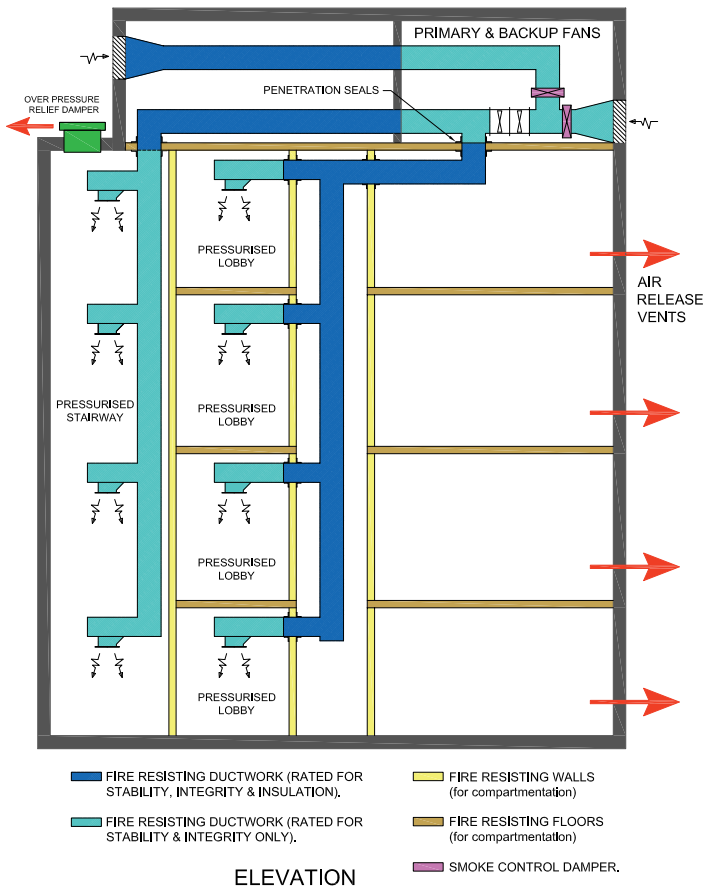
The principal function of a Pressurisation system is to create a higher air pressure in the protected area in order to prevent the ingress of smoke from surrounding rooms.

Typically these systems are used in the following situations:

- Protected escape corridors
- Stairwells
- Lobbies
- Fire-fighting shafts (i.e. serving deep basements)

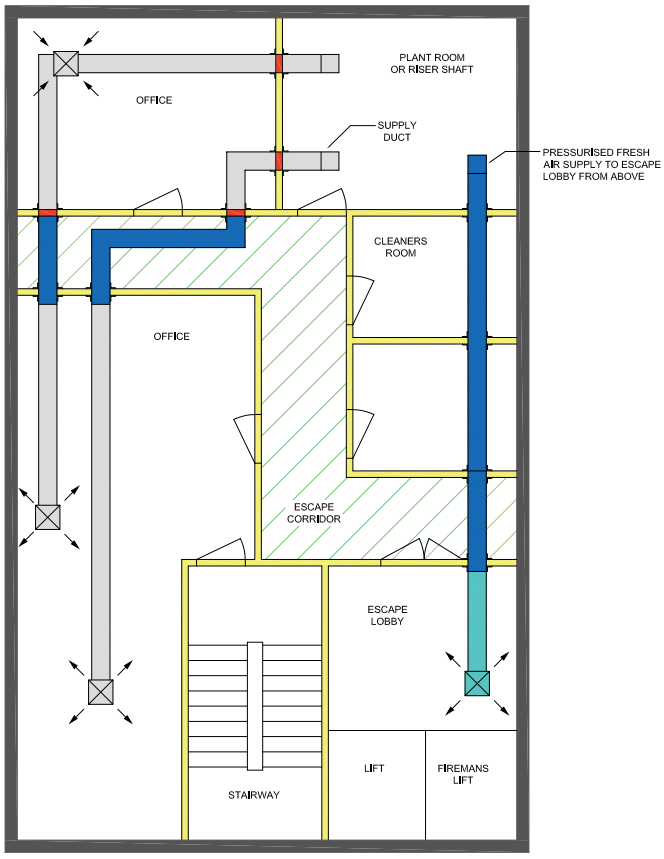
The diagram below illustrates a typical Pressurisation system.

PRESSURISATION SYSTEM



ELEVATION

ESCAPE ROUTE / PRESSURISATION



PLAN

These systems are used to introduce high-pressure, fresh 'make up' air to keep the protected area free from smoke and allow the building's occupants sufficient time to escape. As the system needs to operate at elevated temperatures, fire dampers cannot be used and therefore fire resisting ductwork needs to installed. BS 9999 gives guidance on the use of Pressurisation systems for the purpose of smoke control within buildings.

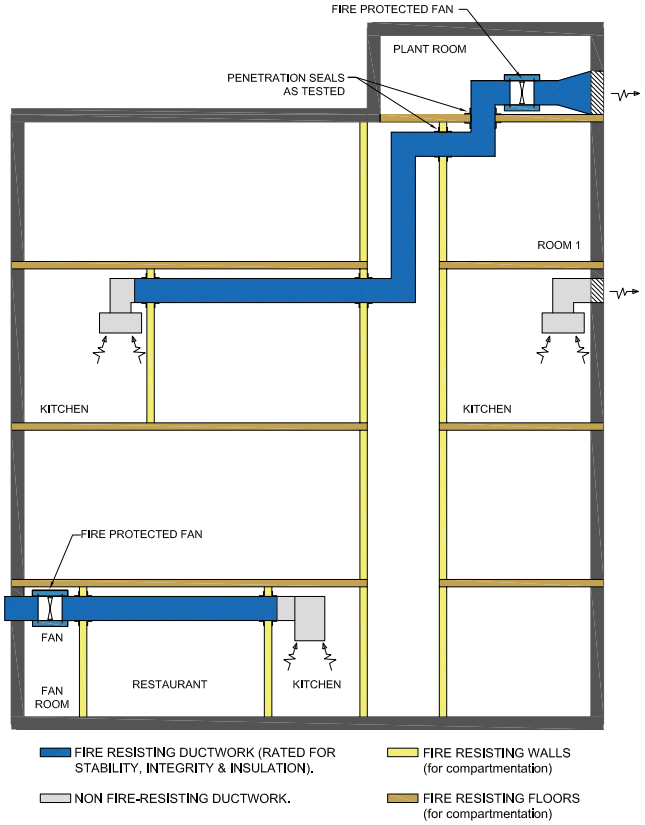
Kitchen Extract Systems

Kitchen Extract systems are designated as standalone systems due to the odours and oil particulates contained in the air that is extracted from cooking appliances.

As stated previously, fire dampers must not be used in Kitchen Extract systems. If it is not possible to discharge directly to atmosphere from the kitchen compartment then the ductwork that penetrates the compartment wall or floor must be fire resisting to the point of discharge.

The diagram opposite illustrates a typical Commercial Kitchen Extract system.

COMMERCIAL KITCHEN EXTRACT



ELEVATION

Fully welded systems

DW172 recommends the use of fully welded Kitchen Extract systems as their construction is specifically designed to prevent grease and cooking fats leaking from the ductwork.

Certain types of cooking appliances may not generate excessive amounts of grease laden air and it is the responsibility of the designer to specify whether or not a fully welded system is required. They should state or seek advice on the material to be used in the ductwork construction i.e. galvanised mild steel, fully welded mild steel or fully welded stainless steel.

Irrespective of the material used to manufacture the ductwork, the system must be fire resisting if it breaches the kitchen compartment.

Insulation

In addition to the Stability and Integrity rating of the Kitchen Extract duct it is often specified that the ductwork be insulated for a rated period of either 30,60,90 or 120 minutes.

In a commercial kitchen there is a likelihood of large flames being created during the cooking process. As these flames travel up into the kitchen extract duct they can easily ignite grease deposits lining the internal faces and create a rapidly spreading and very intense fire within the ductwork. The radiant heat created could then ignite combustible materials in close proximity to the steel duct, leading potentially to the spread of fire into another compartment.

With regards to Kitchen Extract systems, there is a further criteria on Test A (Fire Outside) in which failure would deem to have occurred if the temperature on the inside of the duct exceeds the above limits inside the fire compartment; this temperature is measured by what are commonly known as the 'T3 Thermocouples'.

If a fire was to break out in a room through which a Kitchen Extract duct runs, the grease inside the duct could be ignited relatively quickly if the duct was not externally protected. For the same reason, cleaning regimes on Kitchen Extract ducts need to be both more regular and thorough than with standard ventilation ductwork.

The subject of fire rated insulation is covered in more detail in Section 7, however the general guidance is to include insulation if combustible materials are located within 500mm of fire resisting ductwork.

Cleaning

In order to minimize the build-up of combustible materials (grease) on the inside of Kitchen Extract systems, it is recommended - in both the Building Regulations and DW 172 - that systems are regularly cleaned.

To facilitate thorough cleaning, fire resisting access doors should be positioned every 2m along the ductwork. In addition, fire resisting access doors should be positioned - on either one or two sides - where the ductwork takes a change of direction and also adjacent to any inline plant such as fans, balance dampers, attenuators and heat recovery coils.

CASWELL FIRESAFE® System
- Access Door Detail

BESA (Building Engineering Services Association) document **TR/19 Internal cleanliness of ventilation systems** provides comprehensive, best practice guidance.

5 System Construction Types and Specifications

The design of a dedicated fire resisting ductwork system is focused on ensuring the prevention of the spread of fire and / or smoke from one compartment to another. A fire resisting duct must also comply with the requirements of either DW144 and / or DW172 in normal working conditions.

All CASWELL FIRESAFE® systems meet the requirements of DW144 and Kitchen Extract DW172. They also can, where required, achieve successful air leakage test results in accordance with DW 143 for low, medium and high pressure ratings.

CASWELL FIRESAFE® ductwork has been independently tested and technically assessed to cover the following:

- Horizontal and Vertical (Riser) applications
- Rectangular and Circular shapes (Flat Oval is also available under separate assessment if required)
- Mild Steel, Galvanised Mild Steel or Stainless Steel construction
- Fully welded Mild Steel or Stainless Steel construction
- Stability and Integrity up to 4 hours to BS476:Part 24 (1987) (ISO 6944: 1985)
- Insulation for up to 4 hours (2 hours on Kitchen Extract systems) to BS476:Part 24 (1987)
- Ducts up to 3m x 3m using conventional methods / up to 8m x 6m using panel construction
- 1, 2 and 3 sided applications
- Decorative paint finishes

6 Ancillary Components

Silencers

The use of silencer pods designed to meet specific noise criteria can be incorporated into our CASWELL FIRESAFE® ductwork systems and are covered by assessment report.

Volume Control Dampers

Fire / Smoke dampers converted for manual use as VCDs have been approved for use within the CASWELL FIRESAFE® ductwork system. We can also incorporate specifically designed, dedicated VCDs within our systems based on our latest assessments.

Fire / Smoke Dampers

Fire / Smoke dampers are approved for use in conjunction within the CASWELL FIRESAFE® system provided they have been tested to EN 1366 parts 2 & 10 or BS 476:Part 20. Their most common use in conjunction with fire resisting ductwork is across escape corridors. Generally, standard DW144 ductwork is secured to the room side of the smoke damper and then fire resisting duct runs across the corridor to just inside the compartment wall where it connects back to DW144 ductwork.

This is a particularly cost-effective solution as it negates the need for a damper at the other side of the corridor, along with actuators and the associated costs of control wiring back to the Building Management System.

Access Doors

We can incorporate access doors into any system as required to satisfy the specified cleaning regime and offer alternative designs for Galvanised Steel, Stainless Steel and fully welded constructions.

Internal Flanging / Notched Flanging

If required, due to space restrictions or the installation of motorised fire / smoke dampers, we can provide internal flanges or notched flanges to facilitate insertion and removal of damper actuators.

7 Fire Resisting Insulation

The requirement to include insulation on fire resisting ductwork should not be confused with the use of insulation on standard DW144 ductwork systems. Insulation on DW144 ductwork is generally to prevent condensation forming and / or retain heat in 'return air' systems.

The purpose of specifically using fire resisting insulation is to prevent the ignition of combustible materials in close proximity to a fire resisting duct due to radiant heat, which can be extreme under fire conditions.

During the fire tests (Ducts A & B) the surface temperature on the unexposed section of the ductwork is recorded using 8 thermocouples; commonly known as the T1 & T2 thermocouples.

The speed of the temperature rise on *uninsulated* specimens demonstrates the importance of insulating the ductwork where there is a risk of materials in close proximity being ignited through radiant heat.

Table of Mean Temperatures on Unexposed Surface of Duct (as tested)

	0 mins	10 mins	20 mins	30 mins	40 mins	50 mins	60mins
Duct A - Mean Temp	10ºC	73ºC	192ºC	289ºC	434ºC	473ºC	495ºC
Duct B - Mean Temp	14ºC	284ºC	398ºC	419ºC	486ºC	505ºC	548ºC

After 240 minutes the temperatures on both test specimens were in excess of 700ºC on average.

The definition under BS 476:Part 24 (1987) for insulation is 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:

a) 140 ºC as an average above ambient temperature and / or;
b) 180 ºC as a maximum value above ambient at any one point

The point at which failure occurs dictates the period of insulation from the start of the test.

With regards to Kitchen Extract systems there is a further criteria on Test A (Fire Outside) in which failure would deem to have occurred if the temperature on the inside of the duct exceeds the above limits inside the fire compartment; this temperature is measured by what are commonly known as the 'T3 Thermocouples.'

The additional criteria on Kitchen Extract systems is due to the fact that they are more susceptible to fire being ignited from radiant heat. In normal use they will develop a lining of grease which is highly combustible and has a low ignition point.

If a fire was to break out in a room through which a Kitchen Extract duct runs, the grease inside the duct could be ignited relatively quickly if the duct was not externally protected. For the same reason, cleaning regimes on Kitchen Extract ducts need to be both more regular and thorough than with standard ventilation ductwork.

To facilitate this, access hatches are required every 2m on kitchen extract systems. In a kitchen environment there is a much higher risk of fire due to the cooking appliances, the heat generated and the oils and fats used in the cooking process.

BS 9999: 2017 identifies the design considerations in respect of fire resisting ductwork and also the requirement for insulation; however, in basic terms, insulation should be specified in the following scenarios:

- If the duct is situated within 500mm (as a guide) of combustible materials that could be ignited through radiant heat should there be a fire inside the duct
- Ductwork that runs in the void above protected corridors or shafts i.e. escape routes from buildings
- Fire resisting ducts that pass through rooms containing highly flammable materials and / or materials that are easily combustible
- Ducts where the internal temperature needs to be protected from a fire outside the duct i.e. Kitchen Extract ducts where there is a risk of grease deposits on the internal surfaces of the duct

All insulation materials used must be non-combustible and should have a Class 0 surface spread of flame. CASWELL FIRESAFE® systems utilise Rockwool® Slab which satisfies the requirements of BS 5422 'Method for Specifying Thermal Insulating Materials for Pipes, Tanks, Vessels, Ductwork and Equipment'.

The density and thickness of the insulation required differs depending on the type of duct, the orientation (i.e. horizontal or vertical) and the period of time required before failure can occur.

In the event that a vapour barrier is required the insulation is specified with an aluminium foil face.

Further guidance, in the form of FFRDL Technical Advisory Notes, is available to those who are responsible for specifying, approving or procuring fire resisting ductwork systems. These documents detail the risk assessment procedure which should be undertaken when considering the specification of Insulation on Fire Resisting Ductwork for Life Safety / Smoke Control and Kitchen Extract systems.

8 Ductwork Support Systems

The performance of a fire resisting ductwork system is, amongst other factors, determined by the method of support and the fixings selected.

In designing the ductwork support system the following factors must be considered:

a) The specification of the ductwork in terms of stability, integrity and insulation. This determines the construction of the duct, the thickness of the insulation and the combined weight of the system

b) The required pressure rating. This has significant bearing on the chosen duct construction

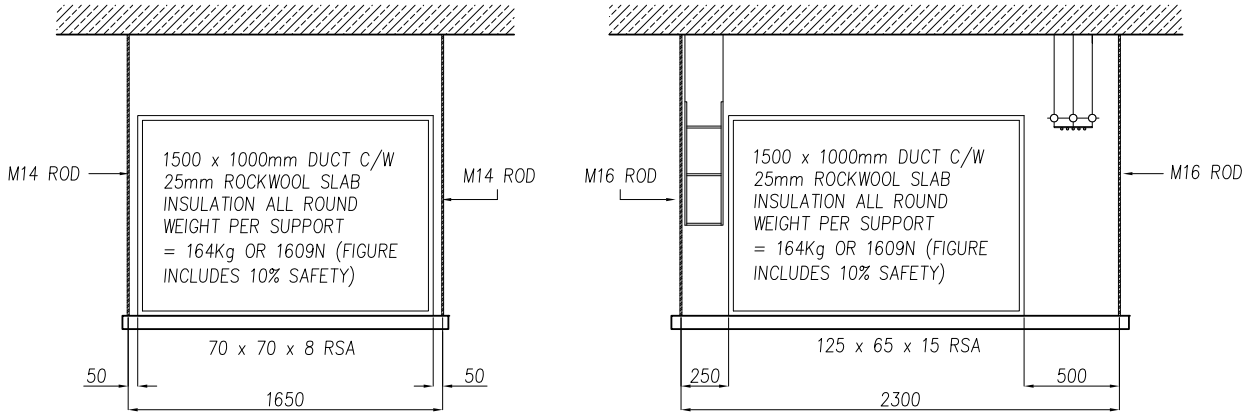
c) The orientation of the duct. There are different forces which need to be calculated where horizontal or vertical (riser) is used

d) The substrate to which the ductwork supports will be secured i.e. concrete, solid block, hollow block, masonry. This dictates the fixing types to be selected

e) Site conditions i.e. can the ductwork supports be installed as standard or are there any obstructions? Do the drop rods need to be spaced further away from the body of the duct than usual?

The strength of steel at ambient temperatures is taken as 275N/mm^2; however, at elevated temperatures steel loses its tensile strength. The higher the temperature, the weaker the steel becomes until eventually it melts.

Factors affecting Bearer specification



It is essential to take the progressive weakening of the steel drop rods and bearers into consideration when using a fire resisting ductwork system. The criteria used to calculate the support system is based upon the following maximum stress levels for unprotected steel.

Fire Duration	Max Tensile Stress σ (N/mm²)	Approx Temperature°C
30 Minutes	30N/mm²	842°C
60 Minutes	15N/mm²	945°C
120 Minutes	10N/mm²	1049°C
240 Minutes	6N/mm²	1153°C

On horizontal ductwork it is also necessary to consider the distance between supports. DW144 stipulates support centres should be a maximum of 3m for standard ductwork however all CASWELL FIRESAFE® support systems are based on 1.5m maximum centres for horizontal bearers. This helps to guard against possible sagging of the ductwork between the supports at elevated temperatures.

Vertical ducts are affected differently as the ductwork is in compression rather than tension. The maximum support centres for vertical (riser) ducts is 5m or 8x the smallest side of the duct. A riser duct of 600mm x 300mm in section would therefore need supports at 2.4m maximum centres to reduce the buckling of the duct under fire conditions.

Riser supports and non-standard horizontal supports are calculated on a project basis as it is necessary to establish the exact installation detail in advance and it is unlikely that any two riser installations would be identical.

The weight of each ductwork specification is carefully calculated and then cross-checked by manufacturing and weighing actual sections of duct. The weight is included in the calculation to establish a suitable bearer and drop rod size. The weight of the selected bearer/rods themselves are then added to the equation to obtain a final specification.

In principle, support systems are based on a number of known factors such as the rating of the system, the physical duct weight (load) and the location of the drop rods in relation to the side of the duct (span).

Fixings

The selection of the correct type of fixing is as critical as selecting the correct size of bearer and / or drop rod for the support. Ultimately, failure of the fixings would lead to the collapse of the entire system.

Assistance can be obtained in the selection of fixings from reputable suppliers and, if required, pull tests can be performed to verify the loads the fixings are capable of supporting.

As a general principle the following guidelines should be followed:

a) Fixings should be ALL steel. Plastic and Aluminium are NOT be used due to their low melting points

b) Minimum depth of penetration for anchors is 50mm for 2 hour systems and 60mm for 4 hour systems

c) Friction type fixings should NOT be used due to the risk of expansion

d) Spring Nut / Washer type fixings - as used in slotted channels - should NOT be used

e) Chemical type fixings ARE permitted provided they are fire rated for the same duration as the system

A Schedule of approved fixings for use with CASWELL FIRESAFE® ductwork systems is available on request.

It is necessary to establish the construction of the substrate to which the duct supports are to be attached prior to specifying the fixings.

On new projects this information will be readily available from the Contractor. For existing building refurbishments, what may appear to be solid concrete or block can in fact be hollow and as such it is critical to establish this before installation commences. If there is any doubt whatsoever, it is strongly recommended that test holes are drilled and “pull tests” undertaken to confirm suitability of a specific fixing type.

It should also be recognised that the element of building fabric (substrate) to which the support system is attached must have a fire rating of at least that specified for the duct.

9 Fire Compartments & Penetration Seals

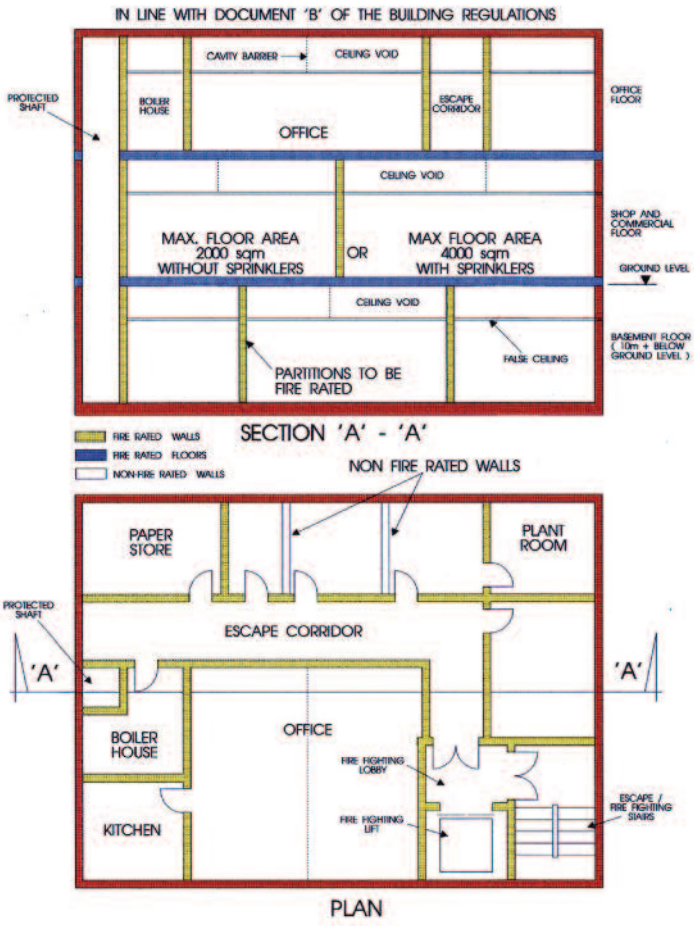
A Compartment in fire terms is defined by the ASFP as a part of a building comprising one or more rooms, spaces or storeys constructed to prevent the spread of fire from, or to, another part of the same building.

Compartmentation

In conventional ductwork systems fire compartments are protected by installing fire dampers within the compartment wall in accordance with DW145.

The correct installation of a fire damper is critical to the compartment maintaining its integrity under fire conditions.

In fire resisting duct systems the correct installation of the duct and combined penetration seal system is just as critical.



Penetration Seals

The fire-stopping of service penetrations is not normally part of the ductwork contractors package, however it is essential that the penetration is fire stopped in accordance with the tested method. If the specific application is outside the scope of the tested method then an alternative fire-engineered solution should be agreed and implemented to the satisfaction of the approved authority.

All contractors involved with the forming of the penetration, the installation of the fire resisting ductwork system and the subsequent sealing of the penetration have a joint responsibility to coordinate the works and to ensure each understands what is required to provide a compliant system.

It is not acceptable for any party to distance themselves from this responsibility even if they have not physically undertaken the fire-stopping element of the works.

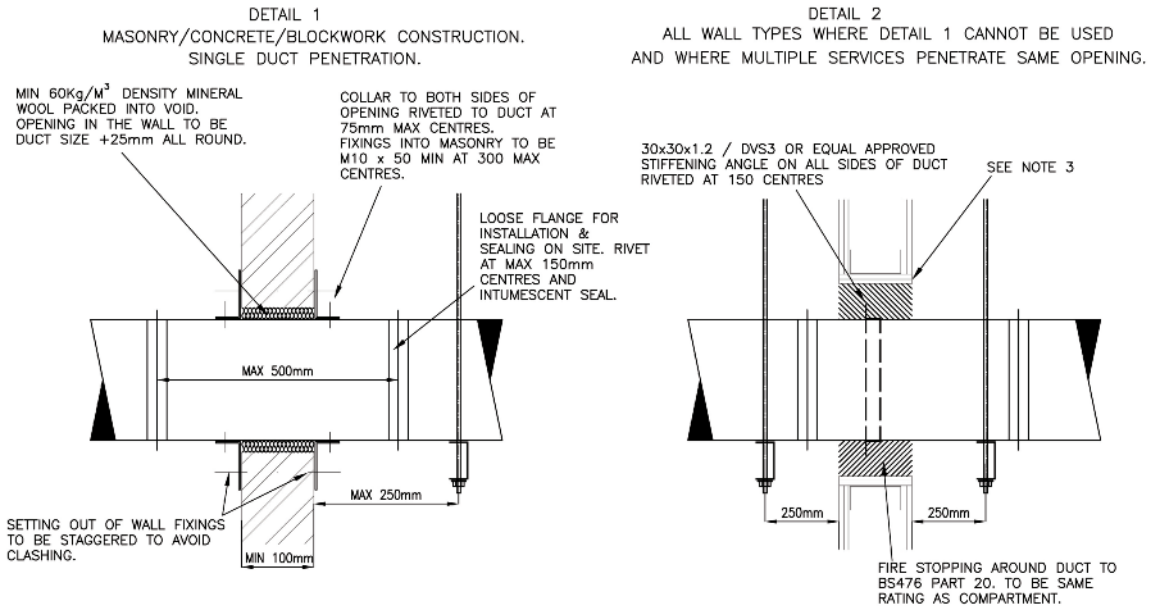
As every site can differ and service penetrations can be utilised by multiple services it may be necessary to either find an alternative route for the fire resisting ductwork or obtain an assessment for an alternative method of sealing the compartment penetration.

In any situation where the tested or assessed methods cannot be used it is mandatory to obtain the advice and expert opinion of a specialist in the field. This should be followed up by a written assessment report which would include full details of the alternative method to be used.

The local authority / building control should also be made aware of any non-standard methods as, ultimately, it is their responsibility to 'sign off' the building for fire safety.

The positioning of supports in relation to the wall / floor penetration is also critical to minimise the stress imposed on the penetration seal. Typically supports should be fitted within 250mm (max) from either side of the penetration.

The CASWELL FIRESAFE® system has two alternative methods of dealing with penetrations through compartment walls / floors as detailed in drawing 3141 / 109 Rev B below:



1. DUCT SUPPORTS TO EACH SIDE OF PENETRATION MUST BE WITHIN 250mm OF WALL (HORIZONTAL DUCTS).
2. WHEN THE PENETRATION IS TO BE FIRE STOPPED BY OTHERS, THE CONTRACTOR RESPONSIBLE MUST ENSURE THE SYSTEM / METHOD HAS BEEN TESTED AND CERTIFIED TO BS476 PART 20 AND MUST INDEPENDENTLY OBTAIN APPROVAL FROM BUILDING CONTROL OR THE APPLICABLE INSPECTING BODY.
3. WHERE THE WALL IS LIGHTWEIGHT CONSTRUCTION (PLASTERBOARD) THE PENETRATION MUST BE CAPPED OFF ALL AROUND THE PENETRATION AS SHOWN.

10 Quality Assurance & Certificates of Conformity

Fire resisting ductwork is classed as Passive Fire Protection, a building component designed to prevent the spread of fire from its origin to other building spaces, limit building damage and provide more time to the building occupants to reach a place of safety via protected corridors and stairwells.

Fire resisting ventilation systems are used to rapidly clear smoke to assist evacuation and introduce fresh air which aids emergency services in quickly reaching the source of the fire.

CASWELL
Fire Resisting Ductwork
Manufacture + Install + Certify

CERTIFICATE OF CONFORMITY

CASWELL FIRESAFE® Fire Resisting Ductwork System

CERTIFICATE No. 1234 / 1
PROJECT NAME: Manchester University - Sackville Building
CLIENT: A N Other Mechanical Services
S/O No. 1234
SYSTEM DESCRIPTION: Car Park Smoke Extract (System Ref CPSE/1)
STABILITY & INTEGRITY RATING: 2 HR
INSULATION RATING: 0 HR

We hereby certify that the above ductwork system has been manufactured and installed in accordance with Firesafe Fire Rated Ductwork Ltd procedures and will satisfy the requirements of BS 476 Part 24: 1987 (ISO 6944 - 1985) for the time periods specified above.

Test & Assessment Report References:
WARRES No. 128976 & Review 334472/A ("Type A" Fire Outside)
WARRES No. 128977 & Review 334472/B ("Type B" Fire Inside)
WFRC Report No. 335274 Issue 6 (Assessment Report)

SAMPLE CERTIFICATE

Signed for and on behalf of C. Caswell Engineering Services Ltd:
Signature:
Print Name:
Date:
Position:

This certificate must only be issued once all corrective action has been completed and signed off following completion of factory and site inspections; as referenced in QA / QC procedures in the FFRDL Manufacture and Installation Manual.

Caswell Fire Resisting Ductwork, being a division of C. Caswell Engineering Services Ltd, are an authorised manufacturer and installer of the CASWELL FIRESAFE® fire rated ductwork system with permission granted under license from Firesafe Fire Rated Ductwork Ltd

FIRESAFE Certificate of Conformity Rev H

FIRESAFE FIRE RATED DUCTWORK®

Quality of manufacture and installation is of paramount importance, so each stage is checked, inspected and signed-off before a Certificate of Conformity is issued.

Completed duct items are factory inspected before dispatch to ensure they comply with the specification and the system itself is inspected both during installation and on completion to ensure it is compliant.

All inspection reports are compiled and checked by the Project Manager or Engineer.

Records are retained in a dedicated project file in accordance with our ISO 9001 quality assurance system.

11 Advantages of the CASWELL FIRESAFE® system

CASWELL FIRESAFE®, unlike many other fire resisting ductwork products on the market, is a system which does not require any special treatment, paint finishes or cladding to offer Stability and Integrity ratings of up to 4 hours to BS 476:Pt 24 (1987) (ISO 6944: 1985).

'Real world' benefits

Speed
Removing the need for a multi-process coating means that CASWELL FIRESAFE® ductwork is quicker to manufacture. This enables our manufacturing partners around the world to react swiftly and so better meet customer expectations; especially for any urgent add-on orders

Economy
Using CASWELL FIRESAFE® systems can reduce the number of dampers required by 50%, compared to a 'standard' DW144 type system. This can provide savings in the total capital cost of dampers, their installation and on-going costs associated with periodically testing, maintaining and, ultimately, replacing failed dampers over time

Prestige
In addition to mandatory fire labelling, CASWELL FIRESAFE® systems are supplied with a distinctive brand logo, whilst access doors are accented with distinctive red frames. Purposely designed to make it instantly recognisable as a quality, certified fire-resisting product with full traceability, it also provides visual assurance that the specified level of passive fire protection has actually been installed

Consistency
Factory-produced repeatable quality - in both aesthetic and performance terms - is assured

Durability
Non-coated CASWELL FIRESAFE® ductwork is not susceptible to surface damage (i.e. during transportation and / or installation) or degradation (over time and / or due to vigorous cleaning) which could potentially affect the performance of coated ductwork if not repaired. This makes it particularly cost-effective over the lifetime of the building

Appearance
Galvanised CASWELL FIRESAFE® ductwork is a good match in overall finish when connected to standard DW144 fire-resisting ductwork. In order for DW144 ductwork to blend with coated or clad ductwork, it would need to be painted to match. This would clearly add cost and time to a project

Maintenance
Non-coated CASWELL FIRESAFE® ductwork is easier to clean and maintain than spray coated or clad systems. Visual checks are also simple and quick to conduct as nothing is concealed

Environmental
No additional chemicals are used for etching, priming and coating the ductwork during the manufacture of CASWELL FIRESAFE® systems, so environmental impact is reduced

Safety
Unlike some other systems which require the in-situ application of bonding agents and fillers, there is no specific requirement for RPE (Respiratory Protective Equipment) or a well-ventilated work area, over and above normal Health & Safety measures

12 Licensed Partners

Designed in Britain - Manufactured Worldwide

Our solution is to source reputable ductwork manufacturers in key regions around the world who understand their market and all requirements with regard to manufacturing and installing fire-resisting ductwork systems. This licensed manufacturing programme allows our partners to supply CASWELL FIRESAFE® systems to meet the demand from markets which recognise world-class benchmarks for safety, reliability and consistency and offer clients the surety of supply and on-site response which only an 'in-region' source can provide.

We are in regular contact with all our partners. We visit their manufacturing facilities and a representative sample of their installations to ensure that our detailed quality procedures are being followed. Our documented compliance audit ensures that the manufactured product meets our stringent specification.

Our partners are available to assist you with your fire-resisting ductwork requirements in their respective geographical regions. As we expand the reach of this partner network, additional regions will be added to service both existing and emerging markets for CASWELL FIRESAFE® products.

Up-to-date details are available at www.firesafeductwork.co.uk/international-partners

13 Continuous Professional Development (CPD)

FFRDL are able to offer technical support and advice by telephone or email. We are also registered as a CPD Course Provider with CIBSE (Chartered Institution of Building Services Engineers) and can offer training seminars to provide insight into why, when and where fire resisting ductwork systems are required and how they should be specified.

If you are interested in a CPD seminar, please do get in touch by email or via our webpage **www.firesafeductwork.co.uk/contact-us**

This technical manual is produced by Firesafe Fire Rated Ductwork Limited. We operate a policy of continuous product improvement and reserve the right to amend specifications and methods without notice.

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CASWELL FIRESAFE®