



NON-COATED FIRE RESISTING DUCTWORK

# TECHNICAL MANUAL

EN 1366 SYSTEMS



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## 1 Introducing CASWELL FIRESAFE®

Firesafe Fire Rated Ductwork Limited (FFRDL) is a member of Caswell Holdings Limited, a group which also incorporates 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 (FRD) systems and that this sector of the industry was poorly served. Caswell embarked on developing a range to fully meet these needs.

In February 2003, CASWELL FIRESAFE® fire rated ductwork was successfully tested and assessed to BS 476:Part 24 (1987), attaining a rating of up to 4 hours for Stability, Integrity and Insulation. Following the introduction of the Construction Products Regulations (CPR), we undertook further product development to satisfy test standards EN 1366-1 & 8 and comply with product standard EN 12101-7. Achieving these objectives enables us to offer CE marked products for the European Economic Area (EEA).

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 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' National 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 manufactured and installed under licence in many countries worldwide.

## 2 Regulations, Codes & Standards

Approved Document B1 (Means of Escape) and B3 (Internal Fire Spread Structure) of the Building Regulations 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:

- DFES Building Bulletin 100 - Design for Fire Safety in Schools
- 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 & 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)

The above documents and regulations assist in both the selection and establishing the required performance of FRD systems within any building design. The Construction Products Regulations (EU 305 / 2011) define the rules for manufacturers and distributors on how construction products are placed on the market. In respect of FRD, this is not a clear or straight-forward process, as some of the required standards have yet to be ratified. The current status of these Regulations - including advice on what can and what cannot be provided within these Regulations - can be found in Section 3.

Several Standards relate to the testing of products suitable for use as fire resisting ductwork systems:

### British Standards

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

### European Standards

EN 1366-1 : 2014 Fire resistance tests for service installations - Ventilation ducts  
EN 1366-8 : 2004 Fire resistance tests for service installations - Smoke extraction ducts  
EN 1366-9 : 2008 Fire resistance tests for service installations - Single compartment smoke extraction ducts  
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

*NOTE: This Technical Manual relates to products specific to **EN 1366-1 & 8** testing which are used in the EEA. For information on products covered by **BS 476:Part 24** test standards, refer to our BS Technical Manual.*



## 3 Fire Resisting Ductwork, CPR & CE Marking

### Construction Products Regulations (CPR)

**Regulation EU 305 / 2011** states... “When a construction product is covered by a harmonised standard or conforms to a European Technical Assessment which has been issued for it, the manufacturer shall draw up a declaration of performance. The CE marking shall be affixed before the construction product is placed on the market.”

However, not all of the Standards relating to Fire Resisting Ductwork are yet published and this significantly restricts what is available to be supplied. Under the European Standards, Fire Resisting Ductwork has been split into two system types - each with their own specific standards - as below.

#### SMOKE CONTROL SYSTEMS

Smoke Extraction and Pressurisation systems

In essence, a Fire Resisting Ductwork system with a smoke control function wholly or partly designed to operate in the event of fire.

|  |                          |
|--|--------------------------|
| <b>Product Standard</b>                | <b>EN 12101-7</b>        |
| <b>Classification Standard</b>         | <b>EN 13501-4</b>        |
| <b>Test Standard *</b>                 | <b>EN 1366-8 &amp; 9</b> |
| <b>Extended Application Standard**</b> | <b>prEN 15882-5</b>      |

#### FIRE RESISTING VENTILATION SYSTEMS

Ventilation systems (including Kitchen Extract systems) other than Smoke Control systems.

|                                      |                   |
|--------------------------------------|-------------------|
| <b>Product Standard **</b>           | <b>prEN 15871</b> |
| <b>Classification Standard</b>       | <b>EN 13501-3</b> |
| <b>Test Standard</b>                 | <b>EN 1366-1</b>  |
| <b>Extended Application Standard</b> | <b>EN 15882-1</b> |

\* Prior to testing to EN 1366-8, successful testing to EN 1366-1 must have been completed (with Duct A at -500Pa)

\*\* prEN = provisional EuroNorm. A draft standard issued for comment before ratification and not yet published

### Consequences of delayed EU Standards

It is only possible for Smoke Control ducts up to 1250mm x 1000mm - or 1000mm diameter - to be supplied in accordance with the regulations. Until the provisional Standards are ratified and adopted, manufacturers can continue to supply ductwork outside this scope using existing national Standards i.e. BS476:Part 24

Smoke Control ductwork must have been tested to both EN 1366-1 and an additional, more stringent test to EN 1366-8. As a result of successful tests to this stricter performance criteria, FFRDL have decided to supply **all** CASWELL FIRESAFE® FRD systems to this Part 8 Smoke Control Product Standard, irrespective of whether or not the Construction Products Regulations apply.

Similarly, systems which are only required to meet EN 1366-9 - which has a significantly lower performance test criteria - will be supplied to the higher Part 8 standard. Our Product Selection Guide (**FFRDL / PSG / 01**) provides Construction Tables to assist specifiers in understanding what systems are available.

## Classification

Once tested, the Classification Standards EN 13501-3 (Fire Resisting Ventilation) & EN 13501-4 (Smoke Control) are used to create a code.

A typical code such as E I 120 (ve ho) S 1500 Multi identifies the performance the product has achieved based on the following criteria:

- E - Integrity ( $E_{600}$  identifies tests to EN 1366-9 i.e. 600°C maximum)
- I - Insulation
- S - Smoke leakage (Increased performance on leakage)
- Time - 30 / 60 / 90 / 120 minutes
- Horizontal ( $h_o$ ) & Vertical ( $v_o$ ) orientations
- Pressure levels (3 levels to allow design under-pressures of 500 / 1000 / 1500 Pa)
- Multiple compartment or Single compartment
- Duct A - Out to In / Duct B - In to Out

## CE marking



**The Construction Product Regulations (CPR) Statutory Instrument 2013 No. 1387** states...“A person who supplies a construction product that is covered by a harmonised standard or conforms to a European Technical Assessment that has been issued for it, shall be guilty of an offence unless:

- There is supplied with the product in accordance with Article 7 of the 2011 Regulation a Declaration of Performance for the product drawn up in accordance with Articles 4 and 6 of the 2011 Regulation **and**
- the product has affixed to it the CE marking in accordance with Article 8(2) of the 2011 Regulation”.

By affixing or having affixed the CE marking, manufacturers indicate that they take responsibility for the conformity of the construction product with the declared performance as well as the compliance with all applicable requirements laid down in this Regulation and in other relevant Union harmonisation legislation providing for its affixing”.

Note: CE Marked products only provide an assurance that the product has been supplied correctly.

The **installation** of systems is **not** covered by this; however, in practical terms, is of equal importance.



- CE conformity marking consisting the 'CE' symbol given in Directive 93 / 68 / EEC
- Identification number of notified product certification body

- Manufacturer's name or identifying mark
- Registered address
- Contact number

- First 2 year digits in which marking was affixed
- Number of Certificate of constancy of performance

- European Standard Reference
- Description of Product
- Manufacturer's Type / Model Reference

- Classification to EN 13501-4

|   |     |
|---|-----|
| <br>0370   |     |
|  <b>CASWELL</b><br>Fire Resisting Ductwork<br><b>Manufacture + Install + Certify</b><br>Knowsley Road Ind Est, Haslingden, Rossendale BB4 4RR UK<br>TEL NO: +44(0) 1706 227935 |     |
| <b>Year of Manufacture - 20</b><br><b>0370 - CPR - 2799</b>   |     |
| Project No:   | S/O |
| Drawing:  |     |
| ITEM NUMBER:  |     |
| Declaration of Performance Ref: CES-CPR-01  |     |
| <b>EN 12101-7</b><br>Smoke Control Duct Section<br>Model Ref: CF/EN/E120/I00/GS/CT14/R  |     |
| <b>CLASSIFICATION</b><br>E120 (ho ve)S1000 multi  |     |
| THIS PRODUCT IS STRICTLY CONTROLLED PLEASE CONTACT THE NUMBER ABOVE PRIOR TO MAKING ANY MODIFICATIONS. THE SUPPORT SYSTEM MUST NOT BE UTILISED FOR ANY OTHER PURPOSES. FAILURE TO OBSERVE THIS MAY INVALIDATE THE SYSTEM CERTIFICATION. Ref: CF/227/CES/02          |     |



## 4 Testing Requirements & Certification

Standard ductwork systems manufactured to DW144 (or DW172 for kitchen extract systems) cannot be used where Fire Resisting Ductwork is specified. The EN 1366-1 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.

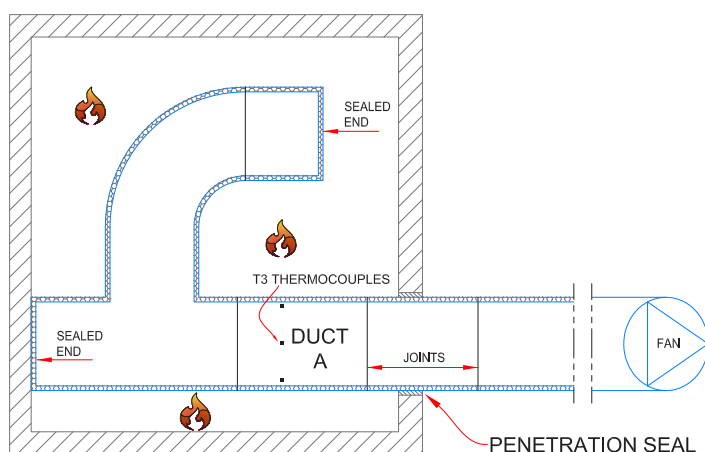
There are two test types as follows:

### 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.

Kitchen Extract systems passing through other compartments are subjected to an additional insulation performance measurement. This is performed by the T3 thermocouples as indicated. See Section 8 for details.

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

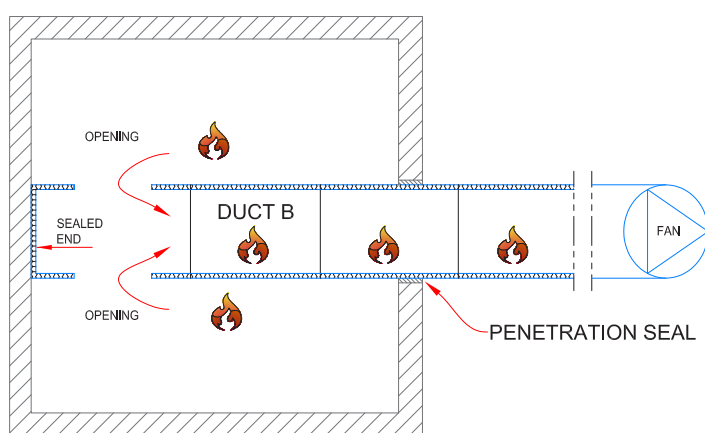


### Duct B Fire Inside

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 arrangements for horizontal ducts to EN 1366-1

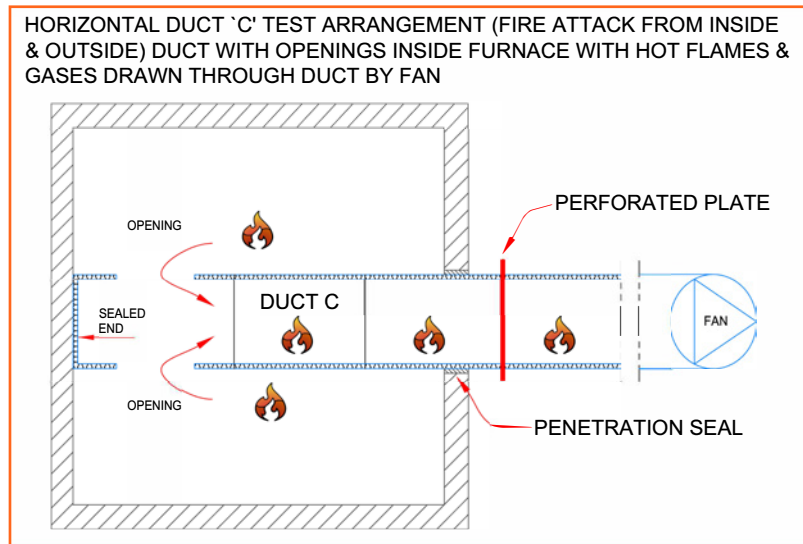
Once the Duct A & Duct B tests are conducted in order to comply with the product standard for Smoke Control ductwork, the following test must also be performed to EN1366-8. This test is essentially a combination of Duct A & Duct B with the Integrity (E) leakage measurement set at a lower rate and the cross-section of the ductwork being monitored during the test to establish the 90% remaining area criteria.

## Duct C Fire Inside

The duct configuration is the same as a Duct B, however the perforated plate creates an under-pressure (as in Duct A) on the ductwork external to the furnace.

It is this section where the reduction of cross-section is measured. There are 3 levels of under-pressure available; 150, 300 & 500 Pa. These allow a system designed under-pressure of 500 / 1000 / 1500 Pa.

Ductwork tests performed to EN 1366-9 are identical to the arrangements in the EN 1366-8 test, except the furnace temperature is set to a maximum of **600°C**.



Typical test arrangements for horizontal ducts to EN 1366-8

Fire resistance of ductwork is expressed in minutes duration of exposure for Integrity (E), Insulation (I) and Smoke leakage (S).

The criteria for failure is stated within EN 1366-1 & 8 as follows:

**Integrity (E)** - This is the time in completed minutes for which the test specimen continues to maintain its function without developing - on its unexposed surface - any of the following;

- cracks or openings
- ignition of a cotton pad
- sustained flaming on the unexposed surface

In addition the system must;

- meet leakage measurements for Duct A  $\leq 15 \text{ m}^3 / (\text{h} \cdot \text{m}^2)$  / for Duct C  $\leq 10 \text{ m}^3 / (\text{h} \cdot \text{m}^2)$
- maintain its cross-sectional area, within the  $\leq 10\%$  allowable reduction rule
- remain intact within the furnace i.e. it must not collapse

**Insulation (I)** - This is the time in completed minutes for which the test specimen continues to maintain its separating function during the test without developing temperatures on its unexposed surface which:

- increase the average temperature above the initial ambient temperature by more than 140°C; or
- increase at any location (including the roving thermocouple) above the initial ambient temperature by more than 180°C.

In respect of Kitchen Extract ducts, there is an additional requirement on a Duct A test that the temperature rise inside the duct within the furnace shall not exceed the above limits, as referenced by the T3 thermocouples.

**Smoke Leakage (S)** - For Duct A -  $10 \text{ m}^3 / (\text{h} \cdot \text{m}^2)$  and for Duct C -  $5 \text{ m}^3 / (\text{h} \cdot \text{m}^2)$

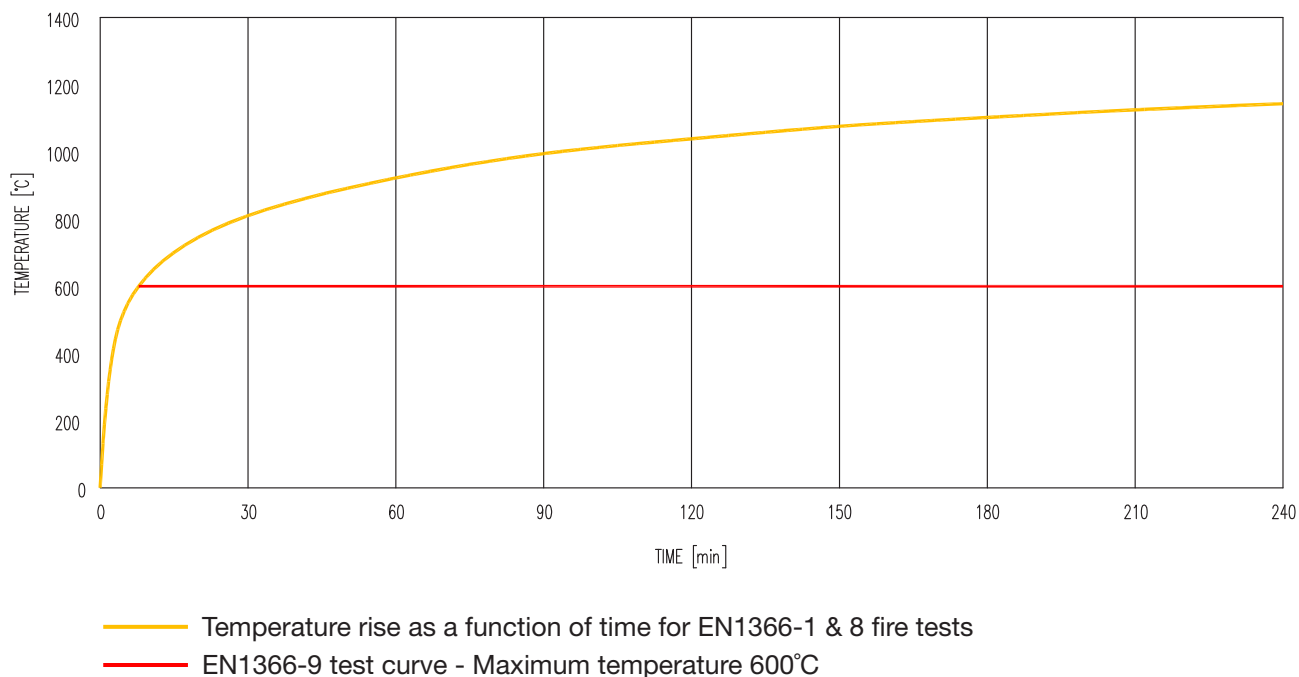
This is a higher rating for leakage performance typically specified for systems where smoke leakage is a particular concern e.g. a protected corridor or space.



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 is approximately 750°C and reaches over 1100°C after 4 hours.

## ISO 834 (E) Fire Resistance Test

### Standard Time - Temperature Curve



## Certification

CASWELL FIRESAFE® has been certified as suitable for use either horizontally or vertically in Fire Resisting Ductwork systems and has the following classifications: -

- E 120 (ve ho) S 1000 multi Galvanised steel ductwork**
  - **CE** up to 1250mm x 1000mm rectangular & 1000mm diameter
  - Not CE marked up to 2500mm x 2000mm rectangular
- E 60 (ve ho) S 1000 multi Galvanised steel ductwork**
  - **CE** up to 1250mm x 1000mm rectangular & 1000mm diameter
  - Not CE marked up to 2500mm x 2000mm rectangular
- EI 120 (ve ho) S 1000 multi Galvanised steel ductwork (with 90mm insulation)**
  - **CE** up to 1250mm x 1000mm rectangular

## 5 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.

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 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 carbon 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.72°C (162°F), 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 applications:

**Smoke Extract / Car Park Ventilation**  
**Smoke Control / Dual Purpose Systems**  
**Pressurisation Systems for protected escape routes**  
**Commercial Kitchen Extract Systems**  
**Passive Make-Up Air for protected lobbies**

Once the system type has been chosen, the fire rating to EN 1366-1 & 8 for Integrity and Insulation (in minutes duration) must be stated. The required operating pressure limits of the ductwork, as defined by BESA specification DW144, need to be defined as one of the following classes:

|               |   |
|---------------|---|
| <b>Low</b>    | Class A - Up to 500Pa positive or 500Pa negative  |
| <b>Medium</b> | Class B - Up to 1000Pa positive or 750Pa negative |
| <b>High</b>   | Class C - Up to 2000Pa positive or 750Pa negative |

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

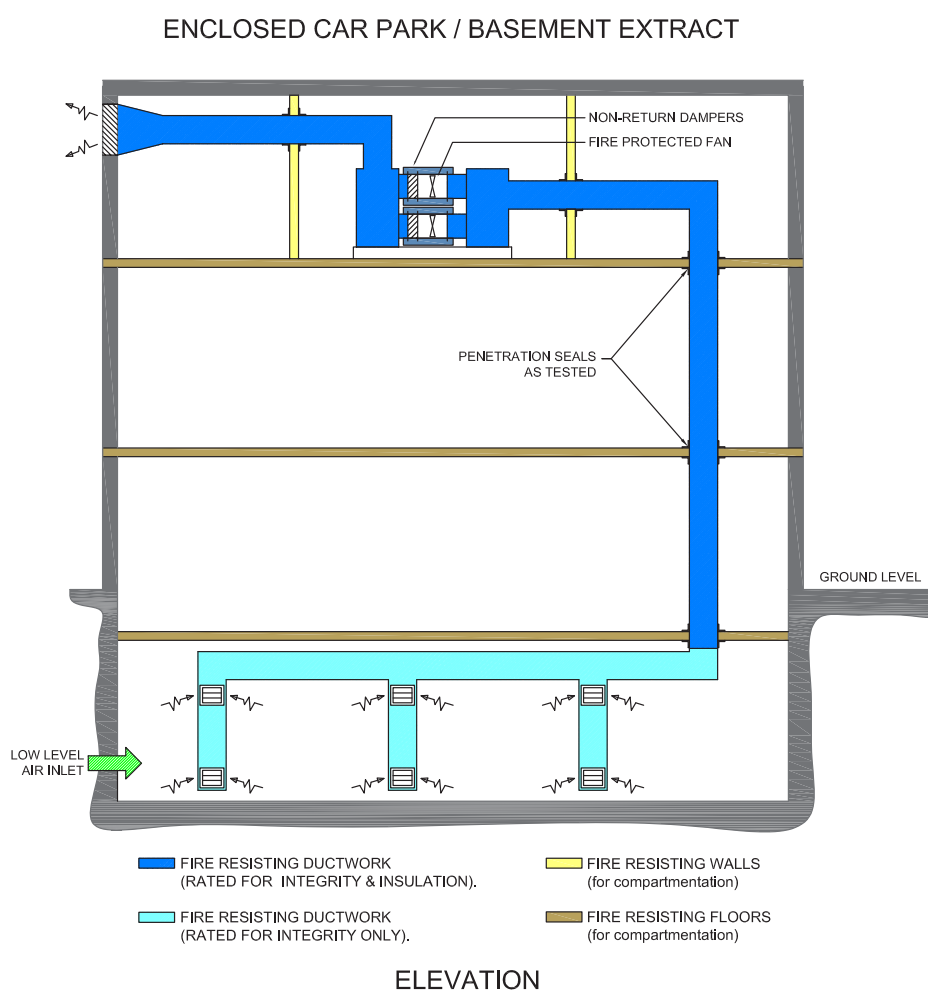


## Smoke Extract / Car Park Ventilation

Smoke extraction involves the evacuation of products of combustion, such as smoke and toxic 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.



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.

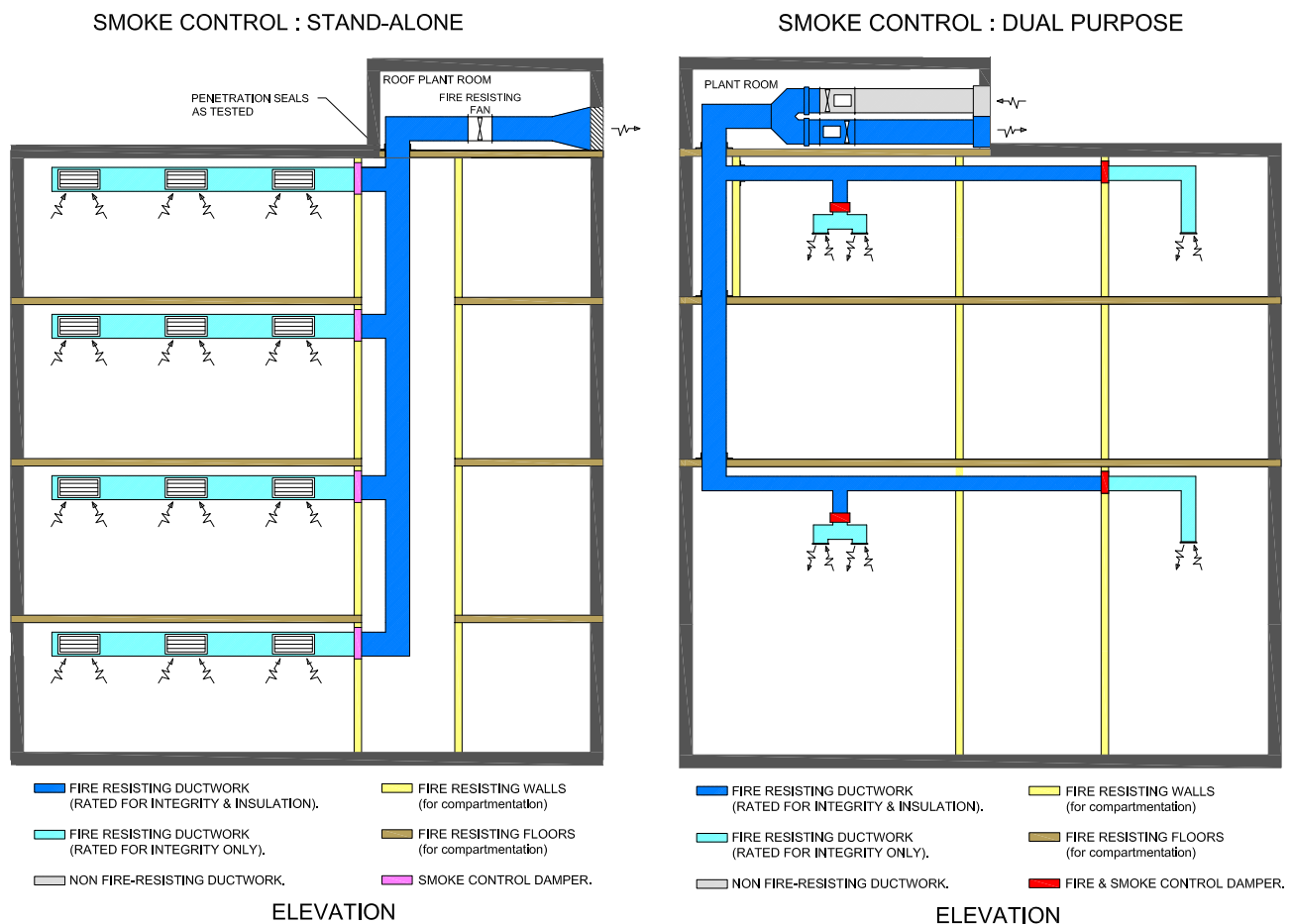
Car parks requiring mechanical ventilation must have separate and totally independent extract systems due to the polluted nature of the air. Fire dampers should not be installed in car park extract systems and as such the systems should be fire resisting and treated as a dedicated smoke extract function; with the requirement to maintain 90% of their original cross-sectional area under fire conditions.

## Smoke Control / Dual Purpose Systems

Where a dedicated extract system is not required, it is possible to incorporate a fire resisting Smoke Control duct as part of the general ventilation system; supply or extract.

Under normal operating conditions the system supplies or extracts air to each area. In the event of an emergency, the fire / smoke detection system would automatically close certain dampers to shut off the general supply or extract. It would then immediately open dampers on the smoke control side of the system to allow the extraction of smoke or introduction of pressurised air. These systems can also be manually controlled by fire & rescue services via a dedicated switch independent of the alarm system.

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 control in the event of fire.





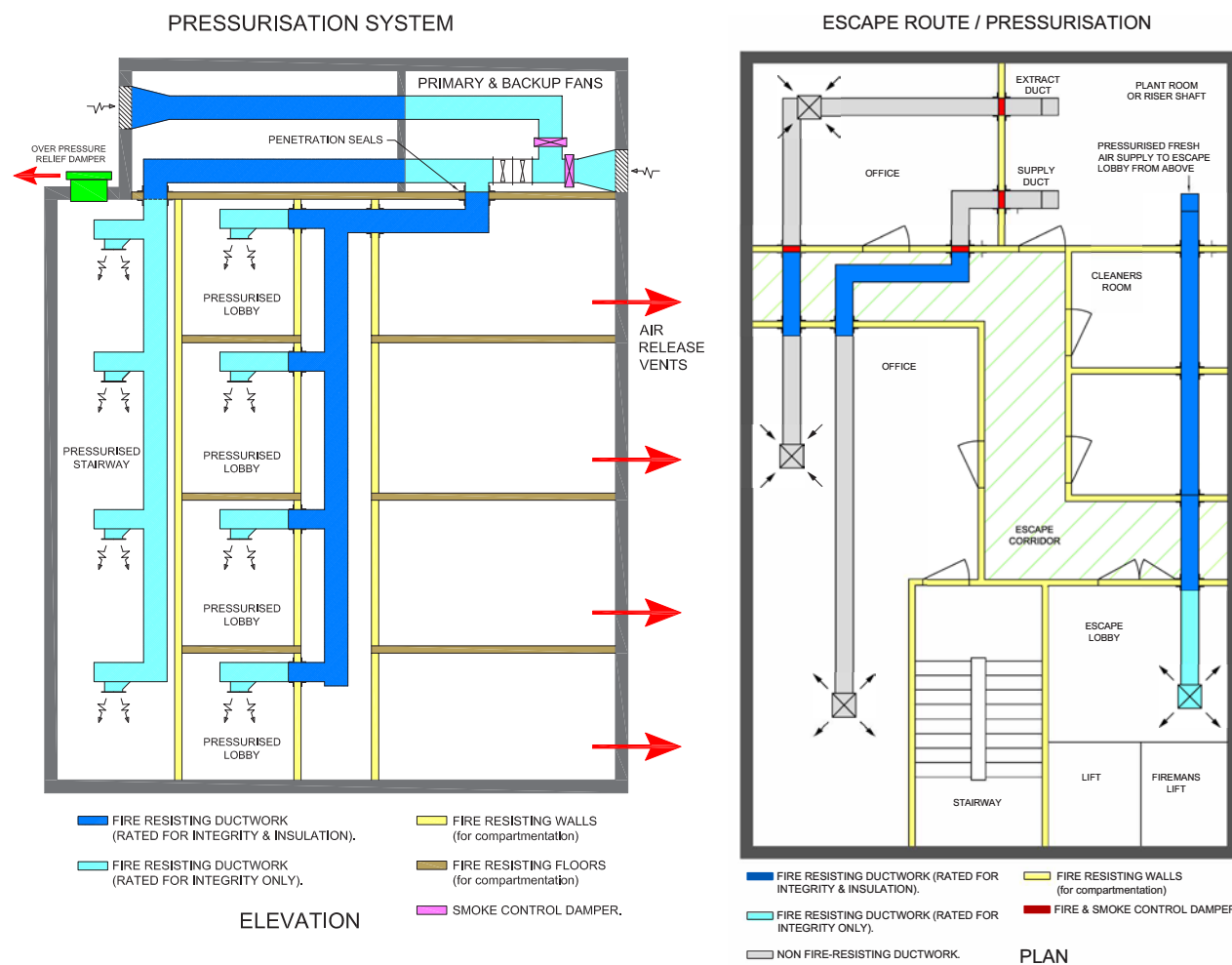
## Pressurisation Systems

The principal function of a Pressurisation system is to create a higher air pressure in the protected area 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 diagrams below illustrate a typical Pressurisation system.



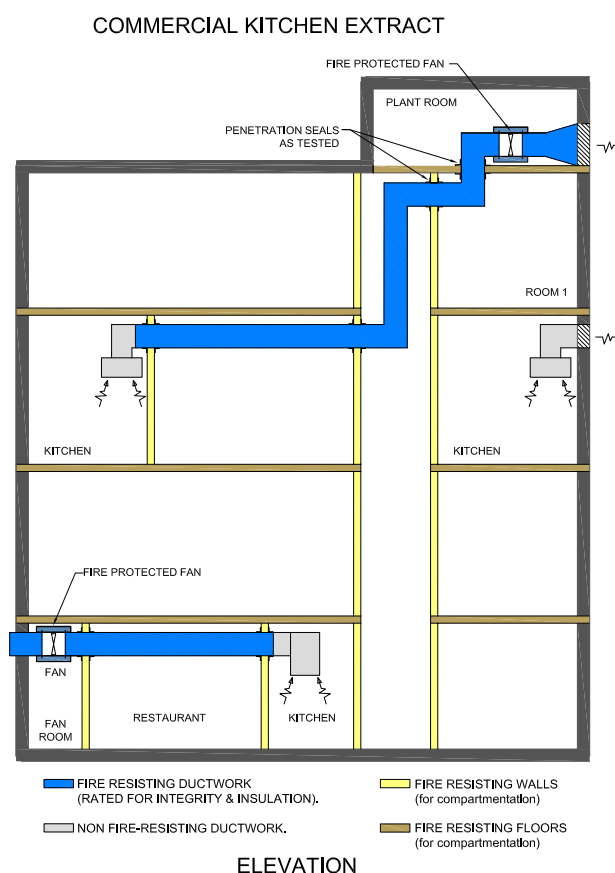
These systems are used to introduce high-pressure, fresh 'make up' air to keep the protected area free from smoke and allow the building's occupants sufficient time to escape. As the system needs to operate at elevated temperatures, fire dampers cannot be used and therefore Fire Resisting Ductwork needs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

## Commercial 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 below illustrates a typical Commercial Kitchen Extract system.



## 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 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 and fully-welded mild 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 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 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 criterion on Test A (Fire Outside) in which failure would deem to have occurred if the temperature on the inside of the duct exceeds the limits inside the fire compartment (see Page 8 - Insulation). 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 resisting insulation is covered in more detail in Section 8. The general guidance is to include insulation if combustible materials are located within 500mm of Fire Resisting Ductwork. Our separate Technical Advisory Note documents (FFRDL / TAN / 01 & 02) offer comprehensive advice and are available on request.

## 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.



BESA document **TR/19 Internal cleanliness of ventilation systems** provides comprehensive, best practice guidance.

**CASWELL FIRESAFE®** system  
- Saddled Access Door detail



## 6 System Construction Types & Specifications

The design of a 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 can, where required, also 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:

- Horizontal and Vertical (Riser) applications
- Rectangular and Circular shapes
- Integrity up to 120 minutes
- Insulation for up to 120 minutes (60 minutes on Kitchen Extract systems)
- Uninsulated rectangular ducts up to 2500mm x 2000mm tested to EN 1366-1
- Decorative paint finishes

## 7 Ancillary Components

The range of CASWELL FIRESAFE® access doors comes in 5 standard sizes to both insulated and uninsulated specifications. They have been successfully tested as an integral part of our systems and are clearly labelled to attest to this fact.

### Silencers

The use of silencer pods designed to meet specific noise criteria can be incorporated into our CASWELL FIRESAFE® ductwork systems.

Note that supporting systems will need to allow for the additional weight.

### Fire / Smoke Dampers

Fire / Smoke dampers can be used in conjunction within the CASWELL FIRESAFE® system provided they have been tested to EN 1366 Parts 2 & 10 and installed in accordance with their manufacturer's details.

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 fire / 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.

### Internal Flanging

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

## 8 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 Uninsulated Ducts (as tested)

|                           | 0 mins | 10 mins | 20 mins | 30 mins | 40 mins | 50 mins | 60 mins |
|---------------------------|--------|---------|---------|---------|---------|---------|---------|
| <b>Duct A</b> - Mean Temp | 10°C   | 73°C    | 192°C   | 289°C   | 434°C   | 473°C   | 495°C   |
| <b>Duct B</b> - Mean Temp | 14°C   | 284°C   | 398°C   | 419°C   | 486°C   | 505°C   | 548°C   |

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

The definition under EN 1366-1 for insulation is the ability of 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°C as an average above ambient temperature and / or;
- b) 180°C 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.

For Kitchen Extract systems there is a further criterion 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.'

This additional onus is due to the fact that Kitchen Extract systems 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 for Fire Resisting Ductwork but does not offer clear guidance on the requirement for insulation. It is advisable to perform a risk assessment to determine the need for insulation but, in general, it would normally 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, they should have a 'Class 0' surface spread of flame and be supplied with the ductwork to ensure systems are installed 'as tested'.

CASWELL FIRESAFE® systems utilise DuctRock® Slab which also satisfies the requirements of BS EN 14303. It is 90mm thick and the finished surface colour is black.

Further guidance - in the form of FFRDL Technical Advisory Notes (FFRDL / TAN / 01 & 02) - 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.

## 9 Ductwork Support Systems

The performance of an FRD 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:

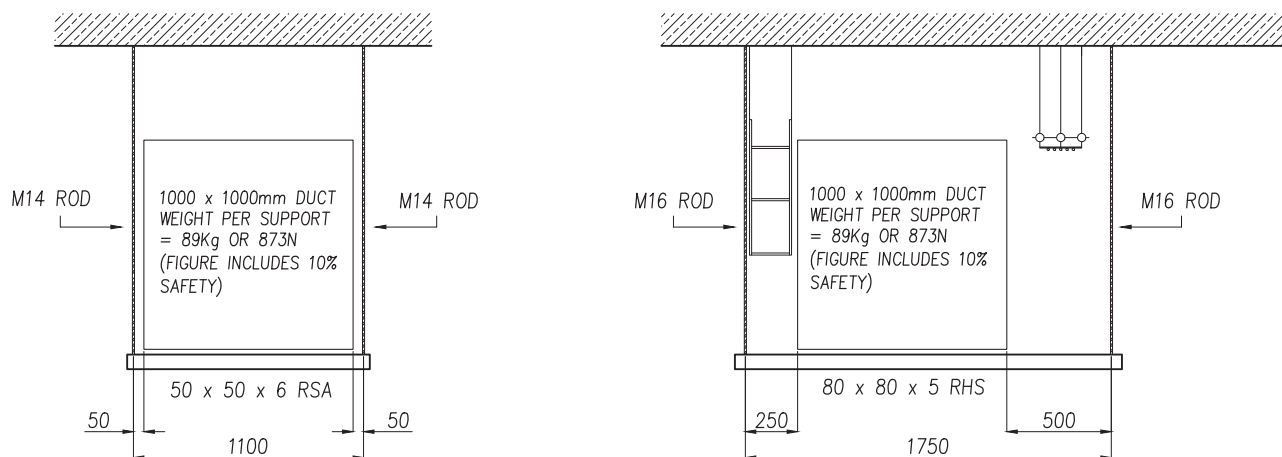
- a) The specification of the ductwork in terms of Integrity and Insulation. This determines the construction of the duct, the thickness of the insulation and the combined weight of the system
- b) The required pressure rating
- c) The orientation of the duct. There are different forces which need to be calculated where horizontal or vertical (riser) ductwork 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<sup>2</sup>; however, at elevated temperatures steel loses its tensile strength. The higher the temperature, the weaker the steel becomes until it eventually melts.



## Factors affecting Bearer specification



It is essential to take the progressive weakening of the steel drop rods and bearers into consideration when specifying 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 $\sigma$ (N/mm <sup>2</sup> ) | Approx Temperature °C |
|---------------|--|-----------------------|
| 60 Minutes    | 9N/mm <sup>2</sup>                               | 945°C                 |
| 120 Minutes   | 6N/mm <sup>2</sup>                               | 1049°C                |
| 240 Minutes   | 3N/mm <sup>2</sup>                               | 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; unless the duct construction is enhanced.

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. 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)** Anchors / fixings should be fire resisting, selected to suit the substrate and installed as per manufacturers' instructions
- c)** Friction type fixings must NOT be used due to the risk of expansion and detachment
- d)** Spring Nut / Washer type fixings - as used in slotted channels - must 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.

## 10 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. They also serve to protect designated escape routes / fire-fighting access routes.

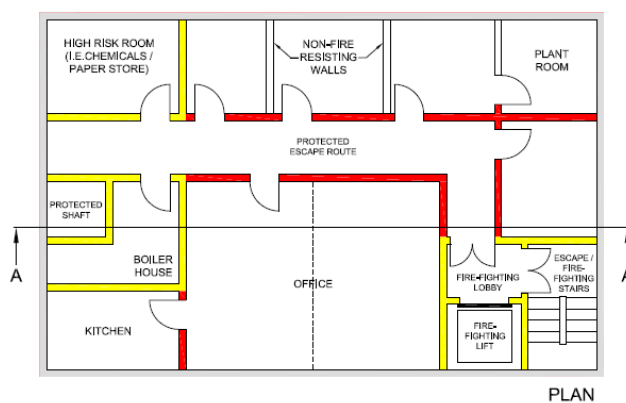
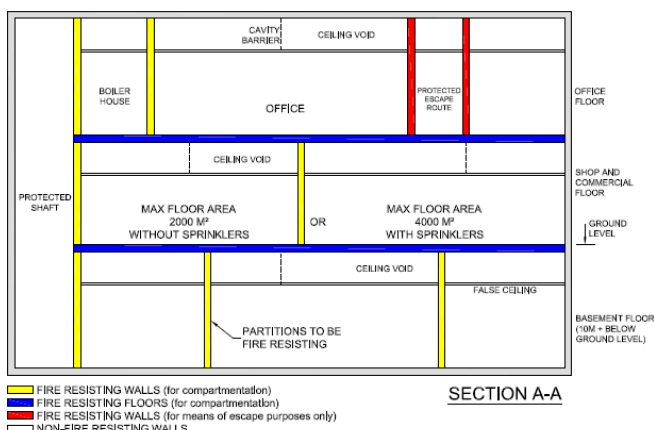
### Compartmentation

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.

#### FIRE-RESISTING SEPARATION

for compartmentation and means of escape purposes; in line with Approved Document B of the Building Regulations



### Penetration Seals

The fire-stopping of service penetrations is not normally part of the ductwork contractor's 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.

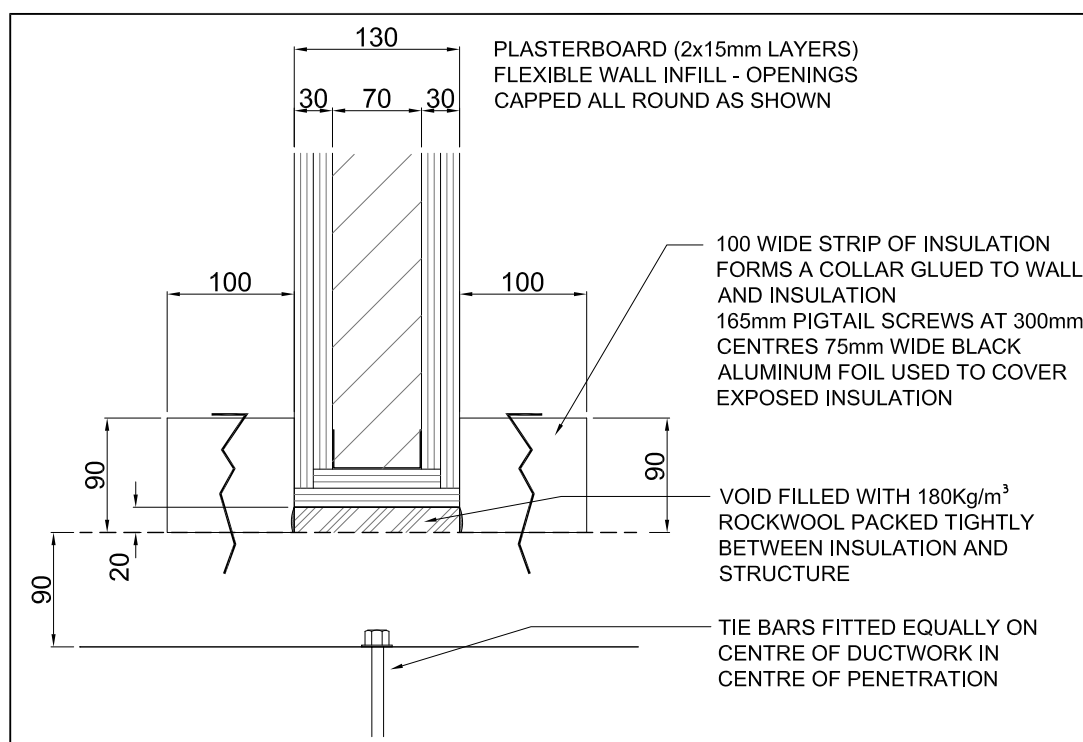
The 'Authority Having Jurisdiction' (AHJ), such as Local Authority Building Control, should be made aware of any non-standard methods as, ultimately, it is their responsibility to 'sign off' the building for fire safety.

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 650mm (max) from either side of the penetration.

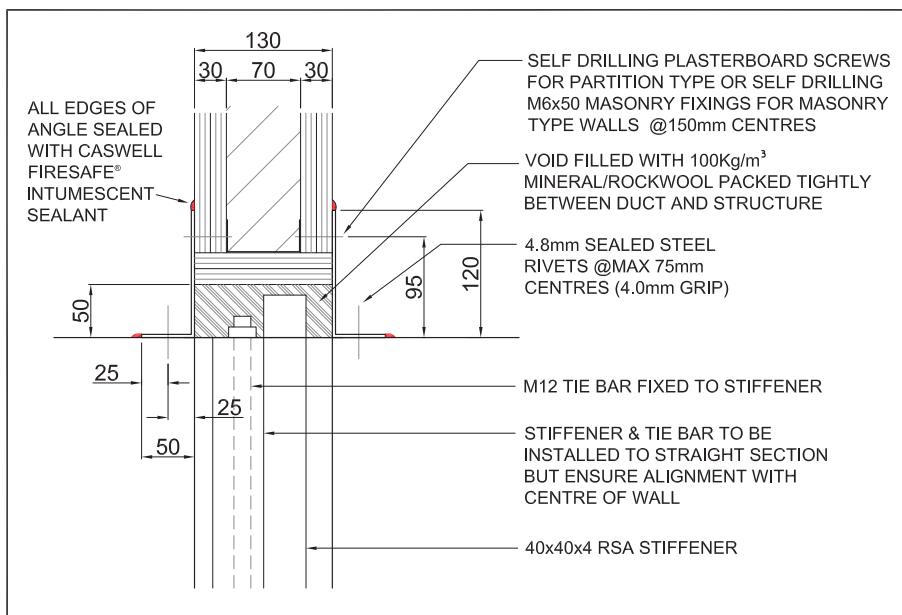
## Penetration details

The CASWELL FIRESAFE® system employs many alternative methods for dealing with penetrations through compartment walls / floors. The specific detail to be followed depends primarily on the shape of the ductwork section and whether it is insulated or uninsulated.

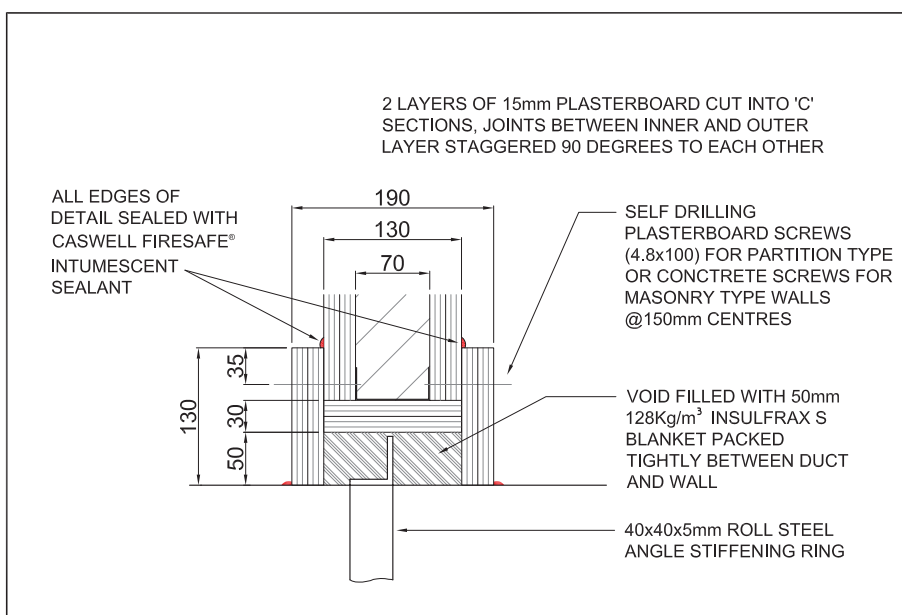
3 of the most common arrangements are shown below. Other configurations are available on request.



Penetration detail for CASWELL FIRESAFE®  
**Insulated Horizontal Rectangular**



Penetration detail for CASWELL FIRESAFE®  
Uninsulated Horizontal Rectangular



Penetration detail for CASWELL FIRESAFE®  
Uninsulated Horizontal Circular

## 11 Quality Assurance & Certificate 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.



CE marking of eligible Fire Resisting Ductwork provides the additional assurances of a globally accredited, third-party certification scheme. This offers many benefits, most importantly:

**Factory Production Control (FPC)** - Our Notified Body - **Applus (0370)** - conducts an annual inspection of our FPC to verify that our manufacturing processes are repeatable and output is consistent. This independently attests to our capability to supply product faithful to that used in the testing process.

**Materials traceability** - All materials used in the manufacture of CASWELL FIRESAFE® are meticulously recorded. This includes, but is not limited to, information on raw material source, physical characteristics, chemical properties, warranty and environmental credentials.

**Total Quality Management** - As a responsible organisation FFRDL would capture this information in any event, however, the strict governance of a structured, legal framework for CE marked systems provides the whole supply chain with a transparency and level of confidence which are not systemically available through BS testing.

Quality of manufacture and installation is of paramount importance. 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 9001:2015 quality assurance system.

**A Certificate of Conformity**  
is issued by FFRDL Licensed  
Manufacturing Partners





## 12 CASWELL FIRESAFE® Benefits

CASWELL FIRESAFE® systems do not require any special treatment, paint finishes or cladding to provide Integrity up to 120 minutes under EN 1366-1 & 8 testing.

### Manufactured for the real world



#### Speed

Removing the need for a multi-process coating means that the manufacturing 'turnaround' for CASWELL FIRESAFE® ductwork can be quick. This enables our manufacturing Partners around the world to react swiftly and better meet customer expectations; especially for any urgent add-on orders.

#### Economy

Using CASWELL FIRESAFE® can assist in 'designing out' fire dampers. This allows considerable savings on the total capital cost of dampers, their installation and on-going costs associated with periodic testing, maintenance and, ultimately, replacement of failed dampers over time.

#### Prestige

CASWELL FIRESAFE® ductwork is supplied with our distinctive flame brand logo; access doors sport distinctive red frames and our ancillary sealant products are clearly branded. Instantly recognisable as a quality, certified fire resisting system with full traceability, it gives assurance that the specified level of passive fire protection has actually been installed.

#### Consistency

3rd party audited Factory Production Control ensures that repeatable manufacturing quality - in both aesthetic and performance terms - is assured.

#### Durability

CASWELL FIRESAFE® ductwork has no coating that could be damaged during transportation and / or installation or that will degrade over time and / or due to vigorous cleaning. Non-coated product is therefore particularly cost-effective over the lifetime of the building. Fire performance relies on a product's dependability and durability. It is critical that this is not compromised.

#### Aesthetics

CASWELL FIRESAFE® Fire Resisting Ductwork is reassuringly branded and labelled. Its galvanised finish is a good match in overall finish for integrating into a standard BESA DW144 ductwork system. To achieve the same result using coated or clad ductwork would require the DW144 ductwork to be painted to match. This would add unnecessary extra cost, time and inconvenience to any project programme.

#### Convenience

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.

# TECHNICAL MANUAL

FFRDL / TM / EN / 01 / 2019

## Environmental

CASWELL FIRESAFE® is manufactured without the need for the additional chemical processes which are required to etch, prime and coat ductwork. This eliminates the environmental impact risk and costs otherwise associated with the production, application and hazardous waste disposal of chemicals / VOCs.

## 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.

## Accuracy

CASWELL FIRESAFE® is principally a factory-finished product and is backed by comprehensive, class-leading technical documentation. Installation time and complexity is therefore minimised and potential for on-site labour quality variances across disparate 3rd party installers is effectively averted.

FFRDL have created a full suite of guidance documents for CASWELL FIRESAFE® systems, in both BS and EN variants. These invaluable sets include Technical Data Sheets, Technical Advisory Notes, Risk Assessments, Product Selection flowcharts, Construction Tables and Site Induction checklists and are made available to our Clients, Consultants, Contractors and associated Building Engineering Services professionals.

## Peace of Mind

The CASWELL FIRESAFE® brand is owned and backed by FFRDL, a member of the Caswell Holdings Ltd group of companies, which have a pedigree in Ventilation technology dating back to 1969.

FFRDL are in the vanguard of Passive Fire Protection industry efforts to improve the standard of FRD installations. FFRDL staff members also have prominent roles on leading industry technical committees, including BSI 22/9 and ASFP TG6.

Our capability to supply CE marked product - where applicable in the European Economic Area (EEA) - adds yet another layer of independent verification and traceability to inspire confidence throughout the entire supply chain.





## 13 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. This offers 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 installations to ensure our detailed quality procedures are being followed. Our documented compliance audits ensure manufactured product meets our stringent specification.

Our Partners are available to assist you with your FRD 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](http://www.firesafeductwork.co.uk/international-Partners)



## 14 Continuing Professional Development (CPD)

FFRDL are able to offer technical support and advice by telephone or email. We are also an accredited CIBSE (Chartered Institution of Building Services Engineers) CPD Course Provider and offer approved, structured content relating to Fire Resisting Ductwork.

These seminars provide valuable insight into why, when and where Fire Resisting Ductwork systems are required, how they should be specified and the regulations to which they should conform.

Find out more at <http://www.firesafeductwork.co.uk/book-a-cpd>



*E & OE. To the best of our knowledge the information contained within this document was correct and current when published. We cannot be held responsible for any consequential losses based on errors, omissions or subsequent revisions in legislation which affect the information provided. In case of doubt, please contact us for clarification.*



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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