B.W.11 Fire Resistant Ductwork

Technical Manual
In 1986, Fire Protection Limited began a research programme to develop an entirely new fire resistant ductwork system.

This programme, which is continuous has resulted in the FLAMEBAR B.W.11 Fire Resistant Ductwork System being manufactured and supplied worldwide.

As a result of continued growth, Firespray International Limited was formed to carry out the ongoing research and development programme and also to market FLAMEBAR products on a global basis. Fire Protection Limited now markets and installs the system in the United Kingdom.

This Technical Manual has been produced for everyone associated with the design and installation of fire resistant ductwork systems and illustrates how to satisfy the requirements of the regulatory bodies. It also clearly emphasises our own commitment to fire safety.

**FLAMEBAR B.W.11 FIRE RESISTANT DUCTWORK SYSTEMS SATISFY ANY REQUIREMENT FOR FIRE RATED DUCTWORK FOR VENTILATION, KITCHEN OR SMOKE EXTRACT APPLICATIONS.**
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1. Testing Requirements


Part 24. Method for determination of the fire resistance of ventilation ducts
ISO 6944 (1985) Fire resistance tests - Ventilation ducts

The purpose of BS 476 Part 24 (1987) and ISO 6944 (1985) is to measure the ability of a ductwork system to resist the spread of fire from one fire compartment to another without the aid of fire dampers. It should be noted that the test relates to a complete ductwork installation and therefore joints, supports and the fire stopping through the furnace wall all form an integral part of the test.


The fire resistance of Ventilation Ductwork shall, according to the Standard, be expressed in Minutes of duration of heating until failure occurs, according to one or more of the following criteria.

1. Stability.
2. Insulation.
3. Integrity.

Criteria of Failure

Stability
Stability failure shall be deemed to have occurred when the Duct specimen collapses inside or outside the area in which there is a fire in such a manner that the duct no longer fulfils its intended function.

Insulation
Insulation failure shall be deemed to have occurred when the temperature rises above ambient temperature on the external face of the duct outside the area in which the fire is present, and exceeds either

1. 140°C as an average value, or
2. 180°C as a maximum value.

Integrity
The presence and the formation of holes or other openings in the Duct in the room adjacent to the fire (or through the fire stopping at the dividing wall) through which flames or hot gasses can pass, shall constitute Integrity failure.

Definitions of Types A & B Fire Exposure

The testing standard differentiates between types of fire exposure; two classifications apply as details below.

- **Fire Outside**
  - Compartment with Fire Outbreak
  - Duct Resists Penetration of Fire from Outside
  - No Fire Penetration from Inside Duct

- **Fire Inside**
  - Compartment with Fire Outbreak
  - Fire Penetrates into Duct through Ventilator or Smoke Extract Opening
  - Duct Resists Penetration of Fire from Inside
  - Fire Penetration from Outside

- **Duct Type A**
  - Fire Outside
  - Adjacent Compartment
  - T1 Temperature Sensor

- **Duct Type B**
  - Fire Inside
  - Adjacent Compartment
  - T2 Temperature Sensor

- **Ventilation or Smoke Extract Opening**
2. Fire Resistant Ductwork

“When and Why”

One of the most important factors taken into consideration when designing and constructing a building is effective compartmentation to limit fire spread throughout the building. Under normal circumstances compartmentation is maintained by fire dampers within ductwork systems. However under certain circumstances fire dampers should not be used and the ductwork itself must provide the same levels of fire resistance as that afforded by the compartment wall or floor.

Ductwork systems which do not normally contain fire dampers are as follows:

1: Smoke Extract Ducts.
2: Car Park Extract Ducts.
3: Pressurisation Ducts.
4: Kitchen Extract Ducts.

In general terms, any ductwork system that is intended to operate or has special use under a fire condition and cannot therefore utilise fire dampers will require a fire rating.

Ventilation systems and applications which have special or operational effect under fire conditions are as follows:

**Mechanical Ventilation System**

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

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

**Smoke Extraction Systems**

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

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

If the ductwork incorporated in a smoke extraction system is wholly contained within the fire compartment, it must be capable of resisting the anticipated temperatures generated during the development of a fire BS 476 Part 24 (1987) and ISO 6944 (1985) also requires duct which is intended for smoke extract should retain at least 75% of its cross sectional area within the fire compartment. If the ductwork penetrates the fire resisting barrier, it must also be capable of providing the same period of fire resistance.

**Dual Ventilation/Smoke Extraction Systems**

These serve as a conventional ventilation system under normal conditions, but are converted to provide smoke extraction in the event of fire, thus providing an economical dual solution.

**Car Park Extraction Systems**

Car parks which require mechanical ventilation must have separate and independent extraction systems, because of the polluted nature of the extracted air. Due to the fire risk associated with car parks these systems should be treated as smoke extract systems and therefore maintain a minimum of 75% cross sectional area under fire conditions in accordance with BS 476 Part 24 (1987) and ISO 6944 (1985). Fire dampers should not be installed in extract ductwork serving car parks.

**Pressurisation Systems**

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

A pressurisation system is a special form of mechanical ventilation system. The air supply creating the pressurisation must be maintained for the duration of a fire, fire dampers cannot be used with the ductwork to prevent the spread of fire. Any ductwork penetrating fire resisting barriers should therefore be fire resistant.

**Kitchen Extraction Systems**

Non-domestic kitchens are required to have separate and independent extraction systems, because of the polluted nature of the extracted air. Fire dampers should not be installed in extraction ductwork serving kitchens, any ductwork penetrating fire resisting barriers should be fire resistant.

Kitchen extract ductwork presents a particular hazard as combustible deposits such as grease are likely to accumulate on internal surfaces. A fire in an adjacent compartment through which the ductwork passes could therefore lead to ignition of these deposits which may continue through the ductwork system, possibly prejudicing the safety of the kitchen occupants. For this reason consideration should be given to the insulation performance of kitchen extract ducts.

Finally, Where possible, access doors, for cleaning, at distances not exceeding 3m are recommended.

**Escape Corridors and Lobbies**

It is a requirement of the Building Regulations, as defined in BS 5588 Part 9, Clause 9.2, that any duct crossing an escape corridor or lobby must be fire rated for stability, integrity and insulation, for the same period of time as the compartment through which it passes. It should be noted that at least one fire damper will be required if either side of the escape corridor is constructed with non-fire rated ductwork.
## 2.1. Regulations & Codes in the United Kingdom

### Statutory Instruments
- England & Wales - Building & the Building Regulations 1991
  - Statutory Instrument, No 2768
- Scotland - Building & the Building Standards (Scotland Regulations) 1990
  - Statutory Instrument, No 2179 Section 187
- Northern Ireland - Building Regulations (Northern Ireland) 1994
  - Statutory Instrument, No 243

### Insurance Requirements
(Association of British Insurers & Lloyds)

### Support Documents
- British Standards Institution (BSI)
- International Organisation for Standardisation (ISO)

### Advisory Guides
- Loss Prevention Council
  - (Inspectors Rules for the Protection of Building)
- London District Surveyors Association
  - (Fire Safety Guide No1
  - Fire Safety in Section 20 Buildings 1990)
  - (Fire Safety Guide No2
  - Fire Safety in Atrium Buildings)
- Department of Health
  - Firecodes
  - HTM 81 (Fire Precautions in New Hospitals)
  - HTM 85 (Fire Precautions in Existing Hospitals)
  - HTM 88 (Fire Precautions in NHS Housing for Mentally Handicapped)
  - HTM 94 (Fire Precautions in New Old Peoples Homes)

### British Standard Codes
- Approved Document B (England & Wales)
  - Fire Safety
  - B1 Means of Escape
  - B2 Internal Fire Spread (Linings)
  - B3 Internal Fire Spread (Structures)
  - External Fire Spread
  - BS Access & Facilities for the Fire Services
- Technical Standard (Scotland)
  - Part D
  - Structural Fire Precautions
  - Part E
  - Means of Escape for Fire
- Technical Booklet E (Northern Ireland)
  - Fire Safety
- BS 5568 Part 9 (1989)
  - Code of Practice for Ventilation & Air Conditioning Ductwork
- BS 7346 Part 2 (1990)
  - Specification for Powered Smoke & Heat Exhaust Ventilators
- BS 8313 (1989)
  - Code of Practice for Accommodation of Buildings Services in Ducts
- ISO 904 (1985)
  - Fire Resistance Tests Ventilation Ducts
- BS 476 Part 20 (1987)
- BS 476 Part 21 (1987)
- BS 476 Part 22 (1987)

### British Standards Institution (BSI)
- Fire Tests International Organisation for Standardisation (ISO)
3. **FLAMEBAR B.W.11**

Fire Resistant Ductwork

Analysis and Performance

3.1 **FLAMEBAR B.W.11** - Single Source Responsibility - Certificate of Conformity

3.2 **FLAMEBAR B.W.11** - Flexibility in Design

3.3 **FLAMEBAR B.W.11** - Construction of **FLAMEBAR** B.W.11 Fire Duct

3.4 **FLAMEBAR B.W.11** - System Integrity - Ancillary Components

3.5 **FLAMEBAR B.W.11** - Panel Construction

3.6 **FLAMEBAR B.W.11** - To BS 7346 Insulation Temperatures

3.7 **FLAMEBAR B.W.11** - Air Temperatures at Various Distances from Duct

3.8 **FLAMEBAR B.W.11** - Guide to Fire Protection of Ductwork

3.9 **FLAMEBAR B.W.11** - Fire Resistance Criteria

3.10 **FLAMEBAR B.W.11** - Supports and Hangers

3.11 **FLAMEBAR B.W.11** - Construction Standards

### 3.1. Single Source - Responsibility - Certificate of Conformity

When considering the use of Fire Resistant Ductwork, issues such as Single Source Responsibility and Certificates of Conformity are often overlooked. When specifying **FLAMEBAR B.W.11** you are assured that every process from design to installation is directly controlled.

**Single Source Responsibility** means exactly what it states, that from design through manufacture, spray coating and installation there is a single source responsibility. Furthermore once all the installation is complete and all contractual commitments are fulfilled a **Certificate of Conformity** is issued to the client. This confirms the periods of fire resistance installed and confirms compliance with the relevant criteria of BS 476 Part 24 (1987) and ISO 6944 (1985).

This document underlines our commitment to providing the best and ultimately most “fire safe” installations available.

### 3.2. Flexibility in Design

**FLAMEBAR B.W.11** offers complete flexibility in design - rectangular, flat oval and circular ducts are available.

The construction of the initial galvanised sheet steel duct means that all **FLAMEBAR B.W.11** Fire Ducts have normal standards of air tightness and are therefore easily capable of being successfully tested.
As well as profile flexibility as depicted in the previous illustrations, FLAMEBAR B.W.11 Fire Ducts can also be supplied as detailed below:

### 3.3. Construction

**FLAMEBAR** B.W.11 Fire Duct is constructed from galvanised sheet steel manufactured to an enhanced standard, then degreased and factory fire sprayed with **FLAMEBAR** B.W.11 which is a specially formulated water based compound. This contains selected mineral filters in a low permeability elastomeric binder to a thickness of approximately 1mm to give a finished product which has been successfully tested for international use under Cellulosic Fire Conditions in excess of 4 hours duration. Ductwork is produced in sections and is assembled on site utilising tested fireproof gaskets/sealants.

The unique properties of **FLAMEBAR** B.W.11 has enabled us to design a low density, highly durable material which accommodates induced stress arising from extreme and varying conditions e.g. Climatic Moisture and Structural Loading Variations, and the effect of thermal shock during a fire.

The completed system has been completed to BS 476 Part 24 (1987) and ISO 6944 (1985) up to temperature of 1133 °C, thereby facilitating complete design freedom should a fire engineering approach be adopted.
3.4. System Integrity

Ancillary Components.

Some of the additional features that can be incorporated in FLAMEBAR B.W.11 Fire Duct Systems

1. Access Doors.
2. Control Device Housings.
3. Volume Control Dampers.
4. Cable and Pipe Enclosures.
5. Internal Flanging.
6. Penetration Seals between Compartments.
7. Protection can be applied to fans, silencers, etc. (If suitably constructed)
3.5. Panel Construction

**FLAMEBAR B.W.11 Fire Rated Ductwork**

*FLAMEBAR* B.W.11 ductwork can either be constructed in flanged lengths of duct, which are then bolted together to make a run of ducting, or in panel form. This construction is especially useful for ducts of large cross-section and can be used on any size of duct up to 25M x 3M.

**SOME OF THE **FLAMEBAR** B.W.11 PANEL CONSTRUCTION SYSTEM BENEFITS**

- Tested for up to 4 hours Stability, Integrity & Insulation to BS 476 pt 24 (1987) and ISO 6944 (1985) for Ventilation Fire Duct, Smoke Duct & Kitchen Extract ductwork.
- When insulation rating is required panels are pre-insulated at the factory.
- Smooth cleanable internal finish.
- Total flexibility in the design and construction of the duct.
- Can be sent to site “flat packed” ready to bolt up.
- Lightest fire duct system available.

The panels are delivered to site precoated on the outside face with *FLAMEBAR* B.W.11 and are then bolted together incorporating *FLAMEBAR* intumescent gasket strip to form the required duct cross-section.
Examples of Panel Configurations

Typical Methods of Panel Manufacture

Depending on Fire Resistance, manufacture should be to **FLAMEBAR B.W.11** Construction Standards.
3.6. **FLAMEBAR B.W.11**

**to BS 7346 Insulation Temperatures**

**FLAMEBAR Solution When Lower Insulation Temperature Required**

All **FLAMEBAR** B.W.11 Fire Ducting has been fully tested to BS 476 Part 24 (1987) and ISO 6944 (1985) for stability and integrity up to 4 hours. However, where lower installation temperatures are required due to ducting being rated the same as the smoke extract fan or a fire engineering consultant having determined a fire engineering solution.

We are able to offer our **FLAMEBAR** B.W.11 product, either on its own or with the addition of various thicknesses of insulation depending upon the insulation fire rating required.

To satisfy the low temperature smoke requirement, we have tested **FLAMEBAR** B.W.11 duct without additional insultant to the principles of BS476 Part 24 (ISO 6944) at 400ºc for 2 hours.

**Smoke Extract Duct Test in Accordance with BS 7346 - Fire Inside Duct**

Mean Furnace and Duct Surface Temperatures

**Minimum Periods of Fire Resistance for Fire Rated Ductwork**

Example showing a typical fire duct run passing through different fire rated compartments

From the example, it can be seen that when the fire duct passes from the 2nd to the 3rd fire compartment, the fire resistance of the duct increases in line with the rating of the fire compartment wall. This rating is not reduced in the 4th compartment, despite the reduced rating of the fire compartment wall between the 3rd and 4th fire compartments.

**Important Note:**

If the fire duct is for extracting smoke, it must also maintain a minimum of 75% of its overall cross-sectional area over the total length of the duct, including the 1st fire compartment. Therefore, smoke extract ductwork in the 1st fire compartment must always be tested to BS 476 Part 24 (1987) for stability and integrity only.
3.7. **FLAMEBAR B.W.11**

Air Temperatures at Various Distances from Duct Without Additional Insulation

Compartment walls and floors will have a prescribed fire resistance in terms of stability, integrity and insulation for between 30 and 240 minutes. It is therefore essential for fire security, that where compartmentation boundaries are penetrated by fire duct, the fire separation and the performance criteria of the penetration wall or floor is maintained, and that the duct should not act as a conduit along which fire may spread to other areas.

In all cases, the time period for stability and integrity should be at least equal to that required by the penetration element. However, controlling Authorities and engineered solutions have in many circumstances waived the insulation requirement. If the ductwork is within the first compartment (see example) it will not need to be insulated and if the fire duct has not been fire insulated for a give period to BS 476 Part 24 (1987), sufficient distance must be maintained between the fire duct and any adjacent combustible material. BS 5588 Part 9, Appendix Clause A4, recommends a minimum of 500mm be maintained for bare metal ductwork.

The graph below gives the air temperature, taken at various distances away from our **FLAMEBAR B.W.11** fire duct. It should be noted that the insulation failure temperature, as per BS 476 Part 24 (1987), is a minimum of 140°C, plus ambient temperature, ie approximately 160°C.
3.8. FLAMEBAR Guide to Fire Resistance of Ductwork


Note: Table designed as indicative guide only - Actual compartmentation requirements must be verified by others.


1) Insulation - Fire inside duct, temperature rise exceeds either (1) 140°C as an average value, or (2) 180°C as a maximum value on duct surface in compartment adjacent to fire seat.

2) Insulation - Fire outside duct, temperature rise exceeds either (1) 140°C as an average value, or (2) 180°C as a maximum value on internal duct surface in fire seat.

3) Insulation - Fire outside duct, temperature rise exceeds either (1) 140°C as an average value, or (2) 180°C as a maximum value on duct surface in compartment adjacent to fire seat.
### 3.9. Fire Resistance Criteria

<table>
<thead>
<tr>
<th>Application</th>
<th>Fire Exposure</th>
<th>Fire Resistance Time-Minutes</th>
<th>Low Temp Insulation Thickness mm&quot;</th>
<th>Approx. Product Thickness mm&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke, Extract</td>
<td>Fire Inside or Outside</td>
<td>240 240 10</td>
<td>210 400</td>
<td>1 (0.04&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside or Outside</td>
<td>240 240 60</td>
<td>240 600</td>
<td>25 (1&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside or Outside</td>
<td>240 240 90</td>
<td>240 650</td>
<td>50 (2&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside or Outside</td>
<td>240 240 120</td>
<td>- -</td>
<td>80 (3.15&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside or Outside</td>
<td>240 240 210</td>
<td>240 650</td>
<td>100 (4&quot;)</td>
</tr>
<tr>
<td>Fire Duct</td>
<td>Fire Inside</td>
<td>240 240 10</td>
<td>210 400</td>
<td>1 (0.04&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside</td>
<td>240 240 30</td>
<td>240 600</td>
<td>25 (1&quot;)</td>
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<tr>
<td></td>
<td>Fire Inside</td>
<td>240 240 60</td>
<td>240 650</td>
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<td>Fire Inside</td>
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<td></td>
<td>Fire Inside</td>
<td>240 240 210</td>
<td>- -</td>
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<tr>
<td></td>
<td>Fire Outside</td>
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<td>Fire Outside</td>
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<td>Fire Outside</td>
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<td></td>
<td>Fire Outside</td>
<td>240 240 90</td>
<td>- -</td>
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<td></td>
<td>Fire Outside</td>
<td>240 240 120</td>
<td>240 600</td>
<td>100 (4&quot;)</td>
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<tr>
<td></td>
<td>Fire Outside</td>
<td>240 240 210</td>
<td>- -</td>
<td>80 (3.15&quot;)</td>
</tr>
<tr>
<td>Kitchen, Extract</td>
<td>Fire Inside</td>
<td>240 240 10</td>
<td>210 400</td>
<td>1 (0.04&quot;)</td>
</tr>
<tr>
<td></td>
<td>Fire Inside</td>
<td>240 240 30</td>
<td>240 600</td>
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<td>Fire Inside</td>
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<tr>
<td></td>
<td>Fire Outside</td>
<td>240 240 120</td>
<td>240 600</td>
<td>100 (4&quot;)</td>
</tr>
</tbody>
</table>

### 3.10. Supports and Hangers

As it is known that tensile strength of steel reduces with temperature, it has been calculated and tested by the Loss Prevention Council that based on the original strength of steel for supports of 430 N/mm², Fire duct supports should be sized based on:–

- Fire Duct rated for 60 minutes 925°C (1697°F). Tensile strength of 15N/mm².
- Fire Duct rated for 120 minutes 1029°C (1884°F). Tensile strength of 10N/mm².
- Fire Duct rated for 240 minutes 1133°C (2071°F). Tensile strength of 6N/mm².

**Weight of FLAMEBAR B.W.11 Fire Duct**

- Total weight of up to 2 Hour Fire Duct without insulation = 10.98 kg/m². (2.24lb/ft²)
- Total weight of up to 2 Hour Fire Duct with 50 mm insulation = 16.23 kg/m². (3.33lb/ft²)
- Total weight of up to 2 Hour Fire Duct with 100 mm insulation = 21.48 kg/m². (4.40lb/ft²)
- Total weight of up to 4 Hour Fire Duct without insulation = 14.12 kg/m². (2.89lb/ft²)
- Total weight of up to 4 Hour Fire Duct with 50 mm insulation = 19.37 kg/m². (3.97lb/ft²)
- Total weight of up to 4 Hour Fire Duct with 100 mm insulation = 24.62 kg/m². (5.05lb/ft²)

Above weights are based on 1000mm x 1000mm (40" x 40") typical standard ductwork per linear metre.
When designing and testing Fire Resistant Ductwork it is critical that the reduction in tensile strength of steel under fire load is given adequate consideration. This applies to hangers (studding) and bearers, but it is equally important that due consideration is given to the performance of the fixing system under fire load.

It must be recognised that the "pull out" load of an anchor under fire conditions is significantly less than at ambient temperature. By specifying FLAMEBAR B.W.11 you can be confident that these issues have been adequately addressed.

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### Table Showing Typical Anchor and Hanger Sizes Required for 2hr. Stability and Integrity FLAMEBAR B.W.11 Smoke Duct

<table>
<thead>
<tr>
<th>Duct Size</th>
<th>Duct area per metre run</th>
<th>Total weight per metre run of duct + BW11</th>
<th>Bearer spacing mm</th>
<th>Weight on each bearer</th>
<th>Weight on each anchor</th>
<th>Max. test load that Hilti HKD anchor will withstand in a fire situation</th>
<th>Size of anchor &amp; hanger used to provide added safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of 2 sides 600</td>
<td>1.2m²</td>
<td>14.4 kg</td>
<td>1500</td>
<td>21.6 kg</td>
<td>10.8 kg</td>
<td>30 kg = 6mm HKD</td>
<td>M8</td>
</tr>
<tr>
<td>Sum of 2 sides 800</td>
<td>1.6m²</td>
<td>19.3 kg</td>
<td>1500</td>
<td>28.95 kg</td>
<td>14.5 kg</td>
<td>30 kg = 6mm HKD</td>
<td>M8</td>
</tr>
<tr>
<td>Sum of 2 sides 1200</td>
<td>2.4m²</td>
<td>33.65 kg</td>
<td>1500</td>
<td>50.7 kg</td>
<td>25.2 kg</td>
<td>30 kg = 6mm HKD</td>
<td>M8</td>
</tr>
<tr>
<td>Sum of 2 sides 1600</td>
<td>3.2m²</td>
<td>51.1 kg</td>
<td>1500</td>
<td>76.6 kg</td>
<td>38.3 kg</td>
<td>40 kg = 6mm HKD</td>
<td>M8</td>
</tr>
<tr>
<td>Sum of 2 sides 2000</td>
<td>4.0m²</td>
<td>65.7 kg</td>
<td>1500</td>
<td>98.5 kg</td>
<td>49.5 kg</td>
<td>60 kg = 10mm HKD</td>
<td>M10</td>
</tr>
<tr>
<td>Sum of 2 sides 3000</td>
<td>6.0m²</td>
<td>98.7 kg</td>
<td>1500</td>
<td>148 kg</td>
<td>74 kg</td>
<td>80 kg = 10mm HKD</td>
<td>M12</td>
</tr>
<tr>
<td>Sum of 2 sides 4000</td>
<td>8.0m²</td>
<td>131.5 kg</td>
<td>1500</td>
<td>197 kg</td>
<td>98.5 kg</td>
<td>120 kg = 12mm HKD</td>
<td>M12</td>
</tr>
<tr>
<td>Sum of 2 sides 5000</td>
<td>10.0m²</td>
<td>202 kg</td>
<td>1500</td>
<td>303 kg</td>
<td>152 kg</td>
<td>300 kg = 16mm HKD</td>
<td>M16</td>
</tr>
</tbody>
</table>

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**Typical Vertical & Horizontal Support Arrangements**

Ensure that fixing into slab is capable of supporting the weight shown on the chart. (Note, all parts of anchor to be steel)

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**N.B.** If ordered, several fire stop details can be provided, please refer to office for details.
3.11. Construction Standards

A series of Construction Standards are produced that directly relate to the requirements of each individual project. These Standards represent varying periods of fire resistance, ductwork profile and operational requirement of the duct system (i.e. smoke extract, ventilation duct or kitchen extract). Detailed below is a typical construction standard.

Each standard is laid out in a clear and concise way. From these standards it is possible to easily identify flange requirements, support requirements, dimensional data etc. It is important to remember that these standards replicate exactly the methods used in actual fire tests therefore ensuring optimum system performance under the required fire conditions.
4. Penetration Seals Between Fire Compartments

If specified we can provide fire stopping compartments as part of our installation service. Detailed below are two typical fire rated ductwork stoppings, as tested to BS 476 Part 24 (1987) and ISO 6944 (1985).

![Diagram of fire stopping compartments]

5. Pro-Forma Specification Example

**FLAMEBAR** B.W.11 Fire Resistant Ductwork to be manufactured by Fire Protection Limited (or other authorised licensee) for our Ventilation/Smoke/Kitchen Extract/Supply System to comply with BS 476 Part 24 (1987) & ISO 6944 (1985), for ........Hours Stability ........Hours Integrity and ........Hours Insulation.

Ductwork to be Rectangular/Flat Oval/Circular construction, complying with Building Regulations Class ‘0’ requirements.

The Duct to be a composite Fire Duct manufactured to Method 3 of BS 5588 Part 9 factory produced. Once erected, to be pressure tested, if required, by client, to HVCA Standard DW 143, Pressure Classification Class .........

On Kitchen Extract Ductwork, Access Doors to be installed at a minimum distance between doors of 3 metres as required by BS 5588 Part 9 (1989).
The range of FLAMEBAR B.W.11 Fire Duct has been tested by the Loss Prevention Council in accordance with BS 476 Part 24 (1987) and ISO Standard 6944 (1985), for vertical and horizontal ductwork, with fire inside and outside the duct, in excess of 4 hours Stability, Integrity and Insulation, for Ventilation Ductwork, Smoke Extract Ductwork or Kitchen Extract Ductwork.

FLAMEBAR B.W.11 Fire Duct has also been tested by the Loss Prevention Council, in accordance with BS 476 Part 7 (1987) for surface spread of flame in accordance with the Flame Spread Classification given in the Standard.

FLAMEBAR B.W.11 Fire Duct has also been tested by the Loss Prevention Council to BS 476 Part 6 (1989) for fire propagation, confirming that the product can be defined as a Class ‘O’ Material in accordance with the Building Regulations 1991.

FLAMEBAR B.W.11 Fire Duct has also been tested by L.U.L. to BS 6853 and satisfied the Fire Safety Code of Practice requirements for smoke emission and toxic fume emission.

FLAMEBAR B.W.11 Fire Duct has the U.S.A. Underwriters Laboratory UL Classification for up to 4 Hr. Fire & Smoke Ductwork.

FLAMEBAR B.W.11 has been tested by Underwriters Laboratory in the USA to determine compliance with NFPA 90A (Installation of Air Conditioning and Ventilating Systems) for flame spread and smoke development with the following results:

Test conducted in accordance with UL Standard 723 “Test for Surface Burning Characteristics of Building Materials” (ASTM E84).

FLAMEBAR B.W.11 Fire Duct has also passed the hose stream test to ASTM - E119 with water pressure of 207 KPa (30 psi) for 2½ mins.

Impact Test of FLAMEBAR B.W.11 Fire Duct
Impact test to BS 5569, in which a dart imparts 44.15 joules (32.5 ft pound force) at maximum drop, resulting in a small indentation which passes under the criteria of BS 5569. FLAMEBAR B.W.11 Fire Duct also has undergone impact testing to the requirements of Appendix A BS 5588 Part 5.

Leakage Testing of FLAMEBAR B.W.11 Fire Duct
The construction and sealing of the Fire Duct System allows the ductwork to be tested up to Class ‘D’ high pressure, if required by the clients specification, which has a leakage limit of .0001 x $P^{0.65}$ litres per second per sq. metre of duct surface area, as laid down by the HVCA Specification DW 143. Higher pressures and lower leakage rates can be achieved if required by the Clients specification.

Exterior Weathering of FLAMEBAR B.W.11 Fire Duct
Duplicate samples were placed on the exterior weathering frame and left totally exposed from January 1993. The results so far show:
1. Some dirt pick-up which can be washed off.
2. No mould growth.
3. No chalking.
4. Material has remained totally intact.

Considering the length of time the samples have been exposed, the material is in good condition.

Artificial Weathering of FLAMEBAR B.W.11 - OUV Weatherometer
The samples undergoing artificial weathering have undergone over 22000 hours of alternate UV and condensation cycling which is extremely excessive in duration terms, normally 1000 hours is sufficient to predict whether a material is suitable for exterior/semi-exposed conditions. 22000 hours is equivalent to 60 years external exposure.

Expansion of FLAMEBAR B.W.11 Fire Duct
As all steel expands with temperature, there will naturally be an expansion of Fire Duct under fire conditions as follows:
- At 1100°C an expansion of 0.01562mm per mm (0.016 in per in)
- At 600°C an expansion of 0.00852mm per mm (0.008 in per in)
- At 430°C an expansion of 0.006106mm per mm (0.006 in per in)

Thermal Properties of FLAMEBAR B.W.11 Fire Duct
‘U’ value - thermal transmittance.
- BW11 without insulation = 5.0 W/mk (0.88Btu/ft2h0f)
- BW11 with 50mm insulation = 0.833 W/mk (0.147Btu/ft2h0f)
- BW11 with 100mm insulation = 0.48 W/mk (0.08Btu/ft2h0f)

Chemical Resistance of FLAMEBAR B.W.11 Fire Duct
The coating has been tested in:
- Standard 10% solutions of the following acids: Hydrochloric, Nitric and Sulphuric.
- Standard 10% solutions of the following Alkalies: Sodium Hydroxide and Potassium Hydroxide.
- The following solvents: Xylene and Acetone. After 10 days total immersion, all the above chemicals failed to cause a Breakdown of the product structure.
7. System Advantages

Single Source Responsibility
1. The design of all FLAMEBAR B.W.11 Systems are to a certified standard.
2. All FLAMEBAR B.W.11 Fire Duct is manufactured and sprayed to QA ISO 9002 Standard.
3. All FLAMEBAR B.W.11 Fire Duct is erected to QA ISO 9002 Standard.
4. Certificate of Conformity is issued following final inspection, certifying compliance with all necessary regulations.

Testing
All FLAMEBAR B.W.11 Fire Duct has been tested to:
BS 476 Part 6 for Fire Propagation Class O
BS 476 Part 7 for surface spread of flame

Weight: FLAMEBAR B.W.11 Fire Duct is the lightest Fire Duct system available.

Shape: FLAMEBAR B.W.11 Fire Duct can be manufactured in Rectangular, Flat Oval or Circular.

Impact Resistance: FLAMEBAR B.W.11 systems are impact resistant to BS 5669 and to BS 5588 Part 5, Appendix A.

Moisture Absorption: FLAMEBAR B.W.11 systems are non-hygroscopic and have been tested in an artificial Weatherometer to an equivalent of 60 years external exposure.

Chemical Resistance: FLAMEBAR B.W.11 Fire Duct is chemically resistant to many acids and solvents and has excellent resistance to chemical attack.

Smoke and Toxic Fume Emission: FLAMEBAR B.W.11 Fire Duct has been tested to BS 6853 for Smoke Emission and Toxic Fume Emission.

Pressure Testing: FLAMEBAR B.W.11 Fire Duct has the same frictional resistance to GSS ductwork, and can be pressure tested to 2500 pascals (10" wg) with a leakage rate of less than 0.16 litres per second per m² (0.032 ft³ per minute per ft²) of surface area.

Anti Drumming: FLAMEBAR B.W.11 Fire Duct has a damping co-efficient to BS AU125(1966) of 19db per second decay rate.

Inline Plant: Inline Plant can be treated with FLAMEBAR B.W.11, if suitably constructed.

Acoustic Properties: FLAMEBAR B.W.11 Fire Duct achieves a Sound Reduction Index to BS 2750 Part 3 (1980) as tabled below:

<table>
<thead>
<tr>
<th>Systems</th>
<th>Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63</td>
</tr>
<tr>
<td>B.W.11</td>
<td>10.2</td>
</tr>
<tr>
<td>B.W.11 + 60kg/m², 50mm insulation</td>
<td>11.0</td>
</tr>
<tr>
<td>B.W.11 + 105kg/m², 50mm insulation</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Size: FLAMEBAR B.W.11 Fire Duct is fully certificated for any size of Ductwork in the vertical and horizontal plane up to 25m x 3m (82’ x 10’) cross sectional area.

Cleaning: The smooth internal finish of FLAMEBAR B.W.11 Systems enable easy cleaning of the ductwork therefore it is ideal for kitchen extract duct installations.

Colour: FLAMEBAR B.W.11 Fire Duct without insulation has a monolithic spray texture with natural buff finish. FLAMEBAR B.W.11 systems can also be overpainted or sprayed with water based paint to obtain any desired colour.