Introduction

Firespray International Limited is internationally recognised in the design and manufacture of an extensive range of specialist fire and acoustical systems into a diverse range of industrial disciplines encompassing the general construction, transportation, power generation and bespoke manufacturing industries.

Accredited to ISO 9002 and ISO 9001:2000, Firespray International is committed to the highest standards in products development, manufacture and customer support.

Since its formation in the early nineties, Firespray International Ltd has become recognised as a world authority in the design and manufacture of Fire Ducting Systems under the brand name FLAMEBAR.

With a primary manufacturing base in the UK, Firespray International Ltd has now developed a highly specialised international Licensees network encompassing the world.

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

FLAMEBAR BW11 FIRE RATED DUCT SYSTEMS SATISFY ANY REQUIREMENT FOR FIRE RATED DUCTWORK FOR VENTILATION, KITCHEN OR SMOKE EXTRACT APPLICATIONS.
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1. Test Requirements


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.

![Furnace Temperature Curve as Specified in BS 476 Part 24 (1987) & ISO 6944 (1985)](image)


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. Integrity  3. Insulation

Criteria of Failure

Stability: Stability failure shall be deemed to have occurred in duct type A within the furnace and in duct types A and B outside the furnace when the duct collapses in such a manner that the duct no longer fulfills its intended function.

Integrity: The presence and the formation of cracks, holes or other openings outside the furnace through which flames or hot gases can pass shall constitute integrity failure.

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

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

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

Definitions of Types A & B Fire Exposure

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

Fire Outside - Duct Type A

Fire Inside - Duct Type B
3. Fire Rated Ductwork

Analysis and Performance

3.1 FLAMEBAR BW11 - Single Source Responsibility - Certificate of Conformity
3.2 FLAMEBAR BW11 - Flexibility in Design
3.3 FLAMEBAR BW11 - Construction of Fire Duct
3.4 FLAMEBAR BW11 - System Integrity - Ancillary Components
3.5 FLAMEBAR BW11 - Panel Construction
3.6 FLAMEBAR BW11 - Air Temperatures at Various Distances from Duct
3.7 FLAMEBAR BW11 - Supports and Hangers

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 BW11 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 BW11 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 BW11 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 BW11 Fire Ducts can also be supplied as detailed below:
3.3 Construction of Fire Rated Duct

**FLAMEBAR** BW11 Fire Duct is constructed from galvanised sheet steel manufactured to an enhanced standard, then degreased and sprayed with **FLAMEBAR** BW11 which is specially formulated water based compound. This contains selected mineral fillers 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** BW11 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** BW11 Fire Duct Systems;

1. Access Doors
2. Control Device Housings
3. Volume Control Dampers
4. Cable and Pipe Enclosures
5. Penetration Seals
6. Protection can be applied to fans, silencers, etc.
3.5 Panel Construction

*FLAMEBAR* BW11 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.

**Benefits of the Panel Construction System**

- 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 pre-coated on the outside face with *FLAMEBAR* BW11 and are then bolted together incorporating *FLAMEBAR* intumescent gasket strip to form the required duct cross-section.

**Examples of Panel Configurations**

- 4 Panel Construction
- ‘U’ and Panel Construction
- ‘U’ Panel Construction
- ‘L’ Panel Construction
3.6 Air Temperatures at Various Distances from Duct

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 BW11 fire duct. It should be noted that the insulation failure temperature, as per BS 476 Part 24 (1987), is of a minimum of 140°C, plus ambient temperature, i.e. approximately 160°C.

**Average Temperatures At Various Distances From BW11 Duct Surface, at 1hr & 2hrs**

![Graph showing air temperatures at various distances from BW11 duct surface.](image)

**FLAMEBAR Solution When Lower Insulation Temperature Required**

All FLAMEBAR BW11 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 BW11 product, either on its own or with the addition of various thicknesses of insulation depending upon the insulation fire rating required.
**Smoke Exhaust Duct Test in Accordance with BS 7346 - Fire Inside Duct**

**Mean Furnace and Duct Surface Temperatures**

![Graph showing temperature curves](image)

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

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

![Diagram showing duct layout](image)

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 Supports and Hangers

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 430N/mm$^2$. Fire duct supports should be sized based on:

- Fire Duct rated for 60 minutes 925°C (1697°F)
  - Tensile strength of 15N/mm$^2$

- Fire Duct rated for 120 minutes 1029°C (1884°F)
  - Tensile strength of 10N/mm$^2$

- Fire Duct rated for 240 minutes 1133°C (2071°F)
  - Tensile strength of 6N/mm$^2$

**Weight of FLAMEBAR BW11 Fire 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>Weigh on each bearer</th>
<th>Weight on each anchor</th>
<th>Max test load that Hilti HKW 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>1.2m$^2$</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>1.6m$^2$</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>2.4m$^2$</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>3.2m$^2$</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>4.0m$^2$</td>
<td>65.7 kg</td>
<td>1500</td>
<td>98.5 kg</td>
<td>49.5 kg</td>
<td>80 kg = 10mm HKD</td>
<td>M10</td>
</tr>
<tr>
<td>Sum of 2 sides 3000</td>
<td>6.0m$^2$</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>8.0m$^2$</td>
<td>131.5 kg</td>
<td>1500</td>
<td>198 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>10.0m$^2$</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>

Above weights are based on 1000mm x 1000mm 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 BW11 you can be confident that these issues have been adequately addressed.
4. Fire Rated Ductwork
“When & 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

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 to match the compartmentation it passes through.

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

- Smoke Extract Duct System
- Non-Domestic Kitchen Extract System
- Basement and Enclosed Car Park System
- Escape Route Ducts
- Basement Smoke Extract Duct System
- Dual Ventilation/Smoke Extract System
- Pressurisation System
- High Risk Areas
5. Smoke Extract Duct System

Ductwork used in smoke extract systems should normally be rated for stability, integrity and insulation, at least equal to the compartment wall through which it passes. (Approved Document B Fire Safety, Notes To Table A1, Appendix A).

Smoke extract ductwork must retain at least 75% of its cross sectional area, both in the fire compartment as well as in adjacent compartments. If the duct is contained within a dedicated shaft or there is at least 500mm separation between the ductwork and combustible materials (e.g. in car parks) stability and integrity ratings may be required within the area to be protected.

IN THE DIAGRAM

Office extract ductwork shown must be suitable for clearing smoke within the compartments and normally rated for 1 hour for stability and integrity to resist hot smoke and fire from inside (Type B). Insulation fire rating is not required in the first compartment.

Where the office extract duct crosses the escape corridor shown it must maintain stability, integrity and insulation fire rating for the same period of time as the compartment through which it passes and this may be required for the remainder of the ductwork route through the building to outside.

In some circumstances insulation requirements may be waived or varied by the regulatory authority if there are no combustible materials within 500mm of the duct, such as in the plantroom shown (BS 9999:2008 Ref. W.4).

In order that the 75% cross sectional free area criteria is maintained, fire rated ductwork would be used within the service shaft requiring stability and integrity shown. However, if there are combustible materials within 500mm of the duct, insulation would still be needed.

Building Regulations and BS 476-24/ISO 6944 stipulate that all fire rated ductwork should be tested and installed to comply with the full ‘cellulosic’ time/temperature fire test curve (ISO 834 Fire Curve). A fire engineered solution designed by a qualified fire engineering consultant for lower smoke temperature may be allowed by the regulatory authority, thus reducing the insulation requirement. However, the duct must still be tested and installed to maintain stability and integrity to the full test temperature.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
6. Non-Domestic Kitchen Extract

Non-domestic kitchen extract ductwork is sometimes referred to as grease ducting and should be tested for Type A fire outside and Type B fire inside. Both tests are required to prevent flammable grease from either catching fire when it passes through an adjacent area or, if the grease itself is already alight, causing a fire to start within the adjacent area by radiant heat.

Non-domestic kitchens must have separate and independent extract systems (BS 9999:2008 Clause 33.4.7). Fire dampers should not be used in kitchen extract ductwork (BS 9999:2008 Clause 33.4.3.2 and 33.4.4.2). Access doors must be installed at three metre intervals where possible (BS 9999:2008 Clause 33.4.7) and internal surfaces must be smooth to enable easy cleaning of the grease. Care must be taken to ensure combustible deposits in the duct cannot ignite in adjacent compartments.

In the diagram

Kitchen extract ductwork presents a particular hazard in that combustible deposits such as grease are likely to accumulate on its internal surfaces. Therefore, the ductwork should resist fire from inside (Type B) and must be rated for stability, integrity and insulation, for the same period of time as the compartment through which it passes shown.

A fire in an adjacent compartment through which the kitchen extract ductwork is passing, could initiate a fire within the ductwork, which in the absence of fire dampers might prejudice the safety of kitchen occupants, it should also be tested to fire outside (Type A) with the additional requirement that the internal surface of the ductwork within the compartment must meet the insulation criteria.

In some circumstances insulation requirements may be waived or varied by the regulatory authority, if the duct passes through an area where fire cannot be present shown such as a protected shaft. However, stability and integrity must still be maintained for the relevant period of time.

Ductwork within the kitchen (the first compartment) does not have to be fire rated shown.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
7. Basement & Enclosed Car Park

Basement and enclosed car parks require an extract ductwork system suitable for clearing smoke and fumes. Either natural or mechanical methods may be used to ventilate basement and enclosed car parks.

Natural ventilation requires the permanent opening of the floor area, at 2.5%, to provide a through draft (Approved Document B, Fire Safety, B3 Section 11.5). Mechanical ventilation must provide six air-changes per hour in normal conditions and ten in the event of a fire. Extract points must be arranged so that 50% are at high level and the remainder at low level (Approved Document B, Fire Safety, B3 Section 11.6).

All components of the system must have a minimum melting point of 800°C (Approved Document B, Fire Safety, B3 Section 11.6). Fire dampers should not be used in any basement or enclosed car park extract system (BS 9999:2008 Clause 33.4.4.2). Ductwork must retain at least 75% of its cross sectional area in the fire compartment and in adjacent compartments.

IN THE DIAGRAM

The car park extract ductwork shown must be suitable for clearing fumes and smoke from within the car park and normally rated for a minimum of 1 hour for stability and integrity to resist hot smoke and fire from inside (Type B). All components of the ductwork system must have a minimum melting point of 800°C and therefore aluminium grilles and fixings etc are not permitted.

Where the extract leaves the car park and crosses into another area shown it must maintain stability, integrity and insulation fire ratings for the same period of time as the compartment through which it passes. In some circumstances insulation requirements may be waived or varied by the regulatory authority if there are no combustible materials within 500mm of the duct, such as in the void before the plantroom shown (BS 9999:2008 Ref. W.4).

In the area shown the plantroom may have been constructed as a total fire rated compartment. However, in order that 75% cross sectional free area is maintained fire rated ductwork would be used requiring stability and integrity. If combustible materials were within 500mm of the duct insulation would also be required.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
8. Escape Route Ducts

Escape route ducts are any duct crossing an escape corridor. In accordance with BS9999:2008, clause 33.4.2, escape route ducts must be fire rated.

IN THE DIAGRAM

The pressurised air supply duct shown from the fire rated plantroom above crosses the cleaner’s room and the escape corridor to provide air to the escape lobby. Pressurisation ductwork systems are dealt with in full on page 21, but it should be noted that where any type of fire rated duct crosses the escape corridor it will require stability, integrity and insulation shown for the same period of time as the compartment through which it passes.

Both the normal ventilation supply duct and extract duct follow a route from the riser shaft through the office using fire dampers and galvanised sheet steel duct (method 1 of BS 9999:2008) shown Where the ducts cross and run in the escape corridor shown the duct must be fire rated and will require stability, integrity and insulation for the same period of time as the compartment through which it passes.

It will also require at least one fire damper if either side of the escape corridor is constructed with non fire rated duct.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
9. Basement Smoke Extract System

A basement smoke extract system consists of smoke outlets/vents to provide a route for heat and smoke to escape to the open air.

Either natural or mechanical means may be used to ventilate smoke/heat from basements. Where a system of mechanical ventilation is used a sprinkler system must be fitted - Approved Document B, Fire Safety B5, section 18.13.

The air extraction system should give at least 10 air changes per hour - Approved Document B, Fire Safety B5, section 18.14. The fire duct must be constructed to resist water impingement from any sprinkler system.

IN THE DIAGRAM

The fire rated duct system shown must be suitable for clearing smoke within the compartments and normally rated for 1 or 2 hour stability and integrity to resist hot smoke and fire from inside (Type B). Insulation fire rating is not required in the first compartment.

Where the basement duct rises through the shop above shown it must maintain stability, integrity and insulation fire rating for the same period of time as the compartment through which it passes and this may be required for the remainder of the ductwork route through the building to outside.

In some circumstances the insulation requirements may be waived or varied by the Regulatory Authority if there are no combustible materials within 500mm of the duct, such as in the plantroom shown (BS 9999:2008 Clause W.4).

In all areas the duct must retain at least 75% of the cross sectional area, for the same period of time as the compartment through which it passes.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
10. Dual Ventilation/Smoke Extract

Dual ventilation/smoke extract systems can operate in two different modes to provide an economical solution for ventilation and smoke extraction.

Operates as a conventional ductwork system under normal conditions. Operates as a smoke extract system under fire conditions. Smoke extract ductwork must retain at least 75% of its cross sectional area, both in the fire compartment as well as adjacent compartments.

IN THE DIAGRAM

Systems that can operate in two different modes may offer economical solutions for smoke extraction. The ductwork shown must be suitable for clearing smoke within the compartments and normally rated for 1 hour for stability and integrity to resist hot smoke and fire from inside (Type B). Insulation fire rating is not required in the first compartment.

Where the duct crosses the escape corridor shown it must maintain stability, integrity and insulation fire rating for the same period of time as the compartment through which it passes and this may be required for the remainder of the ductwork route through the building to the outside.

In some circumstances insulation requirements may be waived or varied by the Regulatory Authority if there are no combustible materials within 500mm of the duct, such as in the plant room shown (BS 9999:2008 Ref. W.4) But, stability and integrity must still be maintained for the relevant period of time.

In order that the 75% cross sectional free area criteria be maintained, fire rated ductwork would be used within the service shaft requiring stability and integrity shown However, if there are combustible materials within 500mm of the duct, insulation would still be needed.

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
11. Pressurisation Ductwork System

Pressurisation ducts must be able to maintain an air supply to critical areas for the duration of the fire.

Air supply must be maintained, fire dampers cannot be used. All ductwork penetrating fire compartments must be fire rated in order to maintain compartmentation.

Pressurisation plant should be in a dedicated plant room or separated from other equipment by a one hour fire resistant enclosure – BS 5588 part 4, clause 6.3.4.

**IN THE DIAGRAM**

A pressurisation system is a special form of mechanical ventilation which maintains a positive pressure in critical areas to stop smoke from entering from adjacent areas, typically used in protected stairways, lobbies, corridors and fire fighting shafts.

Ductwork shown is passing through a dedicated plantroom supplying air and requires a minimum rating of 1 hour for stability and integrity to resist fire from outside (Type A).

Where it passes through the office shown it must maintain stability, integrity and insulation fire rating for the same period of time as the compartment through which it passes and this may be required for the remainder of the ductwork route through the building to the pressurised lobbies. Ductwork within the lobby or corridor shown need not be fire rated.

Ductwork shown is in a protected shaft constructed to Method 2 of BS 9999:2008 with no other services and in some circumstances insulation requirements may be waived or varied by the Regulatory Authority if there are no combustible materials or other services within 500mm of the duct (BS 9999:2008 Ref W.4).

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
12. High Risk Areas

Areas of high risk will require separate and independent extract systems (BS 9999:2008 Clause 33.4.2.)

Such areas would typically include: boiler rooms, solvent extracts, specialist dust extracts and lift ventilation ducts.

IN THE DIAGRAM

Some ductwork systems extracting fine powders or chemical solvents are considered to have a high fire risk and are recommended to be independent of the ventilation system extracting from the building.

The duct systems shown must all be suitable for resisting fire from inside (Type B) rated for stability and integrity. Insulation rating is not required in the first compartment.

In all the remaining areas the duct shown must retain stability integrity and insulation fire rating for the same period of time as the compartment through which it passes and this may be required for the remainder of the ductwork route through the building.

In some circumstances insulation requirements may be waived by the Regulatory Authority if there are no combustible materials within 500mm of the duct, such as in the plantroom shown (BS 9999:2008 Ref. W.4)

All fire rated ductwork and penetration seals must be tested to BS 476-24/ISO 6944 by a recognised NAMAS/UKAS accredited laboratory.

Note: Final approval must always be obtained from the Local Building Control Officer/Fire Department prior to commencement of construction.
13. Penetration Seals Between Fire Compartments

Fire stopping must be carried out between compartments. Detailed here are two typical fire rated ductwork stopping’s, as tested to BS 476 Part 24 (1987) and ISO 6944 (1985), with the FLAMEBAR duct system.

**Mineral Wool & Calcium Silicate Board Fire Stopping**

![Mineral Wool & Calcium Silicate Board Fire Stopping](image)

- **FLAMEBAR GFS 1000 Fire Stopping**

![FLAMEBAR GFS 1000 Fire Stopping](image)

It is very important that the fire duct is adequately stiffened within or adjacent to the penetration seal to prevent delaminating of the duct in a fire situation which would compromise the integrity of the fire compartment.
14. Standards

Testing
The range of FLAMEBAR BW11 fire rated ductwork has been tested by the Loss Prevention Council in accordance with BS 476 Part 24 (1987) and ISO 6944 (1985), for vertical and horizontal ductwork, with fire inside and outside the duct, in excess of 4 hours stability and integrity and up to 4 hours insulation, for ventilation ductwork, smoke extract ductwork or kitchen extract ductwork.

FLAMEBAR BW11 fire rated ductwork has also been tested by the Loss Prevention Council in accordance with 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 BW11 fire rated ductwork 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 BW11 fire rated ductwork has also been tested by LUL to BS6853 and satisfied the fire safety code of practice requirements for smoke emission and toxic fume emission.

FLAMEBAR BW11 fire rated ductwork has the USA Underwriters Laboratory UL classification for up to 4 hours fire and smoke ductwork.

FLAMEBAR BW11 has been tested by Underwriters Laboratory in the USA to determine compliance with NFPA 90A (Installation of Air Conditioning and Ventilation Systems) for flame spread and smoke development with the following results:

<table>
<thead>
<tr>
<th>NFPA Stipulation</th>
<th>Flame Spread not to exceed 25</th>
<th>Smoke Development no higher than 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW11 Results</td>
<td>9.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

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

FLAMEBAR BW11 fire rated ductwork has also passed the hose stream test of ASTM - E119 with water pressure of 207Kpa (30 psi) for 21/2 minutes.

Impact Resistance
FLAMEBAR BW11 tested to BS EN 1128, in which there was no penetration, debonding, cracking or other visible failure of the coating on impact. Therefore complying with the failure criteria described for particleboard in the standard.

Flexural Strength
FLAMEBAR BW11 has a flexural strength of 468N/mm².

Moisture Absorption
FLAMEBAR BW11 is not recommended for continuous external exposure without additional protection.

FLAMEBAR BW11 is suitable for occasional exposure to rain.

Durability
FLAMEBAR BW11 fire rated ductwork system coating inspection carried out on May 2009 at the Canary Wharf site (installed in 1997) and Brook Green, Hammersmith, London site (installed in 1995) showed no visual deterioration. Warrington Fire report no. 183681.

Environmental
FLAMEBAR BW11 fire rated ductwork complies with Leadership in Energy and Environmental Design (LEED) objectives to maximise the use of recycled materials and reduce the use of natural resources.

Chemical Resistance
FLAMEBAR BW11 has been tested in standard 10% solutions of the following acids; hydrochloric, nitric & sulphuric

10% solutions of the following alkalises; sodium hydroxide & potassium hydroxide and the following solvents; xylene & acetone.

After 10 days total immersion, all the chemicals failed to cause a breakdown of the product structure.
15. System Advantages

Air Leakage
The construction and sealing of FLAMEBAR BW11 fire rated ductwork systems allows the ductwork to be tested up to high pressure, if required by the clients specification, which has a leakage limit of .0001 x P^{0.65} litres per second per square metre of duct surface area, as laid down by the HVCA specification DW143.

Higher pressures and lower leakage rates can be achieved if required by the client’s specification.

Expansion
As all steel expands with temperature, there will naturally be an expansion of fire ductwork under fire conditions as follows:
- At 1100°C an expansion of 0.01562 mm per mm (0.016 in per in)
- At 600°C an expansion of 0.00852 mm per mm (0.008 in per in)
- At 430°C an expansion of 0.06106 mm per mm (0.006 in per in)

Thermal Properties
‘U’ value - thermal transmittance.
- BW11 without insulation = 5.0 w/m²k (0.88 Btu/ft²°F)
- BW11 with 50mm insulation = 0.833 w/m²k (0.147 Btu/ft²°F)
- BW11 with 100mm insulation = 0.48 w/m²k (0.08 Btu/ft²°F)

Pressure
As FLAMEBAR BW11 is based on a GSS duct construction, it has the advantage of the same friction pressure loss as for normal DW144 ducting and the same calculations can be used.

Shape
FLAMEBAR BW11 fire rated ductwork can be manufactured in rectangular, flat oval or circular form.

Weight
FLAMEBAR BW11 fire rated ductwork is the lightest fire duct system available.

Size
FLAMEBAR BW11 fire rated ductwork 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.

Acoustic Properties
FLAMEBAR BW11 fire rated ductwork achieves a sound reduction index to BS 2750 part 3 (1980) as tabled below:

<table>
<thead>
<tr>
<th>Systems</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1k</th>
<th>2k</th>
<th>4k</th>
<th>8k</th>
<th>dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW11</td>
<td>10.2</td>
<td>11.7</td>
<td>16.7</td>
<td>21.7</td>
<td>27.7</td>
<td>32.7</td>
<td>37.7</td>
<td>43.7</td>
<td>dB</td>
</tr>
<tr>
<td>BW11 + 60kg/m³, 50mm Insulation</td>
<td>11.0</td>
<td>12.5</td>
<td>17.5</td>
<td>22.5</td>
<td>28.5</td>
<td>33.5</td>
<td>38.5</td>
<td>44.5</td>
<td>dB</td>
</tr>
<tr>
<td>BW11 + 105kg/m³, 50mm Insulation</td>
<td>13.4</td>
<td>14.9</td>
<td>19.9</td>
<td>24.9</td>
<td>30.9</td>
<td>35.9</td>
<td>40.9</td>
<td>46.9</td>
<td>dB</td>
</tr>
</tbody>
</table>

Single Source Responsibility
1. The design of all FLAMEBAR BW11 systems is to a certified standard.
2. All FLAMEBAR BW11 fire rated ductwork is manufactured and sprayed to QA ISO 9001 standard.
3. All FLAMEBAR BW11 fire rated ductwork is installed by approved licensees.
4. A certificate of conformity is issued following final inspection, certifying compliance with all necessary regulations.

Cleaning
The smooth internal finish of FLAMEBAR BW11 systems enable easy cleaning of the ductwork therefore it is ideal for kitchen extract duct installations.
**FLAMEBAR** BW11 Fire Rated Ductwork Systems are protected by design right.