<table>
<thead>
<tr>
<th>Trade of Sheet Metalwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 5: Ductwork</td>
</tr>
<tr>
<td>Unit 1: Cylinder with Damper, Square &amp; Rectangular Duct</td>
</tr>
<tr>
<td>Phase 2</td>
</tr>
</tbody>
</table>
Table of Contents

List of Figures .................................................................................................................... 6
List of Tables ..................................................................................................................... 7
Document Release History ............................................................................................... 8

Module 5 – Ductwork ....................................................................................................... 9
  Unit 1 – Cylinder with Damper, Square & Rectangular Duct ........................................ 9
    Learning Outcome: .................................................................................................... 9
    Key Learning Points: ............................................................................................... 9
    Training Resources: ............................................................................................... 10
    Key Learning Points Code: .................................................................................... 10

Lockform Machine .......................................................................................................... 12
  Cross-Sectional Type ................................................................................................. 12
  Longitudinal Joints/Seams ......................................................................................... 17

Ductwork ......................................................................................................................... 21
  Standing Seam ............................................................................................................ 21
  Dovetail Seam ........................................................................................................... 22
  Slip Joints .................................................................................................................. 23
  “C” Cleats .................................................................................................................. 23
  “S” Cleats .................................................................................................................. 24
  Peened Joint .............................................................................................................. 24
  Allowance for Peened Joint ....................................................................................... 25
  Abbreviations used in Ductwork ............................................................................... 26
  DW/144 ....................................................................................................................... 26
  Dampers ..................................................................................................................... 26
  Noise ......................................................................................................................... 26

Regulating Dampers ....................................................................................................... 27
  General ....................................................................................................................... 27
    Balancing Damper ................................................................................................. 27
    Control Damper ..................................................................................................... 27
  Types of Airflow Control Damper ............................................................................. 27
    Single-Blade Dampers (Single or Double Skin) ...................................................... 27
    Multi-Blade Dampers (Single or Double Skin) Parallel or Opposed Blade .......... 28
    Iris Dampers .......................................................................................................... 28
    Backdraft Dampers ............................................................................................... 28
    Hit and Miss Dampers ......................................................................................... 28
    Slide and Blast Gate Dampers .............................................................................. 28
  Construction ............................................................................................................. 29
    Materials ................................................................................................................ 29
Dampers used in Low and Medium Pressure Systems ............................................. 29
Dampers used in High Pressure Systems ............................................................... 29
Proprietary Types of Damper ............................................................................... 29
Damper Casings .................................................................................................... 30
Installation ............................................................................................................ 30

Fire Dampers .......................................................................................................... 31
General .................................................................................................................... 31
Types of Fire Dampers .......................................................................................... 31
  Folding Curtain ................................................................................................... 31
  Single Blade ........................................................................................................ 31
  Multi-Blade ........................................................................................................ 32
  Intumescent ...................................................................................................... 32
Materials and Construction .................................................................................. 33
Air Leakage ............................................................................................................ 33
Location ................................................................................................................... 33
Provision for Expansion ........................................................................................ 33
Installation ............................................................................................................ 33

Smoke Dampers .................................................................................................... 34
General .................................................................................................................... 34
Types of Smoke Damper ......................................................................................... 34
  Single Blade ........................................................................................................ 34
  Multi-Blade ........................................................................................................ 34
Materials and Construction .................................................................................. 34
Air Leakage ............................................................................................................ 34
Installation ............................................................................................................ 34

Combination Smoke and Fire Dampers ............................................................... 35
General .................................................................................................................... 35
Types of Combination Smoke and Fire Damper .................................................... 35
  Single Blade ........................................................................................................ 35
  Multi-Blade ........................................................................................................ 35
Materials and Construction .................................................................................. 36
Air Leakage ............................................................................................................ 36
Installation ............................................................................................................ 36

Internal Duct Linings ............................................................................................ 37
General .................................................................................................................... 37
Lining Application Considerations ......................................................................... 37
Circular Ducts ......................................................................................................... 37
Cleaning and Maintenance .................................................................................... 37

Thermal Insulation ................................................................................................. 38
List of Figures

Figure 1 - Round Duct with Damper ................................................................. 11
Figure 2 - Angle and Band Iron Edge ............................................................... 12
Figure 3 - Forming a Dovetail Seam ............................................................... 13
Figure 4 - Standing Seam ............................................................................... 13
Figure 5 - Steps in Making a Hand Seam ......................................................... 14
Figure 6 - Steps in Forming a Government Clip ............................................. 14
Figure 7 - Making a Double Seam ................................................................. 14
Figure 8 - Steps in Making a Bottom Double Seam ....................................... 14
Figure 9 - S and Drive Clips used to Join Duct Sections ............................... 15
Figure 10 - S Clips used to Join Sheet Metal Pieces Covering a Wall............. 16
Figure 11 - Steps in Assembling a Drive Clip Seam ....................................... 16
Figure 12 - Pittsburgh Seams can be Formed on Curves ............................... 17
Figure 13 - Slip Joint Seam ........................................................................... 17
Figure 14 - Proper and Improper Joining of Slip Joint Seams ....................... 18
Figure 15 - Steps in forming the Pittsburgh Lock .......................................... 18
Figure 16 - Common Seams used in Sheet Metal Work ............................... 19
Figure 17 - Steps in Forming a Grooved Seam .............................................. 20
Figure 18 - Steps in Forming the Pittsburgh Seam ......................................... 20
Figure 19 - Lockform Joint .......................................................................... 21
Figure 20 - Standing Seam............................................................................ 21
Figure 21 - Dovetail Seam ............................................................................ 22
Figure 22 - Slip Joints .................................................................................. 23
Figure 23 - “C” Cleat ................................................................................... 23
Figure 24 - "S" Cleats .................................................................................. 24
Figure 25 - Joggled Lap Seam ...................................................................... 24
Figure 26 - Corner Seam with Lap on the Outside ...................................... 25
Figure 27 - 6mm Paned-Down Joint ............................................................. 25
Figure 28 – Allowance for Peened Joint ....................................................... 25
Figure 29 – Alternative Provision for Expansion ......................................... 32
List of Tables

Table 1 - Standard Component Drawings – Rectangular ............................................... 41
Table 2 - Standard Abbreviations .................................................................................. 43
## Document Release History

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/01/07</td>
<td>First draft</td>
<td></td>
</tr>
<tr>
<td>09/04/14</td>
<td>2.0</td>
<td>SOLAS transfer</td>
</tr>
</tbody>
</table>
Module 5 – Ductwork

Unit 1 – Cylinder with Damper, Square & Rectangular Duct

Duration – 21 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Read and interpret HVAC drawings
- Sketch ductwork
- Use the lockform machine
- Produce and fabricate a cylinder with slip joint (big end and small end) and double seam joint (machine joint)
- Produce and fabricate a rectangular duct with cross breaking and propriety flanges
- Produce and fabricate a square duct with damper and use ‘S' and 'C' cleats

Key Learning Points:

<table>
<thead>
<tr>
<th>Rk</th>
<th>Set, use and operation of lockform machine.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rk</td>
<td>Design and position of joints on ductwork and fittings.</td>
</tr>
<tr>
<td>Rk Sk</td>
<td>Marking-out/fabrication techniques.</td>
</tr>
<tr>
<td>Rk Sk</td>
<td>Tacking and closing procedure of joints on ductwork.</td>
</tr>
<tr>
<td>Rk</td>
<td>Damper types and fitting arrangements.</td>
</tr>
<tr>
<td>Rk</td>
<td>(DW144) Ductwork specifications and standards.</td>
</tr>
<tr>
<td>Rk D</td>
<td>Layout of HVAC drawings, abbreviations, use of scale rule, sketching.</td>
</tr>
<tr>
<td>Rk Sk</td>
<td>Ductwork design and quality.</td>
</tr>
<tr>
<td>Rk</td>
<td>Design and use of cleats.</td>
</tr>
<tr>
<td>M</td>
<td>Calculate allowance for double seam and lockform joints and area/weight of metal in ductwork.</td>
</tr>
<tr>
<td>Sc</td>
<td>Work, energy, power and friction, density/specific gravity.</td>
</tr>
</tbody>
</table>
Training Resources:

- Toolkit
- 0.6mm galvanised steel
- DW 143, DW/TM2. TR.7
- DW 144. DW.171.BS 5970:2001
- Workshop drawings
- Live example
- Scale rule. (metric, imperial)
- Refer to reference library
- Safety equipment and protective clothing
- Tools and machinery/equipment

Key Learning Points Code:

M = Maths  D = Drawing  RK = Related Knowledge  Sc = Science
P = Personal Skills  Sk = Skill  H = Hazards
Figure 1 - Round Duct with Damper
Lockform Machine

The allowance for the lockform machine is usually 25mm for a small one and 35mm for the bigger one. There is also a small edge ranging in size from 6mm to 10mm which slots into the larger end. Some machines with age may deviate from the manufacturer’s recommended allowance so trial and error may apply. Sharp edges need to be handled safely when using these machines. Gloves are needed.

Cross-Sectional Type

1. Flanging: Mez type and ordinary angle (iron)

2. Slip joints normally 25mm – 50mm in size

3. S and C cleats

4. Hand seams

5. Flexible joints; here improvement may happen as at the fan connected to the duct.

6. Angle iron edge, band iron edge

![Figure 2 - Angle and Band Iron Edge](image-url)
Some joints may fall into both categories of joint, i.e. cross-sectional and longitudinal.
Figure 5 - Steps in Making a Hand Seam

Figure 6 - Steps in Forming a Government Clip

Figure 7 - Making a Double Seam
Figure 8 - Steps in Making a Bottom Double Seam

Figure 9 - S and Drive Clips used to Join Duct Sections
Figure 10 - S Clips used to Join Sheet Metal Pieces Covering a Wall

Figure 11 - Steps in Assembling a Drive Clip Seam
**Longitudinal Joints/Seams**

The most important thing about a joint is it does not leak. Whichever joint is used it may have to be sealed by a gasket or a sealant like mastic or even soldered. Strength and durability are also very important. It is therefore advisable to be familiar with the specifications for the job. The apprentice should have some knowledge of the manual DW/144 and have a copy at his disposal for the reasons just stated.

---

**Figure 12 - Pittsburgh Seams can be Formed on Curves**

**Figure 13 - Slip Joint Seam**
Figure 14 - Proper and Improper Joining of Slip Joint Seams

Figure 15 - Steps in forming the Pittsburgh Lock
Figure 16 – Common Seams used in Sheet Metal Work
The Pittsburgh lock is also known as the lockform and the grooved joint/seam as the double edged joint seam.

These two seams are the more popular of the above seams. The following pages have more detail for the more commonly used joints in ductwork.
Ductwork

For ducting the most common joint is the lockform. The allowance for this varies with the machine - 35mm and 25mm are common. The lockform is a longitudinal seam as is a groove joint. The lockform or Pittsburgh lock is always positioned on a corner. Groove seams are rarely used in metal heavier than 20 gauge.

![Figure 19 - Lockform Joint](image19)

Standing Seam

Standing seams are used on large site ducting and of sheets of metal to connect and stiffen the metal. This joint eliminates the need for angle iron reinforcement.

The seam comes in various sizes and is secured with rivets or bolts at intervals.

![Figure 20 - Standing Seam](image20)
Dovetail Seam

A dovetail seam is used to connect a round pipe to a square or rectangular duct. In construction it consists of a series of tabs cut into the end of the pipe, with every other tab bent out at a 90° angle. The usual size for these cuts is about 3/8” wide and 3/8” deep. The size of these tabs will vary with the size of the pipe.

![Dovetail Seam Diagram]

**Figure 21 - Dovetail Seam**

In the erection of ductwork, cross seam connections take the following form:

1. Slip joints (solid or "pop" riveted).
2. Angle iron flanges (bolted) and mez flanging.
3. S & C cleats (commonly known as S & Drive cleats) and where extra strength is required.
4. Standing "S" cleats (used with drive cleats) and where extra strength is required.
5. Government/cut clip (not widely used in this country but very popular in the USA).

The type of connector used is determined by the size of the duct, strength required, and the type of application. The more popular types used in this country are items 1, 2, and 3 above, but a lot depends on the specification for a particular contract.
Slip Joints

The usual allowance for slip joints are 25mm, 38mm or 50mm. Slip joints are a popular way of joining square or cylindrical ducting. On cylindrical ducting the end of the pipe is usually swaged about 1½" to 2" away from the end. It is then crimped (reduced) to sit into the end of the next section of ducting. Another way to do it is to make one end of the pipe or duct smaller in diameter than the other end. On square or rectangular ducting, the end of the duct is notched on the corners to allow it to slip into the end of the next section of ducting. It is then sealed and riveted. Slip joints are usually used on small size square or rectangular ducting.

“C” Cleats

"C" Cleat (or drive cleat as it is known). This cleat is generally used in connection with S cleats for connecting cross seams on ducts. It is generally used on the short side of the duct.
“S” Cleats

"S" Cleats are used in conjunction with "C" or drive cleats on the cross seams of ductwork. You may have a plain "S" cleat, hemmed "S" cleat, or the standing "S" cleat where extra strength is required.

Peened Joint

Peened joint is also known as paned joint. The paned or peened joint is used as a simple means of attaching a bottom to an article of cylindrical or conical shape, and it can also be used to secure the segments together in a lobster back bend. The allowance for this joint can very slightly from craftsman to craftsman.
Allowance for Peened Joint

A general method would be to leave a single edge on one side of the pattern (this would be the size of the peened joint) and on the other of the pattern leave a double edge (this would be twice the size of the peened joint). On making the paned joint, the thickness of material will have to be taken into consideration to finish the joint properly.
Abbreviations used in Ductwork

AF = Airflow  
VCD = Volume Control Damper  
CFM = Cubic feet per minute  
F.P.M. = Feed per minute  
TA = To above  
FD = Fire Damper  
HVAC = Heating, Ventilation Air Conditioning  
AHU = Air Handling Unit  
DIA = Diameter  
I.D. = Inside Diameter

DW/144

Ductwork/144 the name given to the design specifications approved by the Heating & Ventilation Association. It makes reference to bend radii, rivet spacings, cross checks on ducts and what size mez flange is required. Its idea is to raise quality and have a standard which no contractor should fall below.

Dampers

There are three types to be aware of:

1. Fire damper, which closes if the temperature rises too high. The reason for this high temperature may be a fire. The idea is to prevent air (oxygen) feeding the fire;
2. Volume control damper, which may be closed partially or fully by mechanical means to reduce or stop air flow;
3. Smoke damper, which restricts the speed of smoke.

Noise

To reduce noise in duct systems a flexible connection may be used when connecting fans to the duct. Baffles, which reduce noise, may also be fitted. The inside of the duct may also be lagged which will help insulation as well as noise reduction. Sharp bends should not be in the system. If they already are, their turning vanes should be installed to reduce noise.

The following pages refer to the DW/144 standards concerning dampers and they also give examples of component drawings and abbreviations.
Regulating Dampers

General

Balancing dampers and control dampers are elements inserted into an air distribution system, or elements of an air distribution system. Balancing dampers permit modification of the air resistance of the system and consequently changing of the airflow rate. Control dampers control the airflow rate and in addition provide low leakage closure of the airflow.

The designer shall specify damper locations and select the damper type, as defined in “Types of Airflow Control Damper” below, appropriate to the airflow, pressure and acoustic characteristics.

Balancing Damper

To achieve the required distribution of air in the ductwork system at inlets and/or outlets. For this purpose, the damper blades are set and locked manually in any required position between fully open and fully closed.

Control Damper

To secure dynamic control of the air flow in the ductwork system. In this function, the damper will always be power - actuated and may require to be modulated between fully open and fully closed, and to be capable of taking up any position between these extremes. In the fully open position, the damper should have a minimum pressure drop. In the fully closed position, it will not necessarily achieve a complete shut off.

Types of Airflow Control Damper

Air flow dampers of various types are available for specific purposes as follows.

Single-Blade Dampers (Single or Double Skin)

Single-blade dampers shall consist of a single pivoted blade contained within a casing or section of ductwork. The blade shall be adjustable through a nominal 90° angle by means of a quadrant or similar operating mechanism. Where automatic control of the damper is required the spindle shall be extended to enable a powered actuator to be mounted.

Single-blade dampers (single-skin section) shall have a maximum duct width of 300 mm and a maximum duct height of 300 mm for rectangular ducts; and for circular ducts a maximum diameter of 315 mm.

Single-blade dampers (double-skin section) are suitable for use in rectangular ducts, and shall have a maximum duct width of 1250 mm and a maximum height of 300 mm.
Multi-Blade Dampers (Single or Double Skin) Parallel or Opposed Blade

Multi-blade dampers shall consist of a number of pivoted blades contained within a casing. The blades shall be adjustable through a nominal 90° angle simultaneously by interconnected linkage or gears, connected to a quadrant or similar operating mechanism. Where automatic control of the damper is required a spindle shall be extended to enable a powered actuator to be mounted.

There is no restriction on the size of duct in which multi-blade dampers or damper assemblies may be used. Where dampers are required for blade lengths in excess of 1250 mm, the blades should be suitably reinforced or supported. No individual damper blade should exceed 200 mm in width.

Iris Dampers

Iris dampers shall consist of a number of radially inter-connected blades which open or close within a casing with duct connection spigots. The blades shall be simultaneously adjusted by a quadrant or similar operating mechanism.

Iris dampers should be installed as specified by the manufacturer's operating and installation instructions, where the product is unidirectional with regard to airflow.

Iris dampers are available for circular ducts only, in diameters up to 800 mm (It should be noted that the damper casing is approximately twice the diameter of the duct).

Backdraft Dampers

Air pressure operated unidirectional rectangular (single or multi-blade) with adaptors if fitted to circular or oval ducts.

Hit and Miss Dampers

Two parallel adjacent plates each with multiple openings sliding against each other. The openings are designed to provide 50% air volume flow rates when they fully coincide. Used for simple operations up to 400 mm longest side.

Slide and Blast Gate Dampers

A damper used as a shut off facility, normally for use in circular ductwork with an external slide housing allowing a blade to be fully inserted to fully extended for maximum air flow.

Generally available in cast/pressed formats up to 355 mm diameter and normally used in industrial exhaust applications.
Construction

Materials

Dampers shall be constructed from steel, stainless steel, aluminium or synthetic materials.

All products should be protected against corrosion as necessary and supplied in a fully finished condition as specified by the designer.

Dampers used in Low and Medium Pressure Systems

The following recommendations apply to dampers forming an integral part of ductwork with pressure classification A and B air leakage limits.

The dampers shall be constructed to prevent distortion and jamming in operation. The blades shall be sufficiently rigid to minimise movement when in the locked position.

The blades shall be securely fixed to the operating mechanism. Spindles shall be carried in either non-ferrous, synthetic or roller bearings. All balancing dampers shall have a locking device located on the outside of the case and shall give clear indication of the actual blade position. All penetrations of the duct shall be fitted with suitable seals where necessary.

Dampers used in High Pressure Systems

Regulating dampers used in ductwork systems to pressure classification C shall meet the construction requirements specified in “Materials” and “Dampers used in Low and Medium Pressure Systems” above with operating mechanisms out of the airstream.

Proprietary Types of Damper

The use of any specific type of proprietary damper shall be confirmed by the designer. In all cases, proprietary dampers shall meet the relevant requirements of this specification.
Damper Casings

Duct damper casings shall be constructed to meet the minimum leakage limits specified for the ductwork system to which they are installed.

In order to apply the square meterage leakage calculation as detailed in DW/143 *A practical guide to Ductwork Leakage Testing*, the reference casing area shall be taken as the perimeter size of the damper multiplied by the equivalent length of one metre, for example an 800 mm x 400 mm duct damper shall have a surface area for casing leakage performance calculated as follows; \[ (2 \times 0.8) + (2 \times 0.4) ] \times 1 = 2.4 \text{m}^2 \text{ casing area.} \]

Other performance and rating test methods for dampers and valves are specified in IS05129 and BS/EN1751, and are referenced below:

a) Leakage past a closed damper or valve  
   BS/EN 1751

b) Flow rate/pressure requirement characteristics  
   BS/EN 1751

c) Operational torque testing  
   BS/EN 1751

d) Thermal transfer testing  
   BS/EN 1751

e) Regenerated sound power levels  
   ISO 5129

Installation

Dampers shall be installed in accordance with any relevant ISO, EN or British Standard, local building regulations and national codes of practice as well as the manufacturer's recommendations.
Fire Dampers

General

Dampers are required in air distribution systems for fire containment. Generally they are called for where ducts penetrate walls or floors which form fire compartmentation. The damper assembly should have a fire resistance rating equal to that of the fire barrier it penetrates and shall be fire tested and rated to the time/temperature curve of BS476 part 20 and 22.

Types of Fire Dampers

Fire dampers of various types are available for specific purposes, as follows:

Folding Curtain

Folding curtain fire dampers shall be constructed of a series of interlocking blades which fold to the top of the assembly permitting the maximum free area in the airway. The blades shall be held in the open position by means of a thermal release mechanism rated at 72°C ± 4°C.

The fire damper must be able to close against static air conditions when mounted in either the vertical or horizontal planes.

In the event of a signal from a remote sensor the fire damper blades shall be released and close the airway. A local excess temperature in the area of the fire damper shall, independent of any remote sensors, automatically release the blades and close the airway by means of the thermal release mechanism, electric solenoid or electromagnet.

Single Blade

Single blade fire dampers shall consist of a single pivoted blade within a fire resistant case.

The blade shall be released from its open position by means of a thermal release mechanism rated at 72°C ± 4°C, electric solenoid, electromagnet(s) or other device.

The blade shall close the airway by means of anyone, or combination of, an eccentric pivot, balance weight(s) and/or spring(s), the spring element being incorporated within the damper or actuator mechanism.

The fire damper shall be able to operate in either or both the vertical and horizontal planes.
Multi-Blade

Multi-blade fire dampers shall consist of a number of linked blades contained within a fire resistant case.

The blades shall be released from their open position by means of either a thermal release mechanism rated at 72°C ± 4°C, or by the force applied from electrical solenoid(s), electromagnet(s), electrical/pneumatic actuator or other device.

![Multi-Blade Diagram]

The blades shall close the airway by means of a spring(s), the spring element being incorporated within the damper or actuator mechanism.

The fire damper shall be able to operate in either or both the vertical and horizontal planes.

Intumescent

Intumescent fire dampers shall be constructed from strips of intumescent material formed into a lattice or from honeycomb material covered with intumescent paint. The damper shall fully seal when heat or flame is applied from either side. Note these devices are generally used in door/partition low velocity applications.
Materials and Construction

The damper shall be constructed from steel or stainless steel or other approved material. Steel products shall be protected against corrosion and supplied in a fully assembled condition as specified by the designer.

Air Leakage

Fire damper casings shall meet the equivalent leakage performance standard specified for the ductwork system to which they are installed.

Classes A, B and C are used to signify the leakage performance of the damper casing with the respective testing method illustrated and specified in BS/EN1751.

In order to apply the square meterage leakage calculation as detailed in the standard, the reference casing area shall be taken as the perimeter size of the damper multiplied by an equivalent length of one metre, for example an 800 mm x 400 mm duct damper shall have a surface area for casing leakage performance calculated as follows: 

\[(2 \times 0.8) + (2 \times 0.4)\] x 1 = 2.4m² casing area.

Location

The effective formed barrier of the damper assembly shall be located within the structural opening. Where this is not possible the section of the casing outside a fire barrier must have a fire resistance not less than that of the fire barrier and be adequately supported/protected against the possibility of displacement/damage by impact.

Provision for Expansion

Damper assemblies generally include built-in clearance frames to meet the requirement that the casing be free to expand in the event of fire. The integrity of the fire barrier is maintained either by metal to metal contact or by fire resistant packing. Acceptable arrangements are shown in Figure 29.

Installation

Damper installation shall be in accordance with the manufacturer's recommendations and the impending HVCA Publication DW/TM3 - Guide to Good Practice, for the design for the installation of Fire and Smoke Dampers and any conflict between the two should be resolved and authorised by the designer responsible for the fire damper selection.
Smoke Dampers

General

Smoke dampers shall be constructed in such a manner as to restrict the spread of smoke and other products of combustion from one occupied space to another. The blade(s) shall overlap each other and/or include edge seals. The blade(s) shall be arranged to minimise the leakage of smoke. If degradable seals are fitted, care should be taken to establish the temperature range of the material used to ensure performance compatibility. The smoke damper shall be able to operate in either or both the vertical and horizontal planes and close against dynamic air conditions.

Types of Smoke Damper

Smoke dampers of various types are available for specific purposes, as follows:

Single Blade

Single blade dampers shall consist of a blade of smoke tight material held in either the open or closed position by a mechanical linkage releasing to close or open and seal against the damper case. The blade shall be mechanically connected to the actuator (electric or pneumatic) and shall be triggered by interfacing with a smoke detector or fire control panel.

Multi-Blade

Multi blade dampers shall consist of blades of smoke tight material including the blade to blade seals, where fitted. The blades shall be mechanically linked to an actuator (electrical or pneumatic) to hold the blades in either the open or closed position. The actuator shall interface with a smoke detector or fire control panel and shall be so designed as to hold the blades close against the smoke seals, where fitted.

Materials and Construction

The damper shall be constructed from steel, stainless steel, other material or composite material with blades fitted to reduce the leakage of smoke and hot gases when the blades are in the closed position. Steel products shall be protected against corrosion and assembled in a fully finished condition as specified by the designer, in some circumstances controls may be supplied separately.

Air Leakage

Smoke damper casings shall be as in “Air Leakage”.

Installation

Damper installation shall be as in “Provision for Expansion” and “Installation”.
Combination Smoke and Fire Dampers

General

Combination smoke and fire dampers are required in air distribution systems to prevent the spread of smoke and hot gases from the fire zone and to maintain the integrity of a fire rated structure for a period compatible with that of the separating structure. They shall be tested and rated to BS476 Part 20 and 22. Reference maybe made to BS5588 Part 4 for specific smoke rating requirements.

The closure of the fire damper under action of the thermal release element shall override all other subsequent signals.

Types of Combination Smoke and Fire Damper

Combination smoke and fire dampers of various types are available for specific purposes, as follows:

Single Blade

Single blade combination smoke and fire dampers shall consist of a single pivoted blade contained within a fire resistant case.

The blade shall be released from its open position by means of either a thermal release mechanism rated at 72°C ± 4°C, or in addition operated by the force applied from electrical solenoid(s), electro-magnet(s), electrical/pneumatic actuator or other device.

The combination smoke and fire damper shall be able to operate in either or both the vertical and horizontal planes and close against dynamic air conditions.

Multi-Blade

Multi-blade combination smoke and fire dampers shall consist of a series of blades mechanically linked and connected to a damper actuator with manual, electric or pneumatic opening and spring loaded closure contained within a fire resistant case.

The blades shall be released from their open position by means of either a thermal release mechanism rated at 72°C ± 4°C, or in addition operated by the force applied from electrical solenoid(s), electro-magnet(s), electrical/pneumatic actuator or other device.

The combination smoke and fire damper shall be able to operate in either or both the vertical and horizontal planes and close against dynamic air conditions.
Materials and Construction

The combination smoke and fire damper case shall be constructed from steel, stainless steel, other material or composite material with compressible side seals fitted between the blade ends and the casing to reduce the leakage of hot gases when the blades are in the closed position.

Steel products shall be protected against corrosion and supplied in a fully finished condition as specified by the designer.

Air Leakage

Damper casings shall be as in “Air Leakage”.

Installation

Damper installation shall be as in “Provision for Expansion” and “Installation”.
Internal Duct Linings

General

Where an acoustic or thermal lining to ductwork is specified it should preferably be fitted at works. Before duct manufacture it should be clarified that specified external duct dimensions allow for the lining thickness. Any form of lining should have fire characteristics having minimum Class 0 rating and must be specified by the Designer for material type thickness, and application method.

Lining Application Considerations

Prior to the application of any lining the internal duct surface must be thoroughly cleaned to provide a dust free dry surface which may additionally be degreased.

Securing the lining to the internal duct surface can be achieved in several ways including applied adhesive, self adhesive and physical methods such as fasteners in conjunction with surface washers at a specified square pitch.

Adjacent sections of lining should abut with minimal gap and integral or separate surface finish lap to such joints and or gap filling proprietary products being applied. This procedure is to obviate any particle migration.

During application and any curing, consideration should be given to ambient temperature and humidity requirements.

In all circumstances linings should be fitted to material manufacturer's recommended methods.

Circular Ducts

Lining circular ducts is impractical and is not recommended.

Cleaning and Maintenance

Designers should be aware of the possible porous/fibrous surface nature of linings as they may present practical/hazardous problems in cleaning and maintenance. Reference in this respect should be made to the following HVCA Publications:

i. DW/TM2 Guide to Good Practice, Internal Cleanliness of New Ductwork Installations.

ii. TR17 Guide to Good Practice, Cleanliness of Ventilation Systems.
Thermal Insulation

The provision and application of thermal insulation to ductwork is not normally the responsibility of the ductwork contractor.

Where ductwork is required to be pre-insulated, the specification should be agreed with the designer.

Where the temperature of the air within the duct is at any time low enough to promote condensation on the exterior surface of the duct and cause moisture penetration through the thermal insulation, vapour sealing may be called for, and in this case the most important requirement is to limit, penetration of the seal.

The extent of any vapour sealing of ductwork thermal insulation and the support method to be used must be clearly specified in advance by the designer.

Standard Component Drawings and Abbreviations

The illustrations in this section not only highlight, where applicable, geometric limitations for the design and manufacture of ductwork components but also recommend standard drawing representation, terminology and abbreviations for both ductwork components and some of the more commonly used ancillary/plant items.

Designers and surveyors should note that bills of quantities should provide a full description.
<table>
<thead>
<tr>
<th>FIG</th>
<th>DRAWING</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td><img src="image" alt="Straight Duct" /></td>
<td><strong>Straight Duct</strong> with slip joints for ducts up to 400 mm longest size</td>
</tr>
</tbody>
</table>
| 82  | ![Straight Duct](image) | **Straight Duct** with stiffened slip joints  
N.B. Depending upon duct size additional stiffeners may be required |
| 83  | ![Straight Duct](image) | **Straight Duct** with integral or slide-on flanges  
N.B. Additional stiffeners may be required |
| 84  | ![Straight Duct](image) | **Straight Duct** with RSA flanges  
N.B. Additional stiffeners may be required |
| 85  | ![Mitred Throat Bend](image) | **Mitred Throat Bend**  
For ducts up to 400 mm wide |
| 86  | ![Short Radius Bend](image) | **Short Radius Bend**  
Applies to any angle and for ducts up to 400 mm wide  
Minimum throat radius = 100 mm |
| 87  | ![Medium Radius Bend](image) | **Medium Radius Bend** (as illustrated)  
Applies to any angle  
**Long Radius Bend**  
Similar but radius = W  
Applies to any angle |
| 88  | ![Short Radius Bend](image) | **Short Radius Bend** with splitters  
Minimum throat radius = 100 mm  
|  |

<table>
<thead>
<tr>
<th>&quot;W&quot; - mm</th>
<th>Spliners</th>
<th>Spliter Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>400–800</td>
<td>1</td>
<td>W/3</td>
</tr>
<tr>
<td>801–1600</td>
<td>2</td>
<td>W/4 W/2</td>
</tr>
<tr>
<td>1601–2000</td>
<td>3</td>
<td>W/8 W/3 W/2</td>
</tr>
</tbody>
</table>

Splitters not required in bend angles less than 45°
<table>
<thead>
<tr>
<th>FIG</th>
<th>DRAWING</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td><img src="image" alt="Square Bend" /></td>
<td>Square Bend with turning vanes</td>
</tr>
<tr>
<td>90</td>
<td><img src="image" alt="Radius Tee" /></td>
<td>Radius Tee with internal splitters</td>
</tr>
<tr>
<td>91</td>
<td><img src="image" alt="Radiussed Twin Bend" /></td>
<td>Radiussed Twin Bend</td>
</tr>
<tr>
<td>92</td>
<td><img src="image" alt="Swept Branch" /></td>
<td>Swept Branch</td>
</tr>
<tr>
<td>93</td>
<td><img src="image" alt="Square Tee" /></td>
<td>Square Tee with Turning Vanes</td>
</tr>
<tr>
<td>94</td>
<td><img src="image" alt="Breeches Piece" /></td>
<td>Breeches Piece</td>
</tr>
<tr>
<td>FIG</td>
<td>DRAWING</td>
<td>DETAILS</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| 109 | ![Telescopic Joint](image) | Telescopic Joint
Illustrated with SMF – self metal flange |
| 110 | ![Single Bladed Damper](image) | Single Bladed Damper |
| 111 | ![Non-Return Damper](image) | Non-Return Damper |
| 112 | ![Multi-Leaf Damper](image) | Multi-Leaf Damper
Can be spiggoted or flanged, opposed or parallel blade

Alternative controls are:-

- Hand
- Motorised
- Pneumatic |
| 113 | ![Blast Gate Damper](image) | Blast Gate Damper |
| 114 | ![Fire/Smoke Dampers](image) | Fire/Smoke Dampers
2hr. Rating
With installation frame
4hr. Rating
Smoke damper |

Table 1 - Standard Component Drawings – Rectangular
<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>FULL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD</td>
<td>Access Door</td>
</tr>
<tr>
<td>AFF</td>
<td>Axial Flow Fan</td>
</tr>
<tr>
<td>AHU</td>
<td>Air Handling Unit</td>
</tr>
<tr>
<td>ALI</td>
<td>Aluminium</td>
</tr>
<tr>
<td>AP</td>
<td>Access Panel</td>
</tr>
<tr>
<td>ATT</td>
<td>Attenuator</td>
</tr>
<tr>
<td>ATU</td>
<td>Air Terminal Unit</td>
</tr>
<tr>
<td>BE</td>
<td>Blank End</td>
</tr>
<tr>
<td>BG</td>
<td>Blast Gate Damper</td>
</tr>
<tr>
<td>CC</td>
<td>Cooling Coil</td>
</tr>
<tr>
<td>CF</td>
<td>Centrifugal Fan</td>
</tr>
<tr>
<td>CTA</td>
<td>Cross Talk Attenuator</td>
</tr>
<tr>
<td>CVU</td>
<td>Constant Volume Unit</td>
</tr>
<tr>
<td>DP</td>
<td>Drain Point</td>
</tr>
<tr>
<td>EHC</td>
<td>Electric Heating Coil</td>
</tr>
<tr>
<td>FAI</td>
<td>Fresh Air Inlet</td>
</tr>
<tr>
<td>FA</td>
<td>From Above</td>
</tr>
<tr>
<td>FB</td>
<td>From Below</td>
</tr>
<tr>
<td>Flex/C</td>
<td>Flexible Connection</td>
</tr>
<tr>
<td>Flex/D</td>
<td>Flexible Duct</td>
</tr>
<tr>
<td>FC</td>
<td>False Ceiling</td>
</tr>
<tr>
<td>FCU</td>
<td>Fan Coil Unit</td>
</tr>
<tr>
<td>FD</td>
<td>Fire Damper</td>
</tr>
<tr>
<td>FFL</td>
<td>Finished Floor Level</td>
</tr>
<tr>
<td>FJ</td>
<td>Flanged Joint</td>
</tr>
<tr>
<td>FOB</td>
<td>Flat on Bottom</td>
</tr>
<tr>
<td>FOT</td>
<td>Flat on Top</td>
</tr>
<tr>
<td>FRP</td>
<td>Fire Retardent Polypropylene</td>
</tr>
<tr>
<td>GAM</td>
<td>Galvanised after Manufacture</td>
</tr>
<tr>
<td>GRP</td>
<td>Glass Reinforced Plastic</td>
</tr>
<tr>
<td>GSS</td>
<td>Galvanised Sheet Steel</td>
</tr>
<tr>
<td>HC</td>
<td>Heating Coil</td>
</tr>
<tr>
<td>HD</td>
<td>Hand controlled Damper</td>
</tr>
<tr>
<td>HH</td>
<td>Hand Hole</td>
</tr>
<tr>
<td>HL</td>
<td>High Level</td>
</tr>
<tr>
<td>IC</td>
<td>Inspection Cover</td>
</tr>
<tr>
<td>ID</td>
<td>Iris Damper</td>
</tr>
<tr>
<td>IU</td>
<td>Induction Unit</td>
</tr>
<tr>
<td>LL</td>
<td>Low Level</td>
</tr>
<tr>
<td>MD</td>
<td>Motor controlled Damper</td>
</tr>
<tr>
<td>MS</td>
<td>Mild Steel</td>
</tr>
<tr>
<td>NRD</td>
<td>Non Return Damper</td>
</tr>
<tr>
<td>ABBREVIATION</td>
<td>FULL</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>NTS</td>
<td>Not to Scale</td>
</tr>
<tr>
<td>OBD</td>
<td>Opposed Blade Damper</td>
</tr>
<tr>
<td>OE</td>
<td>Open End</td>
</tr>
<tr>
<td>PBD</td>
<td>Parallel Blade Damper</td>
</tr>
<tr>
<td>PD</td>
<td>Pneumatic controlled Damper</td>
</tr>
<tr>
<td>PP</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>PRD</td>
<td>Pressure Relief Damper</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>RFC</td>
<td>Rolled Form Channel</td>
</tr>
<tr>
<td>RSC</td>
<td>Rolled Steel Channel</td>
</tr>
<tr>
<td>RU</td>
<td>Roof Unit</td>
</tr>
<tr>
<td>SBD</td>
<td>Single Blade Damper</td>
</tr>
<tr>
<td>SD</td>
<td>Smoke Damper</td>
</tr>
<tr>
<td>SJ</td>
<td>Slip Joint</td>
</tr>
<tr>
<td>ST/ST</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>SSL</td>
<td>Structural Slab Level</td>
</tr>
<tr>
<td>TA</td>
<td>To Above</td>
</tr>
<tr>
<td>TB</td>
<td>To Below</td>
</tr>
<tr>
<td>TD</td>
<td>Top Down (In Direction of Flow)</td>
</tr>
<tr>
<td>TJ</td>
<td>Telescopic Joint</td>
</tr>
<tr>
<td>TP</td>
<td>Test Point</td>
</tr>
<tr>
<td>TV</td>
<td>Turning Vane</td>
</tr>
<tr>
<td>TU</td>
<td>Top Up (In Direction of Flow)</td>
</tr>
<tr>
<td>UOS</td>
<td>Unless Otherwise Stated</td>
</tr>
<tr>
<td>UPVC</td>
<td>Unplasticised Polyvinyl Chloride</td>
</tr>
<tr>
<td>US</td>
<td>Underside</td>
</tr>
<tr>
<td>VAV</td>
<td>Variable Air Volume</td>
</tr>
<tr>
<td>40 SMF</td>
<td>Self Metal Flange (With Size)</td>
</tr>
<tr>
<td>50 RSA</td>
<td>Rolled Steel Angle (With Size)</td>
</tr>
</tbody>
</table>

Table 2 - Standard Abbreviations
Self Assessment

Questions on Background Notes – Module 5.Unit 1

1. Name three longitudinal seams.

2. Name three cross-sectional joints.

3. What is the extra material needed for a 6mm paneled-down joint?
4. Give five abbreviations used in ductwork.
Answers to Questions 1-4. Module 5.Unit 1

1. 

Longitudinal seams:

- Groove seam
- Pittsburgh seam – commonly known as a lock formed joint.
- Standing seam
- Single lock
- Snap lock

2. 

Cross-sectional joint:

- Peine joint
- Slip joint
- Flanging
- Dovetail
- S and C cleats
3.  

16mm - we use 5mm for the small piece and 11mm for the large piece. The 11mm is used with 6mm for the ledge and 5mm is knocked down around the small piece.

4.  

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF</td>
<td>Airflow</td>
</tr>
<tr>
<td>VCD</td>
<td>Volume Control Damper</td>
</tr>
<tr>
<td>CFM</td>
<td>Cubic Feet per Minute</td>
</tr>
<tr>
<td>FPM</td>
<td>Feed per Minute</td>
</tr>
<tr>
<td>TA</td>
<td>To Above</td>
</tr>
<tr>
<td>FD</td>
<td>Fire Damper</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, Ventilation Air Conditioning</td>
</tr>
</tbody>
</table>
Index

C
Combination Smoke and Fire Dampers, 37
  Air Leakage, 39
  General, 37
  Installation, 39
  Materials and Construction, 39
  Types of Combination Smoke and Fire Damper, 37
Construction
  Damper Casings, 31
  Dampers used in High Pressure Systems, 30
  Dampers used in Low and Medium Pressure Systems, 30
  Materials, 30
  Proprietary Types of Damper, 30

D
Ductwork, 21
  Abbreviations used in Ductwork, 27
  Allowance for Peened Joint, 25
  Dampers, 27
  Dovetail Seams, 22
  Dw/144, 27
  Noise, 27
  Peened Joint, 24
  Slip Joints, 23
  Standing Seams, 21
Ductwork; 23, 24

F
Fire Dampers, 32
  Air Leakage, 34
  General, 32
  Installation, 34
  Location, 34
  Materials and Construction, 34
  Provision for Expansion, 34
  Types of Fire Dampers, 32

G
General
  Balancing Damper, 28
  Control Damper, 28

I
Internal Duct Linings, 40
  Circular Ducts, 40

Cleaning and Maintenance, 40
  General, 40
  Lining Application Considerations, 40

L
Lockform Machine, 12
  Cross-Sectional Type, 12
  Longitudinal Joint/Seams, 17

R
Regulating Dampers, 28
  Construction, 30
  General, 28
  Installation, 31
  Types of Airflow Control Damper, 28

S
Self Assessment, 48
Smoke Dampers, 35
  Air Leakage, 35
  General, 35
  Installation, 36
  Materials and Construction, 35
  Types of Smoke Damper, 35
Standard Component Drawings and Abbreviations, 42

T
Thermal Insulation, 42
Types of Airflow Control Damper
  Backdraft Dampers, 29
  Hit and Miss Dampers, 29
  Iris Dampers, 29
  Multi-Blade Dampers (Single or Double Skin)
    Parallel or Opposed Blade, 29
    Single-Blade Dampers (Single or Double Skin), 28
  Slide and Blast Gate Dampers, 29
Types of Combination Smoke and Fire Damper
  Multi-Blade, 37
  Single Blade, 37
Types of Fire Dampers
  Folding Curtain, 32
  Intumescent, 33
  Multi-Blade, 33
  Single Blade, 32
Types of Smoke Damper
  Multi-Blade, 35
  Single Blade, 35