TRADE OF

Industrial Insulation

PHASE 2

Module 5

Ductwork & Vessels

UNIT: 1

Measuring: Ductwork & Other Large Areas

Produced by

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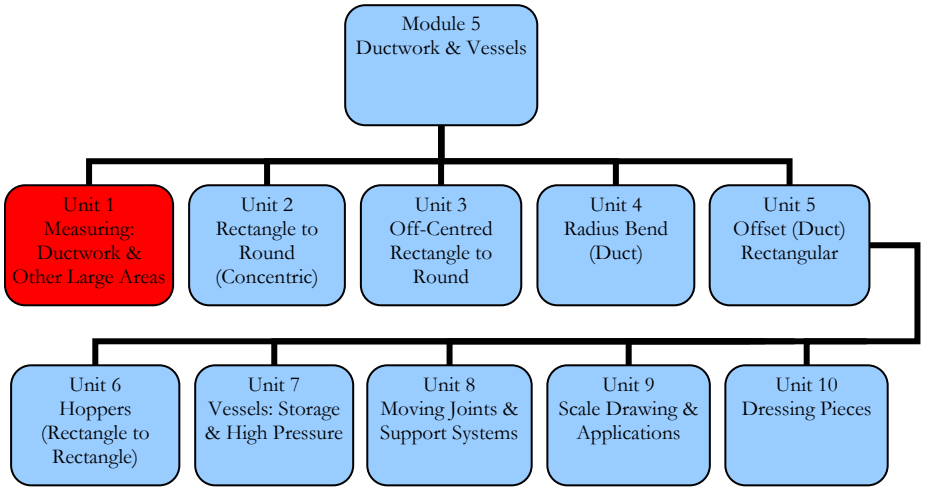
Introduction

Ventilation ductwork systems are installed in buildings to provide fresh air for respiration, preserve the correct level of oxygen in the air and dispose of odours, smoke, dust and other atmospheric contaminants.

A ventilation system is made up of both straight lengths of ductwork (square, rectangular or spiral), and fittings such as reducers, radius bends and offsets. These fittings are used to reduce the size of the duct, change direction of the duct and offset past obstacles which may be in the path of the system.

Measuring such ventilation systems for insulation and cladding requires skill and knowledge. Accurate measuring on site can reduce manufacturing time, reduce waste and increase the profitability of the job.



Unit Objective

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

- Accurately measure ductwork for insulation and cladding.
- Identify and neatly sketch various ductwork forms.
- Read and interpret a works specification and drawings.
- Quantify areas and materials.

1.0 Measuring Ductwork and Other Large Areas

Key Learning Points

- Identification of ductwork forms
- Uses and applications of ductwork
- Bare surface measuring
- Errors caused by measurement errors and inaccuracy
- Calculation of the required insulation allowance
- Use of a plumb line and spirit level
- Accurate centre finding
- Joint positioning on ductwork
- Obstacle location

1.1 Uses and Applications of Ductwork

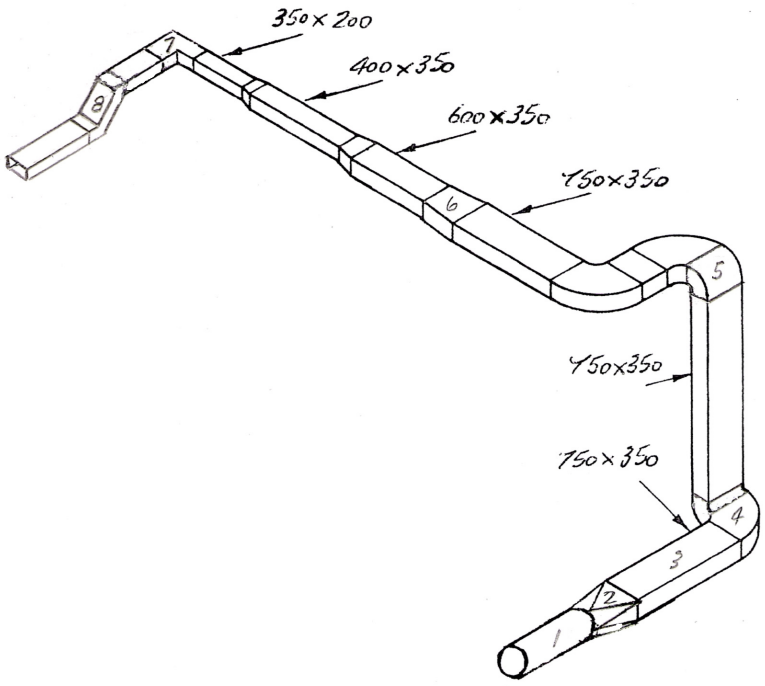
A person's sense of comfort and their capacity for work deteriorate quickly in poor air conditions. More seriously, their general health may be impaired in the long term by living and working in poorly ventilated buildings.

The purpose of a heating, ventilating and air conditioning (HVAC) duct system is to provide building occupants with:

- Thermal Comfort
- Humidity Control
- Ventilation
- Air Filtration

The ductwork systems job is to convey air between specific points in a building, such as from an air-handling unit to a grille or diffuser in an office, hotel lobby, warehouse etc and vice versa.

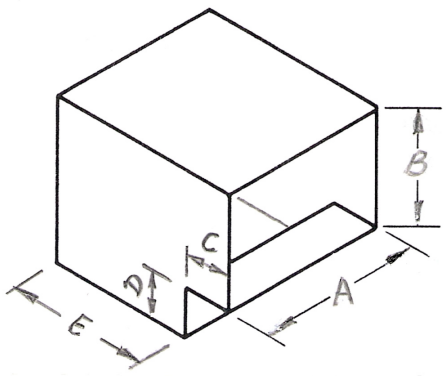
1.2 Identification of Ductwork Forms



1. Round duct.
2. Rectangle to round.
3. Radius bend (hard).
4. Radius bend (easy).
5. Reducer.
6. Square bend.
7. Offset.

1.3 Bare Surface Measuring

As an example measure the 90degree change bend with square throat and heel by taking dimensions A, B, C, D and E and recording them in your notepad. An isometric sketch of the bend is very helpful with the dimensions added to it because it aids understanding of the job and records the information gathered from the work site. Dimension A is the same on both ends of the bend.



1.4 Mistakes Caused by Measurement Errors and Inaccuracy

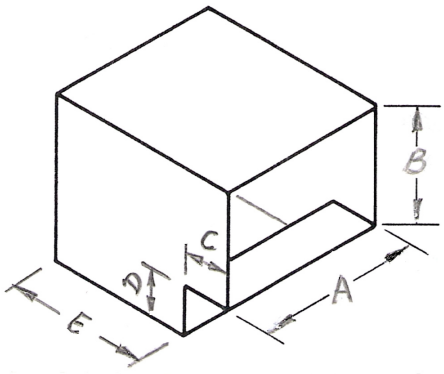
Mistakes caused by poor measuring of a job, whether in the workshop or especially on site, can be costly in a number of ways such as:

- Lost time and money due to reworking job
- Waste of material
- Loss of productivity and falling behind on the job
- Financial penalties due to not having the project finished on time
- Possible strained relationship with client
- Loss of profits to the contractor

It is very important when measuring a job to take the time to study the job, survey the site area for any possible obstacles that may be in the way and to foresee any problems before they arise. Measurements are taken, recorded in the notebook and then double checked to make sure all measurements are correct.

1.5 Calculation of the Required Insulation Allowance

When the existing duct/fitting or 90degree change elbow in this case has been measured the next stage is to decide on insulation thickness. For this example 25mm thick fibreglass slab insulation is required. The measurements for the cladding as shown will be:



Dimension A + 50mm (or 5cm).

Dimension B + 50mm (or 5cm).

Dimension C + 50mm (or 5cm).

Dimension E + 50mm (or 5cm).

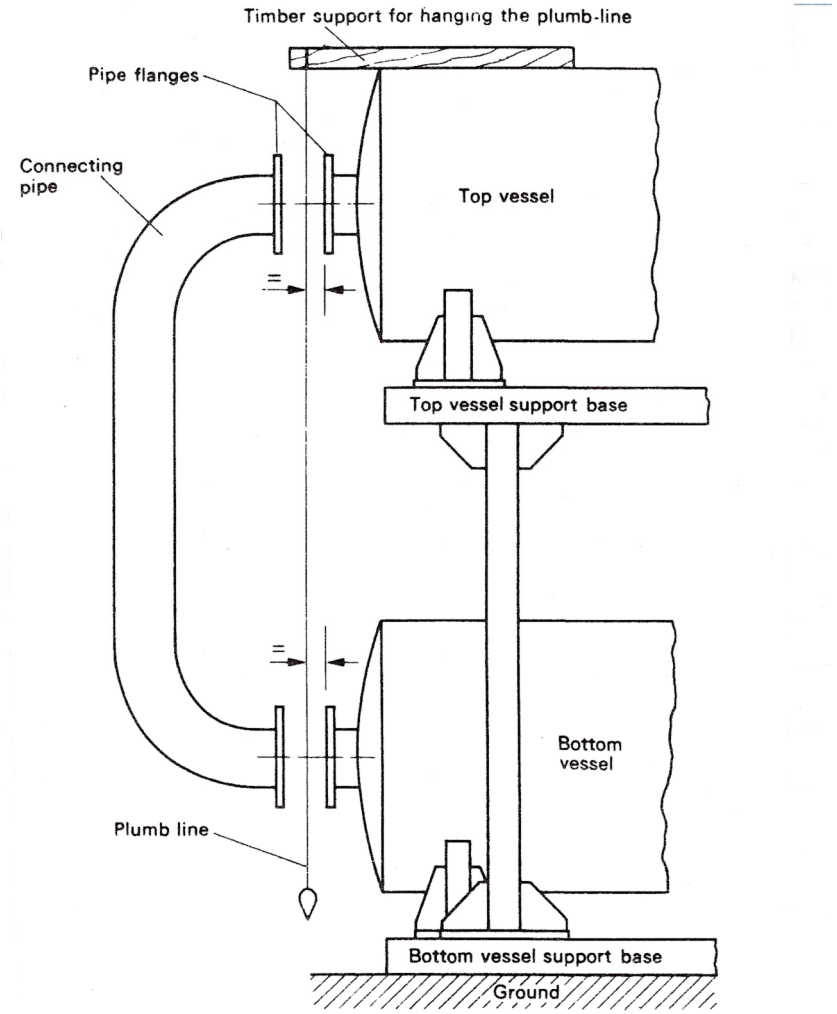
Dimension C and D will change accordingly.

Note: An extra allowance of 5mm – 10mm overall on the dimensions shown may be preferred to facilitate installation.

1.6 Use of Plumb-Line and Spirit Level

Plumb-Line

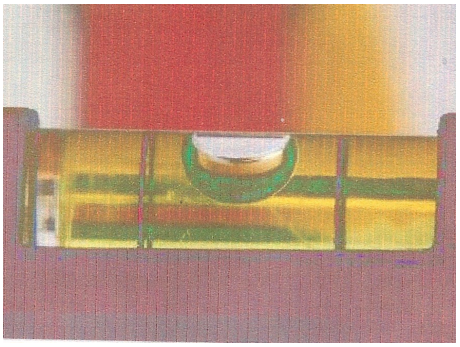
In steel fabrication work for example a plumb-line is used for aligning vessels or other equipment, where one vessel is bolted and fixed in position and the other vessel is aligned with it before being bolted into the required position to receive the connecting pipe-work.



Spirit Level

The spirit level is a common tool used by many construction workers including industrial insulators to determine whether a surface is vertical or horizontal. It consists essentially of a transparent tube that is held in a frame. The tube contains a bubble because it is not completely filled and it is this bubble that indicates if the instrument is level or horizontal. Most spirit levels have two tubes with plumb bubbles – one at either end of the level – so that the device can register a vertical as well as a horizontal position or level.

A selection of spirit levels.



Level bubble.

1.7 Accurate Centre Finding

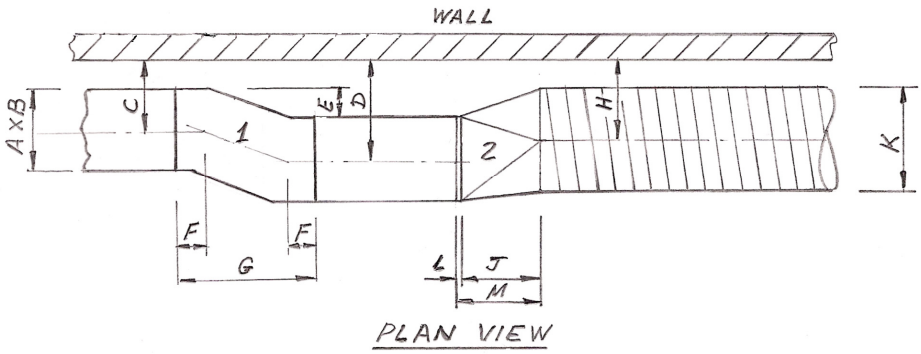
As was mentioned in ***1.4*** mistakes caused by poor or inaccurate measurements can be very costly to a company in a number of ways as outlined. Measuring ductwork and accurate centre finding is straight forward enough, but accuracy and attention to detail is essential to get the job right.

Some of the items needed when measuring a job may include:

- Note Pad – An ordinary pad or an A4 pad with 5mm squares is handy as it can be used as a scale by nominating each square to represent a certain number of millimetres, centimetres or metres. The lines on the page can be very useful for drawing horizontal or vertical lines with accuracy and the squares can be used for drawing 45degree angles.
- Soft pencils, eraser, pencil sharpener or pen
- Calculator
- Tape rule
- Folding rule
- Large square
- Spirit level/Plumb-bob

When taking measurements of a job we may use the surrounding building structure – floor, walls, ceiling, steelwork etc. – to help us get the measurements we require. A lot of the time this won't be necessary because we can take our measurements directly from the job e.g. duct system, pipe-work, tank/vessel etc. Sometimes a combination of both of these methods will be used depending on the system design and location.

Shown in the diagram is a plan view of a small section of ductwork. It consists of sections of rectangular ductwork, an offset (item 1), rectangle-to-round (item 2) and a section of spirally wound round duct.

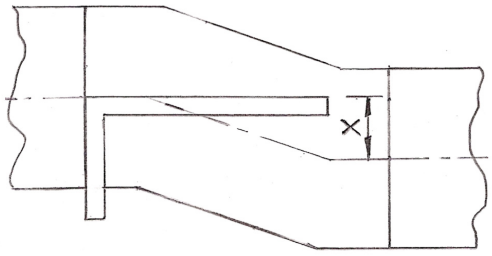


Item 1

Before starting to measure system check that it is fitted parallel to wall. In measuring the rectangular offset we need:

1. Measurements A and B - Duct Size/Offset Size
2. Measurements C and D
3. For centre finding subtract measurement C from D. We can also find the centre distance by finding the offset distance E. We can do this by running a straight edge (spirit level, piece of timber) alone the inside or outside of the offset. If the straight edge needs to run along the duct as well for greater accuracy, the duct flange if fitted will need to be considered.

Another way to find the centre distance "X" is to use the large square as shown "A" mark should be put on the centre of each end of the offset. So an accurate measurement can be taken.



Plan View.

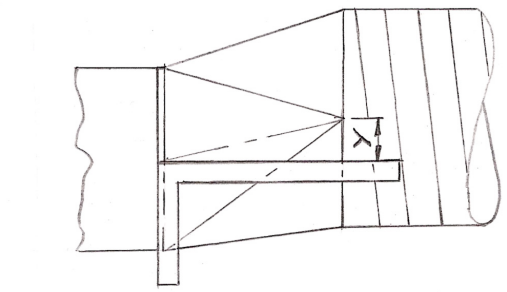
Item 2

In measuring the rectangle-to-round (item 2) we need:

(1) Measurements A and B - Duct Size/Base of rectangle-to-round

(2) D and H.

(3) For centre finding subtract measurement H from D. Another way to find the centre distance "Y" is to use the large square as shown. A mark should be put on each end of the transformer so an accurate measurement can be taken. Note: In elevation the transformer is on-centre.



Plan View.

1.8 Joint Positioning on Ductwork

Longitudinal Seams or Joints

In ductwork manufacturing, there are a variety of seams or joints used to hold the ductwork together. The choice of the seam is determined primarily by the thickness of the metal, the type of metal, the size of the ductwork, the cost of fabrication and the equipment available for making the joint.

The main longitudinal seam that is used for square and rectangular ductwork and fitting is the Pittsburgh Lock or Lockform Joint. This joint is normally positioned on the corner of the duct. For round ductwork the seam most frequently used is the Groved Seam or Double Seam. This seam can also be used for square or rectangular ductwork but it cannot be placed at the corner of the duct but usually, but not always, on the centre of a flat panel. Another seam frequently used for large ductwork for the main riser ducts is the standing seam. This is usually positioned on a flat rather than at a corner.

Cross Seams or Joints

There are a number of different types of cross seams used on ductwork. For square and rectangular ductwork the popular choice is the roll formed or slide-on flange. Another type of cross seam is the socket and spigot joint or slip joint. For larger and heavier type of ductwork the angled flange joint is sometimes used.

For round, straight-seamed and spirally-wound ductwork the socket and spigot – plain (slip joint) with connector and synthetic rubber gasket are popular.

Refer to page 20 of DW144.

1.9 Obstacle Location

When fitting ductwork, pipe work and other equipment on site it is very important that the installers of these systems and equipment leave enough room for the thermal insulators to lag and clad the work. Much wasted time and money is lost due to ductwork and pipe-work etc, being positioned to close to ceilings, walls, steelwork and concrete pillars for example. When these obstacles occur, much time is lost trying to properly measure, cut and fit insulation and cladding so that a professional and quality job can be done. Proper site management and communication with all trades is vital to the smooth operation of a site. As mentioned earlier, the person measuring the job prior to fabrication and installation has a good opportunity to study and foresee any problems, difficulties or obstacle locations before any work commences on the project. This proper planning procedure can save many lost hours of productivity and reduce the stress on the job for all concerned.

2.0 Area Calculations

Key Learning Points

- Calculation of material requirements including sundries
- 3D sketching, isometric sketching and drawing
- Oblique sketching. Job planning and sequencing
- Works specification and drawings interpreting

2.1 Area Calculation of Material Requirements

Area of a Square

The area of a Square = Length of Side x Length of Side.

Example:

Duct Size = 600mm x 600mm or 0.6m x 0.6m.

Area of Duct = 360,000mm² or 0.36m².

Area of a Rectangle

Area of a Rectangle = Length x Width.

Example:

Duct Size = 800mm x 400mm or 0.8m x 0.4m.

= 320,000mm² or 0.32m².

Area of a Circle.

The area of a circle = πr^2.

Example:

Spiral duct size = 50mm diameter or 0.5

Area = πr^2

Area = 3.14 x 250²mm or 3.14 x .25m²

Area = 196,250mm² or 0.19625m²

Note: Sometimes it is better to use square metres instead of squared millimetres as mistakes can be made quite easily using squared millimetres due to the amount of numbers involved. Also when using squared metres we generally round up the number so as to make it easier when adding together e.g. 0.19625m² could be round up to 0.2m².

2.2 Sundry Items

Sundry items are items which are used to fix and secure insulation and cladding to ductwork and other large areas. Such items include:

- Rivets.
- Self tapping screws.
- Self adhesive pins.
- Aluminium foiled tape.
- Mastic and sealant.
- Supporting or "Z" bars for cladding.

It is important when estimating or quantifying a particular job, that an allowance is made for the above sundries. On a small job the amount of sundry items is minimal and would not constitute a large financial amount, however on a large project the amount of money spent on sundry items can be quite considerable. Generally the amount charged per square metre of insulation and cladding will include a percentage for sundry items, however when manufacturing, the amount of sundry items has to be calculated.

For items such as rivets and screws, a general rule of thumb would be to calculate the amount of rivets or screws on each joint and multiply this amount by the number of joints on the job. When calculating the amount of adhesive pins, you would decide on the amount of pins on each panel of cladding and multiply this amount by the number of panels. When ordering such items from the supplier, it is important to remember that these items are usually sold in boxes of 250, 500 or 1000 pieces and so you will have to decide on the nearest quantity required.

2.3 3D Sketching, Isometric Sketching, Oblique Sketching and Drawing

Refer to module 2 – unit 2.

2.4 Job Planning and Sequencing

Refer to module 3 – unit1.

2.5 Work Specification and Drawing Interpretation

Refer to module 2.

Summary

Ventilation ductwork systems are installed in buildings to provide fresh air for respiration, preserve the correct level of oxygen in the air and dispose of odours, smoke, dust and other atmospheric contaminants. A person's sense of comfort and their capacity for work deteriorate quickly in poor air conditions. More seriously, their general health may be impaired in the long term by living and working in poorly ventilated buildings.

Accurate measuring of these systems for insulation and cladding is important as it will reduce manufacturing time, reduce waste of materials, speed up installation time and improve the overall appearance of the job. We use a number of different tools for measuring ductwork systems, including a measuring tape, spirit levels, plumb lines and straight edges. Identifying obstacles which may cause problems during installation is vital to the smooth installation of the insulation and cladding. It is always a good idea to take a detailed sketch of the job when measuring up as it will reduce the risk of inaccuracies, identify problem areas of the job and it will also act as an aid when manufacturing.

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