

TRADE OF  
**Industrial Insulation**

PHASE 2

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Module 5

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Ductwork & Vessels

UNIT: 5

**Measuring: Ductwork & Other  
Large Areas**

*Produced by*

**SOLAS**

**An tSeirbhís Oideachais Leanúnaigh agus Scileanna**  
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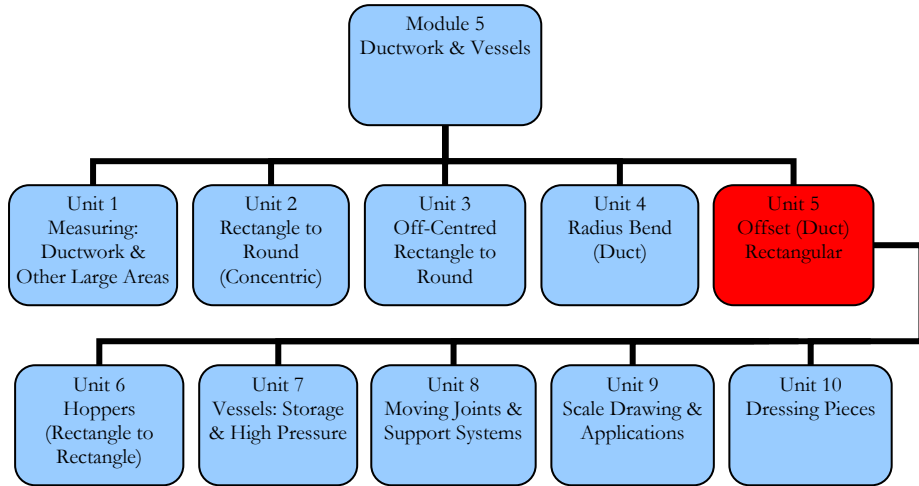
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# Introduction

An offset is a fitting used in ductwork and pipe work systems which changes the direction of a system. It is also used to connect two systems which are at different levels or planes to each other. Accurately measuring an offset requires a number of skills including sketching, measuring centre lines, use of scale drawings and working to a specification.



## Unit Objective

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

- Measure an offset rectangular duct.
- Determine accurately duct centres and angles.
- Sketch and draw an offset duct.
- Calculate areas, materials required and associated costs.
- Mark out, fabricate, insulate and fit polysolene to an offset duct.

# 1.0 Measuring and Sketching

## Key Learning Points

- Measuring and sketching of an offset duct
- Isometric sketching, first and third angle projection
- Explanation of the term offset
- Scale drawings
- Centre finding of an offset duct
- Angle finding of an offset duct
- Calculating costs, insulation allowances and anomalies

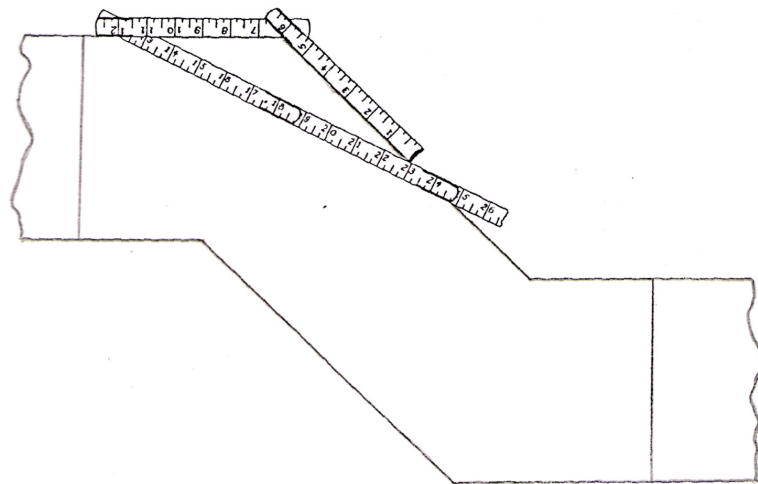
## 1.1 Terminology

An “offset” is used in a duct system to change direction because of an obstruction or obstacle in the way. An “offset” is also used to change direction to meet up with another duct section or to connect to a fan or air-handling unit.

## 1.2 Finding the Angle of an Offset

Using a similar example as in Module 5 – Unit 1 – Section 1.7, we can find the angle of an offset by using a folding rule:

- Bend the folding rule to suit the wrapper angle of the offset.
- At the second joint of the rule bend it back on itself and take a reading from the rule where it meets the start of itself.
- Take a note on your sketch of this measure as it will be used back in the workshop to re-establish the angle by repeating the steps mentioned above.
- The angle and other measurements taken on site will be used to mark out the cladding offset.



*Plan View*

### **1.3 3D Sketching: Isometric Projection - First and Third Angle Orthographic Projections**

*Refer to Module 2 – Unit 2 – Orthographic Projections.*

### **1.4 Scale Drawings**

*Refer to Module 2 – Unit 2 – Orthographic Projections.*

### **1.5 Finding the Centre Line of an Offset**

Mistakes caused by poor or inaccurate measurements can be a very costly exercise to a company both in time and money. Measuring of ductwork and centre line measuring can be straight forward enough, but accuracy and attention to detail is required in order to gets things right.

*Refer to Module 5 – Unit 1 – section 1.7.*

### **1.6 Calculation of Insulation and Costs**

The allowances for estimating the insulation length is the same as estimating for a length of square or rectangular duct. This equates to the perimeter of the rectangular offset plus eight thicknesses of insulation. Once the squared meterage of insulation has been calculated, a rate or unit cost is applied to the square meterage to achieve an overall cost. The rate per square metre will depend on a number of factors within the company:

- Cost of material per square metre.
- Cost per hour for labour.
- Cost per hour for overheads (heat, light, office staff, equipment etc).
- Percentage added for profit.

It is important to note that the unit cost per square metre is sometimes governed by industry rates.

## 2.0 Marking Out, Fabrication and Fitting of Insulation and Cladding

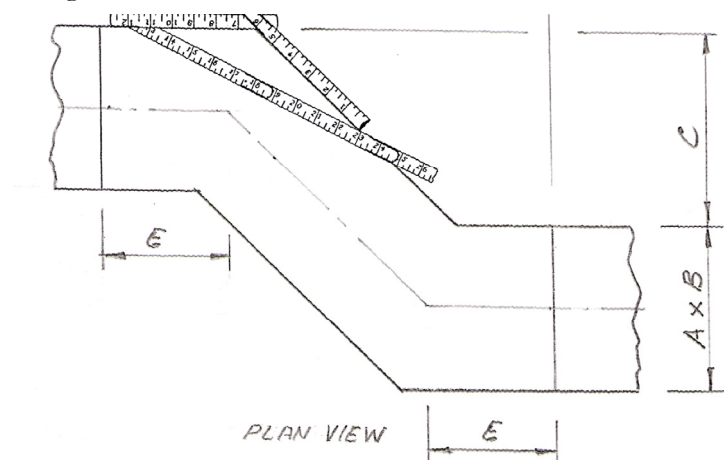
### Key Learning Points

- Duty of the Employer
- Duty of the Employer
- Accurate marking out and fabrication of an offset duct
- Joint weathering
- Properties and applications of polysolene
- Polysolene application.

### 2.1 Marking Out Techniques for an Offset

The main things we need to know before we start marking out an offset are:

- Size of top or bottom of offset =  $A \times B$
- Offset distance =  $C$  ( same as distance between centrelines).
- Overall length =  $D$
- Length  $E$ .



Once the measurements are known, it is developed as shown in *Module 2 – Unit 3 – parallel line development*. The sizes of the cladding offset include the thickness of the insulation all-round plus an extra allowance of 10mm or 1cm to make the fitting of the offset easier on site.

Before a pattern can be developed, it must be decided on how it is going to be made, for example the type of joint to be used, position of joints and whether sheets of material will need to be joined to fabricate the offset.



## 2.2 Accurate Cutting, Forming and Assembly of an Offset

When the patterns have been marked out they are now ready for cutting. The pattern can be cut out using a power guillotine, electric hand shears or a bench shears. Once the patterns are cut they need to be notched using a notching machine or hand snips. After notching, the patterns can be de-burred and punched before they are folded.

Folding and stiffening of the patterns is done on a box and pan folding machine. For larger patterns, a press brake can be used if it is available. Folding large patterns is usually a two person operation. Finally, the sections of the offset are swaged and pre-assembled using either pop rivets or self-tapping screws. If necessary Z-bars may need to be manufactured to support the cladding on the duct and stop deflection on the joints. Seams should be sealed with an appropriate mastic or sealant to prevent the ingress of moisture into the joints and the insulation below.

## 2.3 Accurate Cutting and Fitting of Insulation Using Appropriate Fixings

The insulation of specified thickness is cut, fitted and secured to the offset using a suitable adhesive and/or self-adhesive pins, applied in accordance with the manufacturer's instructions. The pins are necessary to avoid sagging and movement of the insulation, particularly on the underside of the ductwork. All joints should be securely butted together and cover with 75mm or 100mm aluminium foil self-adhesive tape. Where the self-adhesive pins penetrate the class 'O' facing, they should be sealed with the aluminium foil tape to maintain the vapour barrier/ control layer.

## 2.4 Properties and Applications of Plysolene

Plysolene or (PIB) is the ideal water proofing membrane for pipe work and ventilation ductwork. Plysolene has outstanding properties over a wide temperature range (-30°C to 100°C), hence it is used widely in oil refineries, chemical works and power stations. Plysolene is the preferred material for many contractors because it is easy to use and difficult shapes are simply cut and welded on site. Some advantages of plysolene are:

- It will not harden.
- Virtually non-aging.
- Ozone resistant.
- UV resistant.

The standard colour is black and it is available in a range of thicknesses from 0.5mm to 1.2mm. It is also available in white, however this product is only for internal use. Plysolene rolls are available in widths of 1000mm and 1200mm and 25metres long.

## 2.5 Fitting of Plysolene Weathering Membrane

The sheeting is very easily applied over insulated pipe work and ductwork. Suitably sized pieces are cut and wrapped around the outside of the insulation. Overlaps of the membrane need to be at least 80mm. The overlaps are solvent welded by applying Plysolene welding agent E with a stiff brush. Other solvent can be used however more skill is required to achieve really good welds. The solvent should be applied with a circular scrubbing movement to both surfaces so that they become tacky before the overlap is pressed together. The use of too much solvent can lead to premature failure as the excess solvent will continue to dissolve the PIB long after the weld has been made.

Plysolene is a thermoplastic elastomer which will soften with increases in temperature and therefore should not be used to hold the insulation on to the pipe work or ductwork. The insulation should be secured in place prior to applying the PIB.

For ventilation ductwork the PIB should be fully bonded to the to the fixed insulation material, which should be high density resin bonded glass-fibre or mineral wool slab. If expanded polystyrene is used the corners of the polystyrene should be well taped and all sections should butt together tightly to minimise the effects of movement and to prevent a temperature difference existing over a joint.

PIB sheeting will never give a completely flat appearance. Consequently, the top of the ductwork which is close to horizontal should be built-up so as to eliminate the possibility of puddling allow for water to run off the top of the duct. For very large ductwork and any installation where there are large flat areas, sheeting of 1.0mm or 1.2mm should be used.

## 2.6 Weathering of Joints

Cladding joints should be tight fitting and should stop the ingress of water into the insulation below. Reinforcing bars or Z-bars should be placed under each joint to eliminate sagging at the joint. A sealant should be applied to stop moisture penetrating the joint and reaching the insulation

## 3.0 A Professional Approach and Presentation

### Key Learning Points

- Professional approach to house-keeping and presentation
- Safe disposal of waste.

### 3.1 A Professional Approach to House-Keeping and Presentation

Good house-keeping should not just be another chore for the worker. It is an important element in accident prevention and overall efficiency on the job. Good house-keeping begins with planning ahead. Storage areas should be planned to allow for ease of access to materials without blocking up walk ways. Materials should be neatly stockpiled. Access areas and walkways should be kept clear at all times, waste materials, tools and equipment should not be left in the walkways.

Offcuts of insulation, cladding and packaging materials should be disposed of correctly. Recycling bins should be available on site for different types of materials.

It is the responsibility of each worker to maintain their work area in a neat and orderly manner. Keeping areas clean and tidy shows a professional attitude towards safety.

## Summary

An “offset” is used in a duct system to change direction because of an obstruction or obstacle in the way. An “offset” is also used to change direction to meet up with another duct section or to connect to a fan or air-handling unit.

Accurate measuring, the use of centre lines, obstacle identification and related knowledge are all required when measuring, marking out and fabricating an offset.

Insulation is applied to ductwork and pipe work to maintain the temperature integrity of a system. Cladding is applied over the insulation to protect the insulation from corrosion, damage and protect personnel from injury due to high temperatures. Plysolene (PIB) is also used as a protective coating to insulation. Plysolene is a thermoplastic elastomer which will soften with increases in temperature and therefore should not be used to hold the insulation on to the pipe work or ductwork.

Good house-keeping and a professional attitude is essential in accident prevention and the overall efficiency of the job. Work areas should be kept clean and tidy at all times. Waste materials should be disposed of correctly and recycled where possible.

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