

TRADE OF
Industrial Insulation

PHASE 2

Module 1

Sheet Metal and Insulation Fundamentals

UNIT: 4

**General Allowances for
Insulation & Cladding**

Produced by

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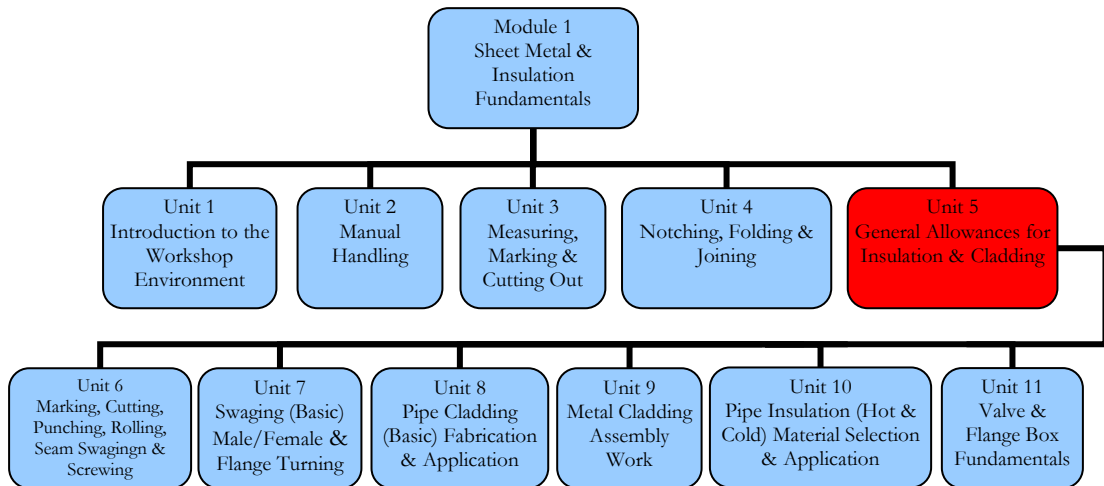
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Introduction

The accurate measuring of both insulated and non-insulated pipe work takes time and effort. The apprentice has to be able to determine the diameter of a pipe from a circumference measurement which he/she will take while the pipe work is in situ. The measurement of such pipe work requires a high level of accuracy and the overall success of the job depends largely on the initial measurements.



Unit Objective

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

- Measure various pipe diameters.
- Calculate circumferences and diameters.
- Calculate cladding allowances.
- Calculate swage allowances and mark out a cladding pipe section.

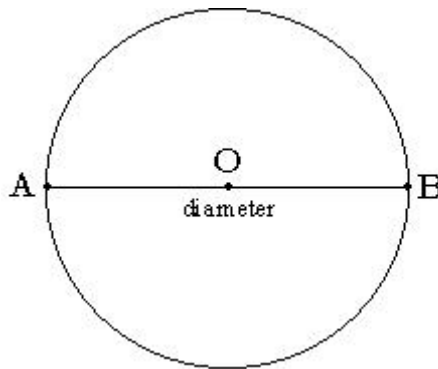
1.0 Measuring Pipe Work

Key Learning Points

- Calculation of circumference from diameter measurements.
- Calculation of diameter measurement to circumference.
- Importance of accurate circumference calculation.
- Errors associated with incorrect circumference measurements.
- Calculation of cylindrical surface areas.

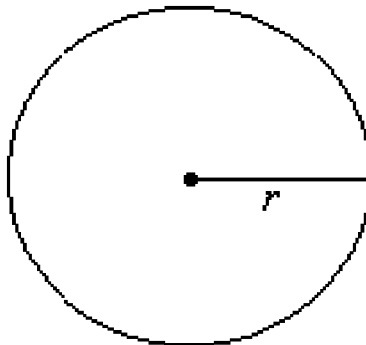
1.1 Diameter of a Circle

The diameter of a circle is the distance across a circle through its center point, therefore it is a line through the center point and touching two points on its edge. The term diameter is denoted by the figure \varnothing .



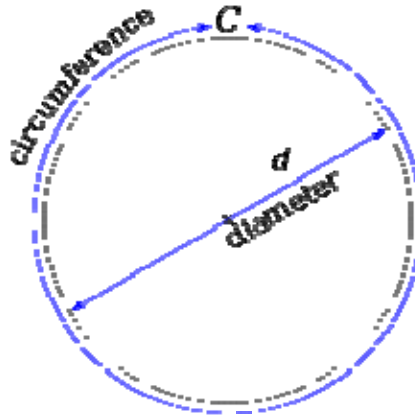
1.2 Radius of a Circle

The Radius of a circle is half the distance of the diameter from the center point to the edge of the circle.



1.3 Circumference of a Circle

The perimeter of a circle is called the **circumference**. The circumference is the distance around the circle, starting at one point and finishing at the same point.



If you divide the circumference of a circle by the diameter of the circle you should find that your answer is always just over 3. In fact, the value of the circumference divided by the diameter is the same for every circle and is denoted by the Greek letter π , pronounced pi. In numeric terms the approximate value for pi is 3.14, this is sufficiently accurate for all practical purposes.

Example 1: Calculate the circumference of a circle whose diameter is 150mm.

$$\begin{aligned} \text{So: Circumference} &= \pi \text{ times the diameter} \\ &= 3.14 \times 150\text{mm} \\ &= 471\text{mm} \end{aligned}$$

Example 2: Calculate the diameter of a circle whose circumference is 628mm.

$$\begin{aligned} \text{So: Diameter} &= \text{circumference divided by } \pi \\ &= 628\text{mm} \div 3.14 \\ &= \text{ø } 200\text{mm} \end{aligned}$$

1.4 Area of a Circle

The area of a circle is the number of square units inside that circle. The formula used to calculate the area of a circle is πr^2 or $\pi \times \text{radius} \times \text{radius}$.

Example 1: Find the area of the circle whose radius is 125mm.

$$\begin{aligned} \text{So: Area of a circle} &= \pi r^2 \\ &= 3.14 \times 12.5\text{cm} \times 12.5\text{cm} \\ &= 490.62 \text{ cm}^2 \end{aligned}$$

Example 2: Find the area of a circle whose diameter is 100mm.

$$\begin{aligned}\text{So: Area of a circle} &= \pi r^2 \\ &= 3.14 \times 5\text{cm} \times 5\text{cm} \text{ (radius} = \frac{1}{2} \text{ the diameter)} \\ &= 78.5 \text{ cm}^2\end{aligned}$$

1.5 Area of a Cylinder

As a tradesman it is important to be able to work out the surface area of different components, that is to calculate the amount of material that is required to manufacture those components. Whether you are manufacturing a ventilation ductwork system or cladding a steam pipe section you need to be able to work out the amount of material you will need to do the job.

When calculating the area of a cylinder or pipe the measurements we are concerned with are the circumference of the pipe and the height or length of the pipe. It is important for the apprentice to understand the need for accuracy when calculating the circumference of a pipe or cylinder as inaccuracies can lead to poor and sloppy fit-up of parts and poor overall quality of the job.

Example 1: Calculate the surface area of a circular duct $\varnothing 200\text{mm} \times 600\text{mm}$ long.

$$\begin{aligned}\text{So: Circumference of the pipe} &= \pi d \\ &= 3.14 \times 20\text{cm} \\ &= 62.8\text{cm}\end{aligned}$$

$$\begin{aligned}\text{Surface area of the pipe} &= \text{Circumference} \times \text{height/ length} \\ &= 62.8 \text{ cm} \times 60\text{cm} \\ &= 3768\text{cm}^2\end{aligned}$$

Example 2: Calculate the surface area of a circular duct $\varnothing 15 \text{ cm} \times 45 \text{ cm}$ long,

$$\begin{aligned}\text{So: Circumference of the pipe} &= \pi d \\ &= 3.14 \times 15\text{cm} \\ &= 47.1\text{cm}\end{aligned}$$

$$\begin{aligned}\text{Surface area of the pipe} &= \text{Circumference} \times \text{height/ length} \\ &= 47.1\text{cm} \times 45\text{cm} \\ &= 2119.5\text{cm}^2\end{aligned}$$

2.0 Measuring Insulated and Non-Insulated Pipes

Key Learning Points

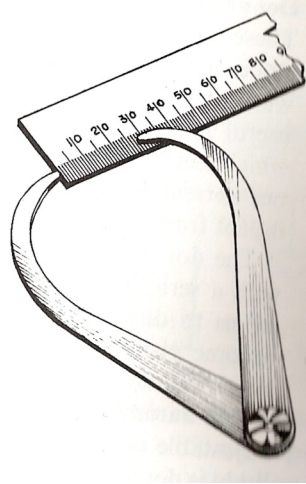
- Accurate measuring of insulated and un-insulated pipe diameters using an outside callipers.
- Determination of insulated and un-insulated pipe circumference using a flexible tape measure.

The accurate measuring of pipe work both insulated and non-insulation is very important for the manufacturing of cladding to cover such pipe work. There are a number of methods for measuring the outside diameter and circumference of different types of pipe work.

2.1 Outside Calipers



The outside callipers is designed to measure the outside diameter of a pipe. Using the adjusting screw at the top of the callipers, open the callipers to suit the outside of the pipe. Accuracy in the use of the callipers depends upon a developed sense of feel that can only be acquired by practice and the apprentice must ensure that the calipers is held square to the pipe when taking a measurement. Once the callipers has been set to the outside of the pipe and using a steel rule or tape the apprentice can obtain an accurate measurement of the pipe.



2.2 Measuring Tape

The measuring tape is a handy tool for measuring the circumference and diameter of both insulated and non-insulated pipes. A small 2 metre tape is ideal as the blade of the tape is both narrow and very flexible allowing for a more accurate measurement around the pipe.

1. Mark a position or starting point on the pipe or cylinder usually at the top of the pipe.
2. Position the start of the tape on this point and holding the tape tightly proceed to wrap the tape around the pipe section until you return back to the starting point again.
3. Take note of the measurement at this point as that is the circumference of the pipe.
4. Using the formula as mentioned in section 1.2- example 2 calculate the diameter of the pipe.

2.3 Steel Rule

Position the steel rule on one side of the pipe and measure across to the other side of the pipe. This measurement is the diameter of the pipe and using the formula in section 1.2- example 1 calculate the circumference of the pipe.

2.4 Calculating the Circumference of an Insulated Pipe

Measure the diameter of the pipe as set out above. Determine from the specification or job details the thickness of insulation to be installed around the pipe section. Once you know the thickness of insulation then calculate the new diameter of the pipe and the circumference of the pipe as follows:

1. Original Diameter of pipe is 100 mm.
2. Thickness of Insulation is 30mm on both sides of the pipe.
3. Therefore the new diameter of the pipe is 160mm =
100mm+30mm+30mm.
4. Circumference of the insulated pipe is $\pi d = 3.14 \times 160\text{mm} = 502.4\text{mm}$.

5. On rigid pipe insulation add an extra 15mm to the circumference of the insulated pipe for extra clearance. There is no need to add extra to the circumference of a non-insulated pipe as there is more flexibility in the insulation.

3.0 Allowances for Cladding Fabrication

Key Learning Points

- Importance of correct lap allowances for insulation and cladding work.
- Importance of correct swage allowances for insulation and cladding work.
- Allowance differential between rigid and non-rigid insulation.
- Allowance differential between various swaging wheels.
- Use of manufacturers' technical manuals and instructions for swaging and lapping allowances.

There are a number of considerations to be taken into account when developing a cladding pipe section. The apprentice should have a good understanding for longitudinal and circumferential seams and allowances of material required.

3.1 Manufacturing a Cylindrical Pipe

1. Starting on the bottom left hand corner of the sheet mark out the circumference of the pipe using the formula $\pi \times \text{diameter}$.
2. Add the allowances for the lap joint onto the circumference of the pipe. Mark the positions of the screw holes for fixing the pipe in place.
3. Cut out the overall blank of the pipe section using the guillotine and check the measurements after the piece has been cut.
4. Punch or drill out the holes for the screws using a hand punch or battery drill.
5. Pre-form the blank piece of material over a round bar prior to rolling to eliminate straights in the pipe.
6. Roll the blank piece of material using the bending rolls until the pipe closes in on itself.
7. Remove the rolled pipe and check to make sure the pipe is perfectly cylindrical.
8. Swage or joggle the longitudinal seam of the pipe for strength and appearance.

3.2 Lap Joint

The lap joint is a longitudinal joint which runs the full length of the pipe section. It is extra material which is added to both ends of the circumference when developing the pipe. When the pipe section is rolled into shape this extra material allows for an overlap (where the rolled metal slides in over itself) which can be fixed in position by rivets or screws.

It is important that the correct amount of material is allowed on the pattern for the lap joint, not enough material will make it very difficult to join the pipe together once rolled, and too much material will make joint bulge and difficult to flatten. It is also important to note that the material allowance for the lap joint may differ depending on whether the pipe section being manufactured is covering rigid or non-rigid insulation as there will be very little flexibility in a rigid insulation section. Generally an allowance of between 15 and 25 mm is added to both ends of the pattern for the lap joint, however always refer back to the drawings for clarification.

3.3 Swaging

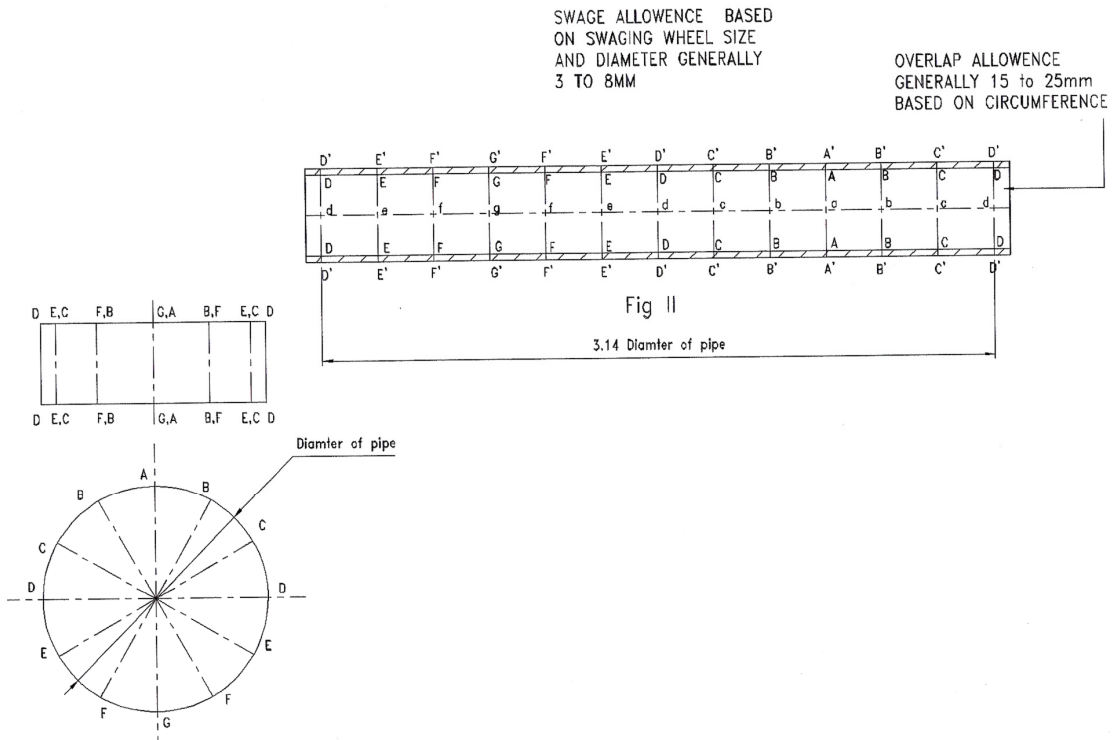
Refer to Module 1 – Unit 7 – section 2.0.

4.0 Pattern Development for a Cylindrical Pipe

Key Learning Points

- Interpretation of drawings.
- Pattern development and layout including swaging and lap allowances.

4.1 Developing and Marking out a Cylinder



1. Read and understand the drawing before starting to develop the cylinder.
2. Draw the plan and elevation of the cylinder as shown above.
3. Divide the plan view of the cylinder in 12 equal parts and letter each part.
4. Draw a horizontal line and mark off the divisions A to G and back to A again. Letter these points as shown.
5. From these points on the base line erect perpendicular lines parallel to each other.
6. Step up on each of these lines the height of the cylinder as shown on the elevation.
7. Draw a line through these points to give the top of the pipe section.

8. On the top and the bottom of the pattern add on the allowance for the swage joint usually 3 to 8mm depending on the swaging wheels.
9. On the ends of the pattern add the allowances for the lap joint usually 15 to 25mm depending on the size of the circumference. Check all measurements for accuracy.

Refer to Module 2 – Unit 3 – Parallel line development.

Summary

When developing a pattern for cylindrical pipes, an allowance must be added to the circumference of the pattern to allow for the joining of the pipe when it is being installed. This allowance will vary depending on the diameter of the pipe, and whether the cladding pipe will be covering insulated or a non-insulated pipe work. The apprentice must take all of these factors into consideration when working out his/her developments. A good understanding of calculating the circumference measurement from the diameter, and the diameter measurement from the circumference is required, as more often the pipe work to be measured is already installed.

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