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Module 4 – General Sheet Metalwork

Unit 11 – On-Centre Round to Square

Duration – 10.5 Hours

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

- Read and interpret drawings involving triangulation
- Organise the production sequence
- Mark out and fabricate a concentric square to round using the triangulation method

Key Learning Points:

- **D** Drawing and development of a central square to round.
- **Sk** Shaping and forming of transformers.
- **M** Mathematical problems involving multiplication and division.

Training Resources:

- Toolkit
- 0.8mm mild steel
- Tools and machinery/equipment
- Notepad
- Job card
- Safety equipment and protective clothing

Key Learning Points Code:

- **M** = Maths
- **D** = Drawing
- **RK** = Related Knowledge
- **Sc** = Science
- **P** = Personal Skills
- **Sk** = Skill
- **H** = Hazards
Figure 1 - On-Centre Round to Square
1. The only difference between the previous job and this one is the round part is bigger. We use triangulation and the pattern should look like this.

2. This square to round (or round to square) has a flat piece at one end to facilitate fitting a flange. It has to be notched at corners Band C.

3. Place your square along edge A B and scribe a line from Z out to edge. Place square along edge B C and again scribe a line out to the edge. The same is done at R.

4. When fabricating bend the lines A¹ - Z, Z - R and R - D¹ first. Bend them down very slightly.

5. Next bend lines 6 - Z, 3 - Z, 3 - R and 0 - R very lightly in an upward direction. We then shape the part over a round bar.

Figure 2 - 1/2 Pattern
Area of Circle

If we were to divide a circle into a very large number of very thin triangles as shown below and then rearrange them as shown underneath, we would obtain a figure which is very nearly a rectangle of length, half the circumference ($\pi r$) and height equal to the radius ($r$).

Figure 3 - Area of Circle

Area of Rectangle = $\pi r \times r = \pi r^2$
Example 1

Find the dimension $Z$, perimeter and area of the figure shown in the sketch below.

[Diagram of a figure with dimensions labeled]

Dimension $Z$:

Radius of each end $r = 2.5 \div 2 = 1.25m$

$Z = 7m - 2r = 7 - 2.5 = 4.5m$

Perimeter:

$= 2Z + \pi D$

$= 2 \times 4.5 + 3.14 \times 2.5 = 16.85m$

Area:

Circle + Rectangle

$= \pi r^2 + 2.5 \times Z$

$= 3.14 \times 1.25^2 + 2.5 \times 4.5 = 16.15625$

$= 16.16m^2$
Test Yourself

Determine the area of the face of the V-Block shown in the sketch below.

\[
\text{Answer:}
\]

Dimension  \[ Z = 100 - 20 = 80\text{mm} \]
\[ X = 80 - 10 = 70\text{mm} \]

Area  \[ = \text{Circle} + \text{Rectangle} - 2 \text{Circles} \]
\[ = \pi x 10^2 + 80 x 20 - 2 \pi x 5^2 \]
\[ = 314 \times 1600 - 157 \]
\[ = 1757\text{mm}^2 \]
Conversion between Units of Area

There are 1000mm in 1 metre.

One square metre contains:

\[ 1000 \times 1000 = 1,000,000 \text{mm}^2. \]

1,000,000 (1 million) is a very large number and is often written as \(10^6\), the 6 represents the number of zeros after the initial 1.

Example 2

1 in. = 25.4 mm. Estimate the number of square mm (mm\(^2\)) in 1 square inch (1 in\(^2\)):

\[
\begin{align*}
1 \text{ in} \times 1 \text{ in} &= 1 \text{ sq. inch} \\
25.4 \times 25.4 &= 645.16 \text{ mm}^2 \\
1 \text{ in}^2 &= 645.14 \text{ mm}^2
\end{align*}
\]

Test Yourself

Determine the number of mm\(^2\) in a circle of radius 2 in.

Answer:

\[
\begin{align*}
2 \text{ in} &= 2 \times 25.4 = 50.8 \text{ mm} \\
\text{Area of circle} &= \pi r^2 \\
&= 3.14 \times 50.8^2 \\
&= 8103 \text{ mm}^2
\end{align*}
\]
**Volume**

The volume of a solid, liquid or gas is a measure of the space it occupies.

The unit of volume is the cubic metre. It is the space occupied by a cube with edges 1 m as shown below.

![Figure 5 - Volume 1](image)

In finding the volume of a figure we need to know how many cubic units are contained in that figure. A rectangular solid is a familiar and simple figure to start with.

**Example 1**

Calculate the volume in cubic metres of a room 3m high x 3m wide x 4m long as shown in Figure 6.

![Figure 6 - Volume 2](image)

From the sketch one may observe that the volume is 36m³. In general, the volume of a rectangular solid is the product of its length, width and height.
Volume and Surface Area – Prisms

A Prism is a solid object which has exactly the same cross-section throughout its length. Thus a triangular prism, shown in Figure 7, is a solid object with a triangular cross-section throughout its length.

![Figure 7 - Triangular Prism](image)

Example 2

Determine the cross-sectional area and the volume of the prism shown above.

Cross-Sectional Area:

\[
\text{Area of Triangle} = \frac{3 \times 4}{2} = 6 \text{m}^2
\]

Volume:

\[
= 6 \times 7 = 42 \text{m}^3
\]
Self Assessment

Questions on Background Notes – Module 4.Unit 11

1. How many mm² in a square metre?

2. How many mm in an inch?

3. Find the volume of the prism.
Answers to Questions 1-3. Module 4.Unit 11

1.

One square metre contains:

\[ 1,000 \times 1,000 \text{mm} = 1,000,000 \text{mm}^2 \]

2.

25.4mm are in an inch.

3.

Cross sectional area \[ = \frac{4 \times 6}{2} = 12 \text{m}^2 \]

Volume \[ = 12 \text{m}^2 \times 10 = 120 \text{m}^3 \]
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