MEM05010B
Apply fabrication, forming and shaping techniques (Heavy Edition)

Learner guide
Version 1

Training and Education Support
Industry Skills Unit
Meadowbank

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Feedback

We value your opinion and welcome suggestions on how we could improve this resource manual. Keep in mind that the manual is intended to help students learn and is not a text book.

Send your comments and suggestions to:
Training and Education Support Industry Skills Unit, Meadowbank
Locked Bag No. 6
Meadobank NSW 2114
Ph: (02) 9942-3200
Fax: (02) 9942-3257
Topic 1 - Square and Rectangular Ducting

Theory and calculations square/rectangular fabrications

Ducting with flanges

Student Organiser

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**Job Planning for Square/Rectangular Fabrications**

Careful job planning is required for all types of fabrication work. Planning enables work to be carried out in an organised way, setting out each step (the sequence) in a sensible, logical order, will assist in making the finished product meet the required standard of quality.

There are three (3) stages to the job planning process.

**Stage 1: Pre-planning**
- Careful pre-planning from the start gives you more control over the entire fabrication process
- Interpret drawings
- Task sequence
- Organising equipment
- Make working drawings
- Develop patterns and/or templates

**Stage 2: Fabrication**
- To ensure the finished product is made to specifications, the fabricator will need to progressively check each step of the fabrication process
- Selection of material
- Mark out
- Cutting
- Forming
- Joining
- Finishing
- Installing
- Final quality check

**Stage 3: Finished product**
- Effective quality control is a key to success for any business. Without quality control the results for the company could be costly
- Loss of repeat work
- High labour cost to do recall / warranty work
- Material losses
- No recommendation for other work
- Company closure and unemployment

**NOTE:** All employees in the workplace are responsible for quality control and safety.
**Drawing Interpretation of Square/Rectangular Fabrication**

Correct interpretation of workshop drawings is vital if the finished fabrication is to meet its specified size, shape and tolerance.

The material used for making ducting varies depending on its application. The most common material used is low carbon steel as it has good workability, structural strength and a relatively smooth surface which helps airflow. Ducting can also be made from stainless steel, aluminium, copper and plastic materials.

**Development method**

Parallel line development is the method used to develop square/rectangular shapes, using a series of parallel lines. The pattern is clearly seen when the shape is folded out flat.

**Marking out**

Involves three main steps:
1. Calculating required dimensions
2. Laying out and developing the pattern/template
3. Following production instructions

**Pattern calculations**

**Pattern length**

Length = Sides x 4

= 200 x 4

= 800 mm

Diagonal length check of pattern

= \sqrt{\text{Pattern length}^2 + \text{Pattern height}^2}

= \sqrt{800^2 + 600^2}

= \sqrt{640000 + 360000}

= \sqrt{1000000}

= 1000 mm

60° Height check

\[ \tan \theta = \frac{\text{opp}}{\text{adj}} \]

\[ \tan 30° = \frac{X}{200} \]

therefore \( X = 200 \times \tan 30° \)

= 200 x 0.577

= 115.4

= 115 mm

True length check of truncated slope

= \sqrt{115^2 + 200^2}

= \sqrt{13225 + 40000}

= \sqrt{53225}

= 231 mm

Pattern little height (h)

= Pattern height - 60° height

= 600 - 115

= 485 mm
**Bend calculations/allowances**

When calculating the stretchout length of a pattern for square/rectangular ducting you must allow for the thickness of material.

Stretchout lengths for material 3mm thick (or under) are calculated using the inside measurements of the ducting, because the amount of material loss in the bend to 90° is small.

When calculating the stretchout length of material greater than 3mm in thickness you must take into account the amount of material loss in the bend to 90°.

**NOTE**

O/S = outside dimension  
I/S = inside dimension  
IR = inside radius  
ID = inside diameter  
MD = mean diameter  
MC = mean circumference

**Calculation:**

\[
\text{I/S Length} = \left( \frac{O/S - 2 \times t}{2} \right) + \left( \frac{O/S - 2 \times t}{2} \right)
\]

\[
= \left( \frac{200 - 2 \times 3}{2} \right) + \left( \frac{200 - 2 \times 3}{2} \right)
\]

\[
= 194 + 194
\]

\[
= 388 \text{ mm}
\]

Half stretch pattern  
2 required @ 3mm by 388 x 600 mm sheet

**NOTE**

I/S = inside dimension  
IR = inside radius  
ID = inside diameter  
MD = mean diameter  
MC = mean circumference

Calculating distance around 90° bend

\[
\text{ID} = IR \times 2  
\text{MD} = ID + t
\]

\[
= 9 \times 2  
= 18 + 6
\]

\[
\text{ID} = 18  
\text{MD} = 24
\]

\[
\frac{1}{4} MC = \frac{MD \times 3.1416}{4}
\]

\[
= \frac{24 \times 3.1416}{4}
\]

\[
= 75.3984
\]

\[
= 18.8496
\]

\[
\text{Say} = 19 \text{ mm}
\]

Half stretch pattern  
2 required @ 407 x 600 x 6 mm plate
**Practical method to calculate the bend allowance**

An outside flange width of 160mm is required. To fabricate an accurate bend it is recommended that you adopt the following procedure using a sample piece of identical material which is used for the job.

**STEP (1)**
Measure a distance from a pre-marked datum lines for the bend, as shown below:

![Diagram showing a 150mm by 150mm plate with measurements](image)

**STEP (2)**
Now bend this to the required angle (i.e. 90°)

![Diagram showing a 158mm by 58mm piece of metal](image)

**NOTE:** The 58mm dimension is used as an example

**STEP (3)**
The sketch shows there is a 2mm reduction on each end. In turn you will have to increase your inside measurement to 152mm to make a finished outside flange width of 160mm.

---

**Production instructions**

Production instructions are the markings on fabricated jobs and components. Their purpose is to identify the component and clearly show what is to be done on (or with) the component. These instructions often determine the way a job is done and how the sequence of operations is carried out. The sketch below shows a typical example:

![Diagram showing production instructions](image)

Materials are cut by mechanical or thermal processes, the following are typical examples.

**Mechanical cutting**

1. Guillotines
2. Bench shears
3. Nibblers
4. Shears

When using mechanical cutting equipment you must comply with all safe operating procedures and OHS requirements.

**Thermal cutting**

1. Oxy-fuel gas cutting is used for any shape cut on low carbon steel.
2. Plasma cutting is often used for cutting and shaping low carbon, stainless steel, aluminium and other non ferrous alloys.