MEM05040B
Perform advanced geometric development - transitions

Learner guide
Version 1

Training and Education Support
Industry Skills Unit
Meadowbank

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Table of Contents

Introduction ................................................................. 7
1. General introduction ....................................................... 7
2. Using this learner guide ................................................... 7
3. Prior knowledge and experience ...................................... 8
4. Unit of competency overview ......................................... 8
5. Assessment .................................................................. 10

Topic 1: Principles and application of triangulation

development in the metal fabrication industry ..................... 13

Pattern development in the metal fabrication industry ........... 13
Determination of true length of lines (TL) .......................... 16
Principles of triangulation ................................................ 20
Computerised development .............................................. 21
Application of triangulation .............................................. 22
Review questions ................................................................ 23

Practical Jobs ................................................................. 25

Job 1: Round to rectangle transition .................................. 26
Job 2: Twisted transition square to square ........................... 28
Job 3: Transforming elbow ............................................... 30
Job 4: Corner forge hood ................................................ 32
Job 5: Irregular flaring transition ....................................... 34
Job 6: Furnace connection .............................................. 36
Job 7: Angular boot ....................................................... 38
Job 8: Three piece elbow - square to rectangle ................. 40
Job 9: Three piece elbow - round to rectangle ................. 42
Job 10: Offset reducing elbow - round to round ............... 44
Job 11: Three piece transitional elbow ............................. 46
Job 12: Three piece reducing elbow ................................. 48
Job 13: Two pronged furnace fitting ................................. 50
Job 14: Two way branch in round pipe ............................. 52
Job 15: Irregular "Y" transition ......................................... 54

Answers to review questions ........................................... 56
Sample assessment (Theory) ........................................... 57
Resource evaluation form ............................................... 59
3. Prior knowledge and experience
You may already have the knowledge, skills and experience relevant to this unit of competency that you have gained due to your work, life experience or from a previous course. If it is the case, ask your teacher about having this learning recognised. You will need to produce evidence to demonstrate that you have the knowledge and skill level required for this unit of competency. Your teacher can advise you as to what types of evidence you could provide if seeking recognition of prior learning (RPL).

4. Unit of competency overview

Unit description
This unit of competency covers the outcomes required to mark out complex fabrications using advanced geometric development techniques. A number of relevant marking off/out tasks and practical jobs have been included in this resource to assist learners apply the triangulation development method to make complex shaped fabrications.

Content in this resource
The theory content in this learning resource has been developed to provide you with the underpinning knowledge (theory) associated with developing the knowledge and skills to apply triangulation pattern development concepts to produce complex transitional fabrications involving square/rectangular/round shapes.

Information in this resource includes:
- Theory notes and allied calculations
- Job sheets and instructions for advanced geometric development of transitional fabrications
- Practice work sheets to draw patterns on paper
- Drawings containing a selection of practical jobs which students can use to make complex shaped components
- Instructions to mark off components to minimise material wastage
- Review questions to help revise what has been learnt.

General note on drawings/sketches
The scale noted on a drawing is an indication for the original drawing only - as drawing/sketches are only depictions in this resource, their dimensions may well be different from their original scales in order to fit them into the layout.

Unit pathway
MEM05040B Perform advanced geometric development - transitions is a unit in the MEM05, Metal and Engineering Industry Training Package. It is a trade level unit of study in Certificate III, IV and Diploma Advanced Trade.

The intention of MEM05040B Perform advanced geometric development - transitions is to develop your knowledge and skills to competently:
- Estimated the amount of material needed to make a job
- Develop patterns
- Produce templates
- Mark off/out fabrications
- Interpret relevant codes, symbols and Standards.

Training in geometric development includes the following unit pathways:
Overview of skill practice / skill tests

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<thead>
<tr>
<th>Job 1</th>
<th>Job 2</th>
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<th>Job 5</th>
<th>Job 6</th>
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Topic 1: Principles and application of triangulation development in the metal fabrication industry

Objectives

To demonstrate competence at the end of this topic you will be able to:

• Define the key principles and elements of triangulation pattern development
• Name the distinguishing features of transitional sections
• List typical industrial applications where triangulation development techniques are applied
• Define terms commonly used in triangulation pattern development
• Determine true length and true shape of lines including labelling
• Describe the use of templates, identification and storage
• Develop patterns for square and rectangular to round transitional reduction pieces to a tolerance of ± 0.5 mm on paper/sheetmetal.

Pattern development in the metal fabrication industry

Pattern development is used to produce templates or to develop a single pattern which is then cut, formed, joined, completed and installed to become a completed article.

Methods of pattern development

There are three common methods of developing patterns/templates for the surfaces of articles. They include:

• Parallel line
• Radial line and
• Triangulation.

Patterns based on the above methods may also be generated by a number of computer packages, many of which are available. The methods used depend upon the geometric form of the article.

In this unit, we concentrate on the triangulation development method to produce complex transitional patterns and shapes.

Triangulation is the pattern development method based on dividing the surface of an article into triangles, finding the true size of each triangle separately and placing them side by side in the correct order to build up the full pattern.

Applications of triangulation development

Triangulation is the plotting of geometric shapes by the use of connecting triangles. Within the fabrication industry triangulation is used to develop patterns for shapes or components that are unsuitable to be developed by either parallel line or radial line methods.

Shapes that require development by triangulation include:

• Three dimensional sections
• Two dimensional panels.

Three dimensional sections

Three dimensional section articles that change their geometric shape from one end to the other and are called transitions. They include hoods, hoppers, reducers, connectors, elbows, tapered branches etc.

Typical types of three dimensional transitions are shown below:

Simple transitions

Obround to round
Rectangle to round
Round to square
**Tapered transitions**
- Rectangle to rectangle
- Square to square
- Round to round

**Twisted transitions**
- Rectangular duct

**Compound transitions**
- Transitional bend (elbow)
- Transitional offset
- Breeching piece

**Two dimensional panels**
They are flat panels, covers and signs that have out-of-square sides. They include covers for boxes, cabinets or frames etc. They would require development using triangulation by diagonals.

**Odd shaped end panels**
- Odd shaped end panels
- Out of square cover

**Typical uses of transitions**
Various types of transitions are commonly used in the fabrication industry to:
- Transform geometric shapes eg square/rectangle to round transitions
- Convey materials eg hoppers and chutes
- Transport air in ventilation systems eg duct fittings and fan casings

**Types of transition**
A transition is a fabricated section used to transfer from one shape or size to another shape or size.
There are two types of transitions:
- Concentric (on centre)
- Eccentric (offset).

Concentric transitions have their centres of openings directly opposite each other on the same axis. Typical examples are shown below.
Eccentric transitions can have their centres of openings offset in one or two directions. Typical examples are illustrated below.

**Offset in one direction**

![Top view of an offset rectangle to rectangle transition offset in one direction](image1.png)

![Top view of an offset rectangle to round transition offset in one direction](image2.png)

**Offset in two direction**

![Top view of an offset rectangle to rectangle transition offset in two directions](image3.png)

![Top view of an offset round to rectangle transition offset in two directions](image4.png)

**Triangulation development terminology**

Before you start to develop shapes it is important to understand the terminology used to describe the components that make up the development. Terms and definitions commonly used in triangulation development include:

- **Axis**: The centreline about which an object may rotate.
- **Bend line**: A location line for forming.
- **Centrelines**: Usually mid-lines which act as datums for dimensions.
- **Generator lines**: The main dividing lines used in pattern development.
- **Projection line**: A line drawn from one view to another.
- **Seam**: A line where two edges are joined together.
- **Stretchout**: The length around a true shape of section (TSS) used for a pattern when unfolded or rolled out flat.
- **True length**: The length of a line viewed at right angles to the line.
- **X-Y line**: A reference datum line drawn at right angles to a centre line.

**Truncated prism**  
A prism cut off at the top or bottom by a plane not parallel to the base.

**True shape (TS)**  
The shape of an object when viewed at 90° to its face.

**Base**  
The bottom surface of an object.

**Top**  
The top surface of an object.

**Edge**  
The boundary line of a surface.

**Curved surface**  
A surface rolled or formed.

**Flat surface**  
A surface with no deviations.

**True shape of section (TSS)**  
The shape viewed when a prism is cut at 90° to its axis.

**Pattern blank**  
The cutting size of the material, including allowances required for the pattern.

The above terminology will be referred to in this learner resource. Some examples are given below.
Determination of true length of lines (TL)

This information is included as revision from other units of competency.

Identification of lines and points is very important when developing patterns/templates using geometric development methods. When interpreting the views presented on a drawing you must be able to identify the lines which are true length (TL). Lines shown on a drawing may appear to be an actual true length but this is not always the case.

**Explanation**

The sketch shows a ladder leaning against a wall. The true length of the ladder can only be seen by viewing from the side. The ladder would appear as a shorter length in the front and top views.

On any front, top or side view, some lines are true lengths. The lines which are not true lengths must be identified so that their true length can be determined. On a drawing, lines which are at 90° to the viewer's line of vision are natural true lengths. Lines which are inclined at an angle towards or away from the viewer are not true lengths.

To determine if a line is a true length the drawing must show the line projected into two (2) or more views.

Illustrated below are the five (5) examples of how a line must be viewed to determine its true length. If none of these examples applies, then the line is not a true length. When producing patterns using the parallel line method of development all generator lines used to mark out the pattern must be true lengths.

The examples can be reduced from five (5) to three (3) because examples 2 and 5 are the reverse of each other as are examples 3 and 4.

These principles apply to all geometric development methods and form a basis on which the true shape (TS) and true shape of section (TSS) or profile view of components can be determined.

**Labelling**

To identify lines and points the fabricator uses a labelling system. There is no standard labelling system and the usual practice is to use letters, numbers or a combination of both. Fabricators will use the system they are most familiar with when developing patterns.

When using the triangulation method of development it can be advantageous to use one letter or a number to identify the generator lines in each view, as shown above.

**Labelling of patterns**

When developing patterns a labelling system must be used to identify generator lines and points. To label the views for transitions the following procedure is normally used:

- Identify the position of the seam on the view showing the true shape of the top and bottom of the transition (TS)
- Label the view, starting at the seam in a clockwise direction
- Label the remaining views to correspond.

**Note:** The position of generator lines will vary from view to view. The number of divisions of the round end of a transition will depend on the diameter of the circle. Larger diameters will require more divisions.