First Published January 2020

Edition 1 – December 2020

Conditions of Use:

Unit Resource Manual

Manufacturing Skills Australia Courses

This Student's Manual has been developed by BlackLine Design for use in the Manufacturing Skills Australia Courses.

Additional resource units can viewed and be ordered at www.acru.com.au

Feedback:

Your feedback is essential for improving the quality of these manuals.

This unit has not been technically edited. Please advise BlackLine Design of any changes, additions, deletions or anything else you believe would improve the quality of this Student Workbook. Don't assume that someone else will do it. Your comments can be made by photocopying the relevant pages and including your comments or suggestions.

Forward your comments to:

BlackLine Design

blakline@bigpond.net.au

Sydney, NSW 2000

Corporate Licenses

State and National TAFE Colleges and Institutes, and Registered Training Organisations are eligible to purchase corporate licenses.

All licenses are perpetual and allow the licensee to upload the material onto a delivery system (Moodle etc), print the resource in book form and sell or distribute the material to enrolled students within their organisation. The license allows the holder to re-badge the material but must retain acknowledgment to BlackLine Design as the original developer and owner.

Aims of the Competency Unit:

This unit of competency defines the skills and knowledge required to produce drawings to AS 1100 Technical drawing or equivalent using manual drafting or drawing equipment, where the critical dimensions, associated tolerances and design specifications are predetermined.

Where a computer-aided design (CAD) system is used unit MEM09009 Create 2-D drawings using computer-aided design system and MEM09010 Create 3-D models using computer-aided design system, should be selected as appropriate.

Unit Hours:

72 Hours

Prerequisites:

MEM09002	Interpret technical drawing
MEM09003	Prepare basic engineering drawing
MEM12023	Perform engineering measurements
MEM12024	Perform computations
MEM13015	Work safely and effectively in manufacturing and engineering
MEM16006	Organise and communicate information

Elements and Performance Criteria

Elements describe the essential outcomes.		Performance criteria describe the performance needed to demonstrate achievement of the element.	
1	Determine job requirements	1.1	Follow standard operating procedures (SOPs)
		1.2	Comply with work health and safety (WHS) requirements at all times
		1.3	Identify job requirements from specifications, job sheets or associated work instructions
2	Prepare assembly, layout and detail drafting	2.1	Prepare drawings in plane orthogonal, isometric projection or equivalent, including auxiliary views and sections to AS 1100 Technical drawing
		2.2	Prepare layout, assembly, and component drawings from specifications
		2.3	Apply drawing dimensions and label using supplied tolerances in accordance with AS 1100 Technical drawing
		2.4	Produce drawings to specification in accordance with SOPs
		2.5	Use standard symbols to AS 1100 Technical drawing, or equivalent, to specify requirements
3	Determine component and material requirements	3.1	Identify component and material requirements according to design specifications
		3.2	Compile component and materials list
4	Complete documentation	4.1	Complete drawings and associated documentation in accordance with SOPs
		4.2	Store drawings and documentation in accordance with SOPs

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

AS 1100 Technical drawing includes the following:	interpretation under guidance, particularly in respect to any geometric tolerancing. AS 1100 Technical drawing is an extensive work, and its application would usually be in line with SOPs

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria on at least two (2) occasions and include:

- following work instructions, standard operating procedures (SOPs) and safe work practices
- preparing layout, assembly and component drawings to AS 1100 Technical drawing in line with SOPs in plane orthogonal, isometric projection or equivalent, including auxiliary views and sections
- applying dimensions and labelling using supplied tolerances
- producing drawings to specifications using standard symbols to AS 1100 Technical drawing or equivalent
- undertaking numerical operations, geometry, calculations and formulae associated with performing basic engineering detail drafting
- compiling a component and materials list
- completing documentation according to SOPs.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- safe work practices and procedures
- appropriate projection for the drawing purpose and reasons for selection
- reasons for including auxiliary views in drawings
- requirements of AS 1100 Technical drawing or equivalent with respect to dimensions, tolerances and labels
- procedures for producing component, layout and assembly drawings, and uses of drawings
- numerical operations, geometry, calculations and formulae associated with performing basic engineering detail drafting
- common symbols used in drawings to AS 1100 Technical drawing or equivalent
- design specifications of components
- appropriate components and materials from supplier catalogues and reasons for selection.

Assessment Conditions

- Assessors must:
  - have vocational competency in performing basic engineering detail drafting at least to the level being assessed with relevant industry knowledge and experience
  - satisfy the assessor requirements in the Standards for Registered Training Organisations 2015 or its replacement and comply with the National Vocational Education and Training Regulator Act 2011, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions. This must cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills
- Conditions for assessment must include access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Exercise Titles and Numbering:

If creating the drawings using CAD each exercise is to be saved in your work folder as the Tutorial Exercise or Skill Practice Exercise number, e.g. MEM09005-SP0101.

If producing the drawings using mechanical drawing techniques, the drawing number is to be the same as the Tutorial Exercise or Skill Practice Exercise number, e.g. MEM09005-SP0101.

Lesson Program:

Unit hour unit and is divided into the following program.

Topic	Skill Practice Exercise
Topic 1 – Revision:	MEM09005-SP-0101 to MEM09005-SP-0105
Topic 2 – Isometric Drawing:	MEM09005-SP-0201 to MEM09005-SP-0204
Topic 3 – Assembly Drawings:	MEM09005-SP-0301
Topic 4 – Assembly to Detail Drawings:	MEM09005-SP-0401 to MEM09005-SP-0408
Topic 5 – General Tolerance Dimensions:	MEM09005-SP-0501 to MEM09005-SP-0508
Topic 6 – Surface Finish Indication:	MEM09005-SP-0601 to MEM09005-SP-0608
Topic 7 – Geometric Tolerance:	MEM09005-SP-0701 to MEM09005-SP-0708
Topic 8 – Keyways & Keyseats:	MEM09005-SP-0801 to MEM09005-SP-0803
Topic 9 – Hole & Shaft Basis Systems:	MEM09005-SP-0901 to MEM09005-SP-0902
Review Question Answers:	MEM09005-RQ-01 to MEM09005-RQ-05
Practice Competency Test	MEM –PT-01

Contents:

Topic 1 – Revision:

Required Skills:

- Name the projection methods used to produce engineering drawings.
- Identify projection symbols and distinguish the difference between First Angle and Third Angle Projection.
- Minimum number of views required to describe the component/assembly.
- Produce a drawing of a components containing a section view.
- Produce a drawing of a component requiring an auxiliary view.

Required Knowledge:

- Application of AS1100.
- Relationship between the views contained in the drawing.
- Objects represented in the drawing.
- Dimensioning detail views.
- Sectional and Auxiliary views.

NOTE:
This topic is intended to introduce the student to the types of projection, names, and positions of the views. The drawing of orthogonal views in engineering drawings is covered in units MEM09003 Prepare basic engineering drawing and MEM09005 Perform basic engineering detail drafting, and other drafting discipline related units.

Orthographic Projection:

Most drawings produced and used in industry are multiview drawings. Multiview drawings are used to provide accurate three-dimensional object information on two-dimensional media, a means of communicating all of the information necessary to transform an idea or concept into reality. The standards and conventions of multiview drawings have been developed over many years, which equip us with a universally understood method of communication.

Multiview drawings usually require several orthographic projections to define the shape of a three-dimensional object. Each orthographic view is a two-dimensional drawing showing only two of the three dimensions of the three-dimensional object. Consequently, no individual view contains sufficient information to completely define the shape of the three-dimensional object. All orthographic views must be looked at together to comprehend the shape of the three-dimensional object. The arrangement and relationship between the views are therefore particularly important in multiview drawings.

Orthographic projection is a system of drawing to represent 3-D objects by using multiple view drawings. The word "Ortho" is a Greek word that means right or true. In this system of projection, the 3-D object is projected perpendicularly onto a projection plane with parallel projectors as shown in Figure 1. 1.

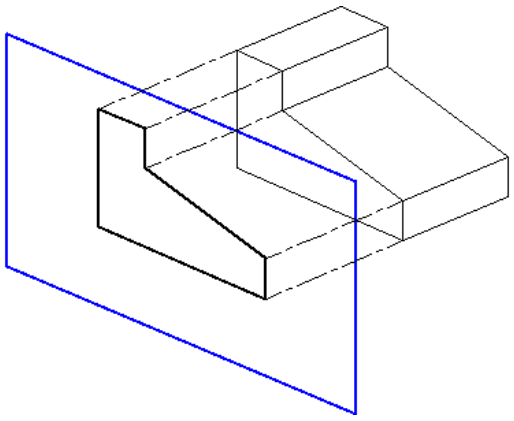


Figure 1. 1

Basic Views:

All objects can be projected in six orthogonal directions (**Error! Reference source not found.**). The resulting views are called basic views. Orthogonal Projection can be thought of as a 3D object being placed inside a transparent box, and views projected orthogonally onto the six walls of the box.

The basic views are:

- Front View
- Top View
- Right & Left Views
- Bottom View
- Rear View

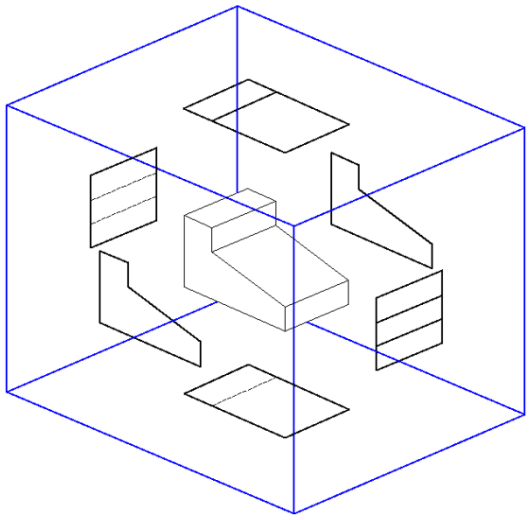


Figure 1. 2

Developing the Box:

The transparent box may suit a "virtual Reality" environment; it cannot be placed on a drawing or forwarded to the workshop. To make sense on the drawing, the box is opened or spread-out onto a common plane which is the drawing sheet.

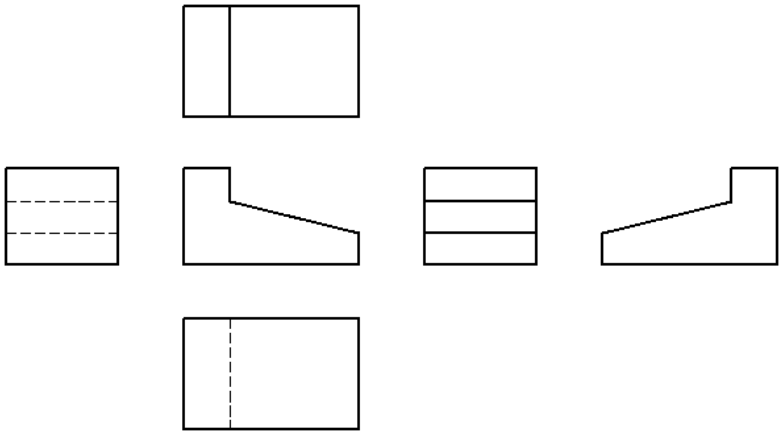


Figure 1. 3

Figure 1. 3 shows how the drawing would look like after cutting and spreading out the box.

Projection Systems:

Two methods of projection have been used to produce engineering drawings; Third Angle Projection is the preferred method stated in AS 1100 and is used throughout Australia in most drafting disciplines; however, some drafting disciplines still tend to use First Angle Projection. The difference between Third and First Angle Projection is the position of the Side, Top and Bottom Views in relation to the Front View. Until around 1890 all countries produced drawings in First Angle Projection, modern multi-national offices work entirely in Third Angle Projection.

Third Angle Projection:

The plane of projection lies between the observer and the object.

When the views are drawn, the Top View is located ABOVE the Front View, the Left Side View is located to the LEFT of the Front View, the Right View is located to the RIGHT of the Front View, and the Bottom View is located directly BELOW the Front View.

N.B. The views are drawn from where the object is being viewed. Viewed from the left and drawn on the left; viewed from on top and drawn on top.

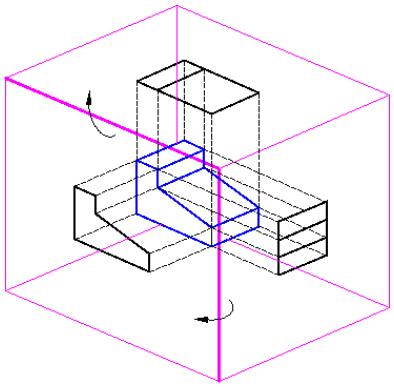


Figure 1. 4

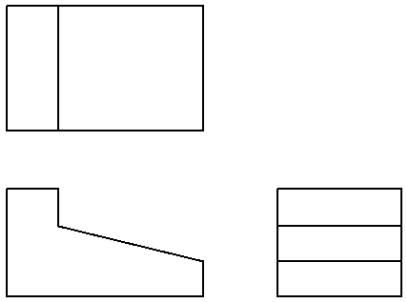


Figure 1. 5

Number of Views:

The number of views required depends on the complexity of the component; some drawings may require only one view with the width of the material shown under the Title while other components may require 5 or 6-views to fully describe the object. Figure 1. 6 shows a complex cam that requires only 1-view to fully show all the features and dimensions; the thickness is constant, and Side View would only show a rectangle so the thickness can be placed below the Title.

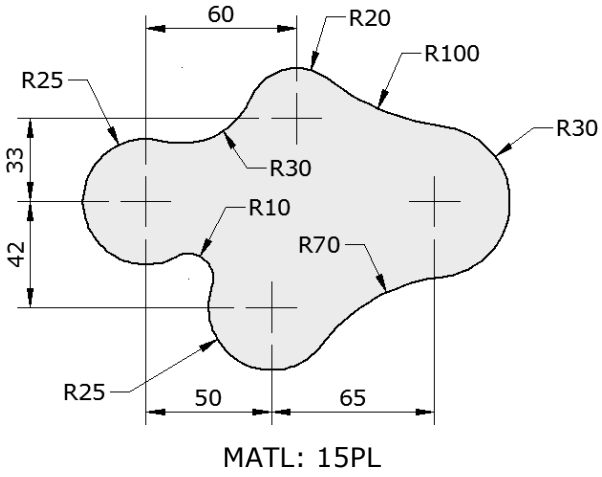


Figure 1. 6

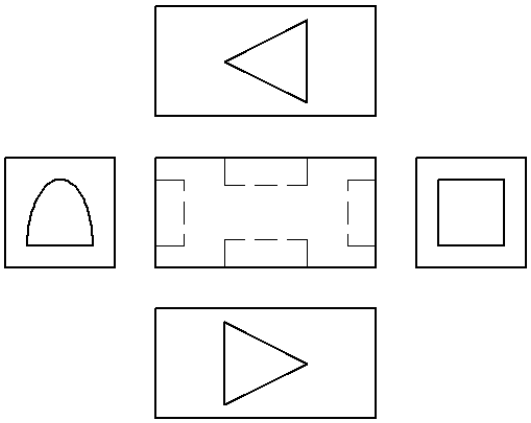


Figure 1. 7

Figure 1. 7 shows a simple hypothetical block with a series of different shape holes; however, 5-views are required to fully describe the shape.

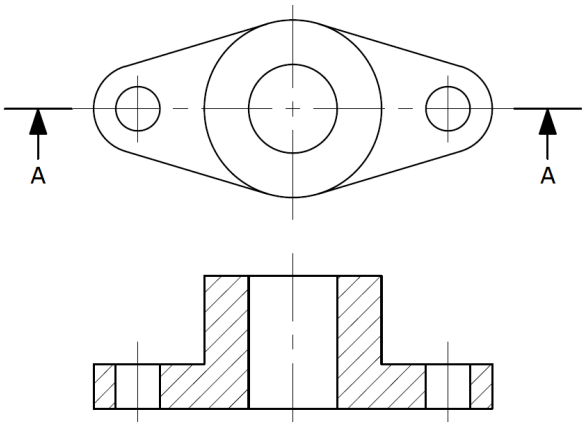
Most detail drawings require 3-views to fully display the shape of the component and its dimensions however some components could only require 2-views, especially if it is symmetrical.

N.B. The number of views depends on the complexity of the object being drawn.

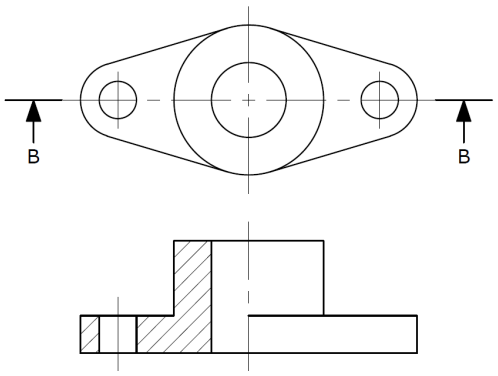
Sections:

A sectional view or a section looks inside an object. Sections are used to clarify the interior construction of a part that cannot be clearly described by hidden lines in exterior views. By taking an imaginary cut through the object and removing a portion, the inside features may be seen more clearly. Any material/s physically cut by the imaginary cutting plane is indicated by cross-hatching.

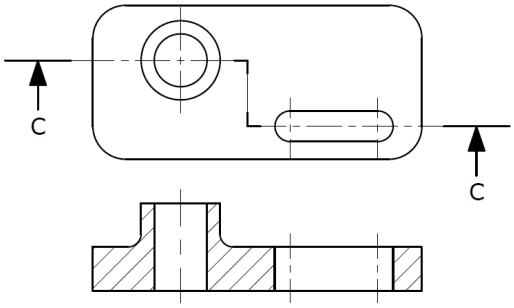
Types of sectional view include Full Section, Half Section, Offset Section, Broken Out Section, Aligned Section, Revolved Section and Removed Section.



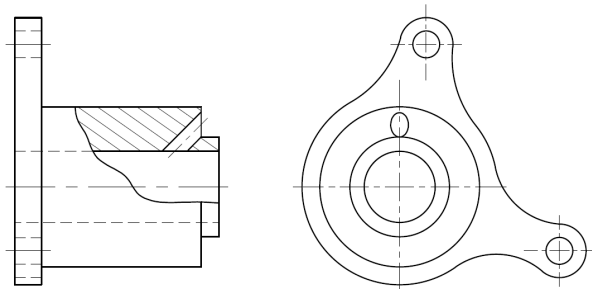
Full Section



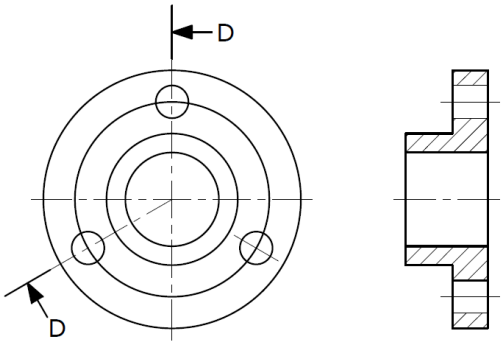
Half Section



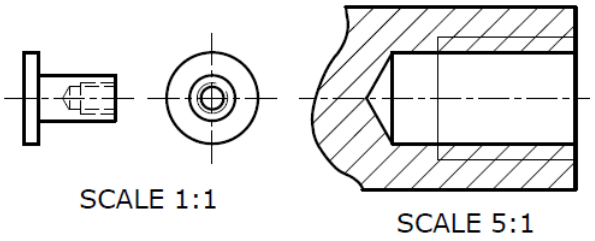
Offset Section



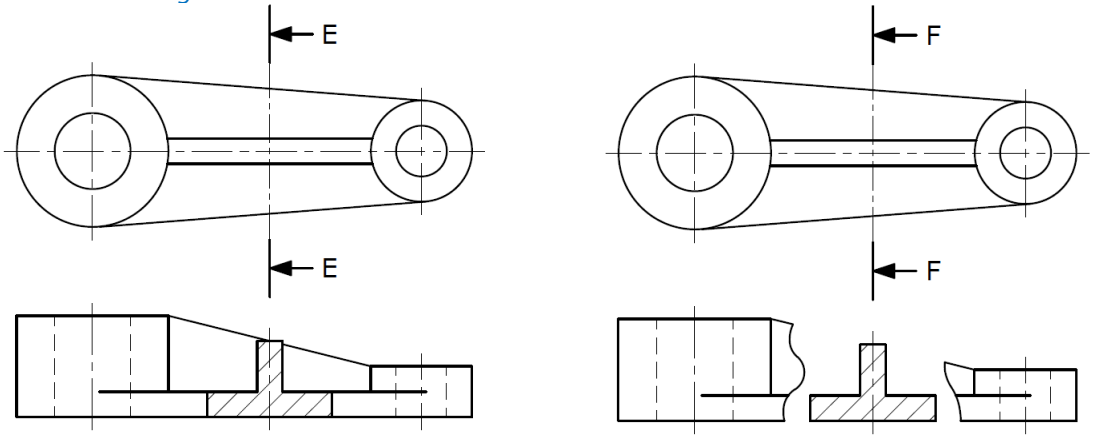
Broken-Out Section



Aligned Section



Removed Section



Revolved Section

Auxiliary Views:

Any view NOT projected onto one of the principal planes is called an Auxiliary View. An Auxiliary View is projected to a plane perpendicular to the inclined surface of the object.

The purpose of the Auxiliary View is to show the true shape and size of an inclined surface of an object because the inclined surfaces appear foreshortened and out of perspective in the normal Front, Top and/or Side Views.

The method of projecting the profile of an object to an auxiliary plane is identical to the method used for projecting a profile to one of the principal planes.

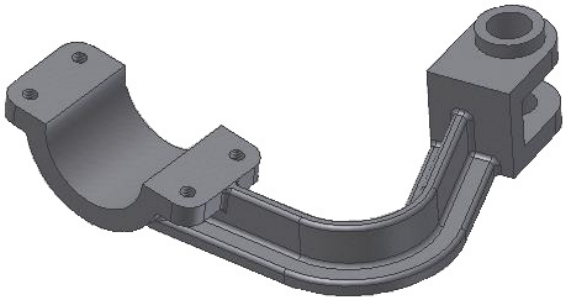


Figure 1. 8

Views of the Steering Arm are projected perpendicular to each face to obtain the true surface in each direction.

In practical work, the main reason for using Auxiliary View is to show the true shape of an inclined surface.

In an Auxiliary View , the inclined surface will be shown in its true shape, but the other faces of the object appearing in the view will be foreshortened and out of shape.

Figure 1. 8 shows a Steering Arm where the Yoke and Bearing Support are both offset at an angle to the principal orthogonal projection planes.

Figure 1. 9 displays Front and Side Views of the Steering Arm the true shapes of the offset ends are slightly foreshortened.

Views A & B in the Front View and C & D in the Right Side View, are Auxiliary and are used to show the correct or trrue shape of the end surfaces.

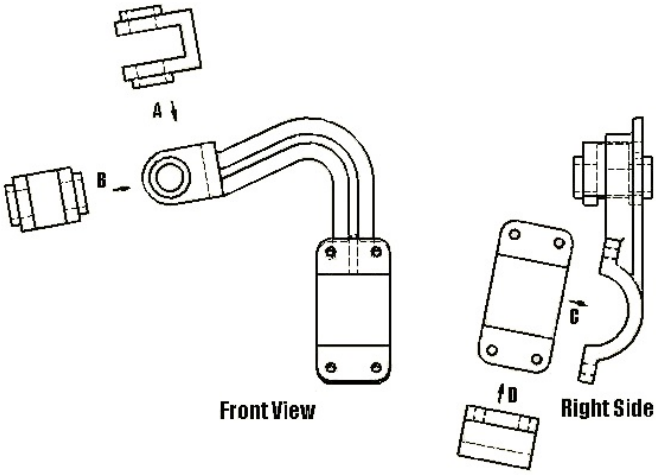


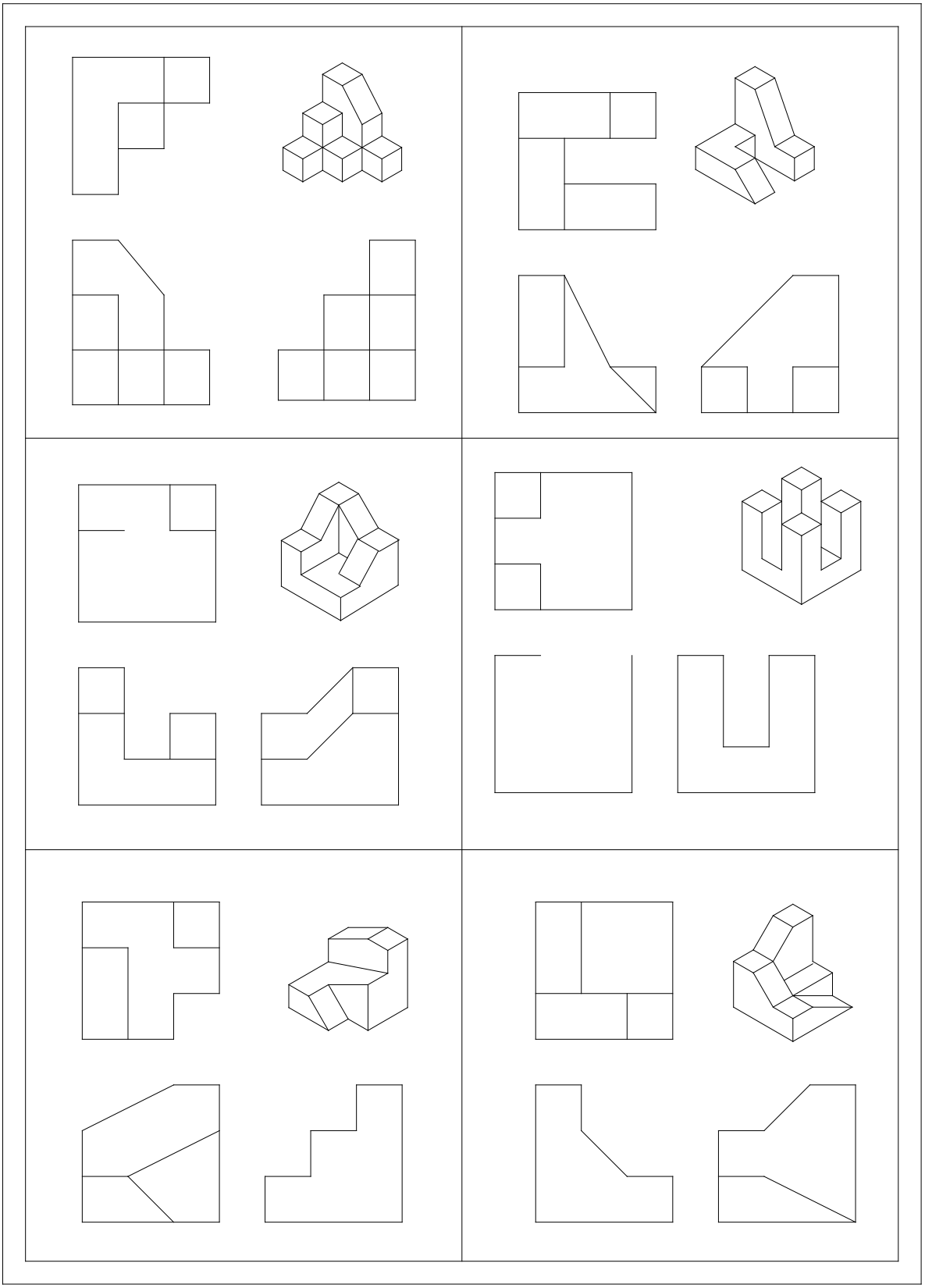
Figure 1. 9

Figure 1. 10

Skill Practice Exercises:

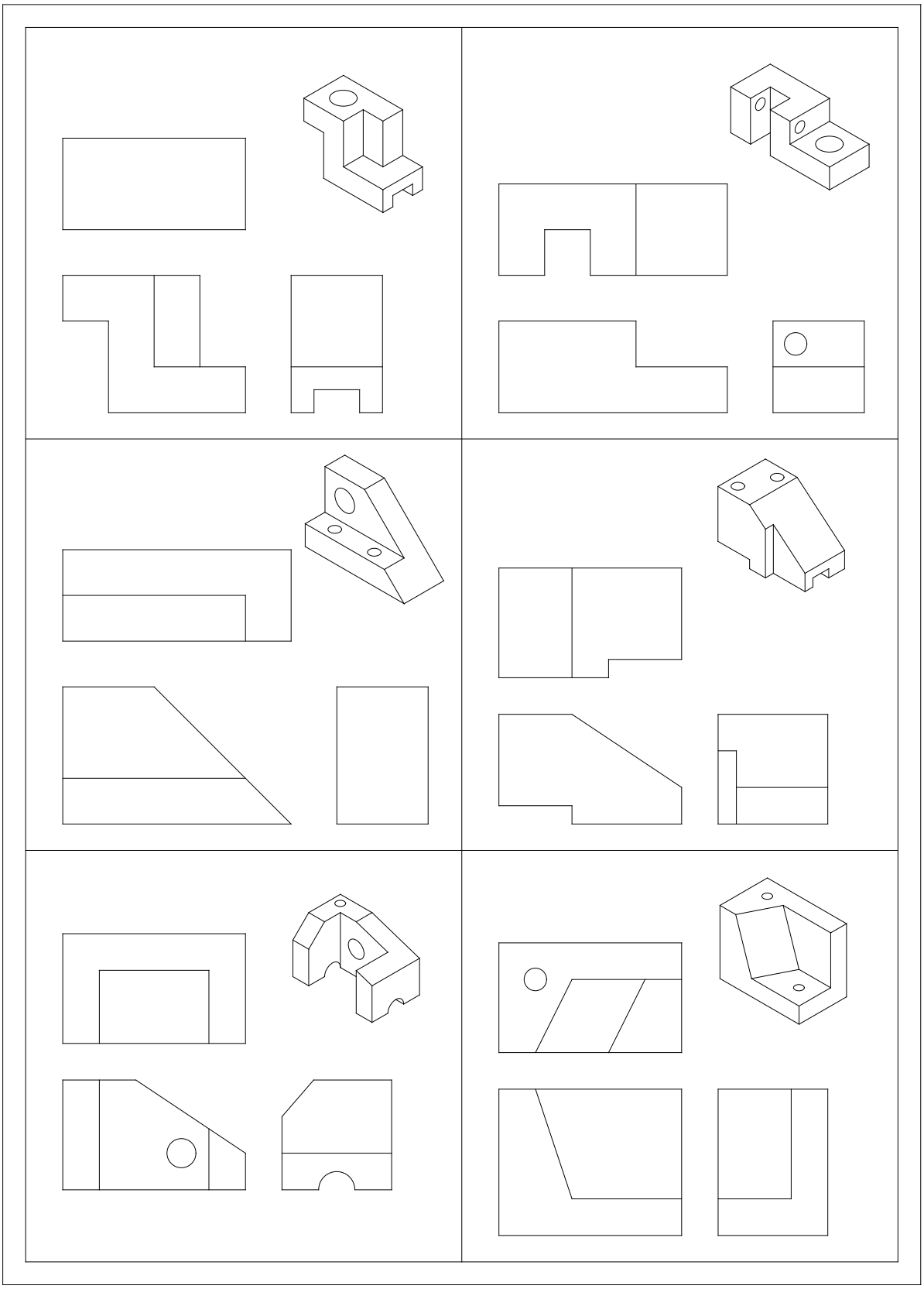
Skill Practice Exercise MEM09002-SP-0101

Print this page and add the missing lines. Write your name on the bottom of the sheet.



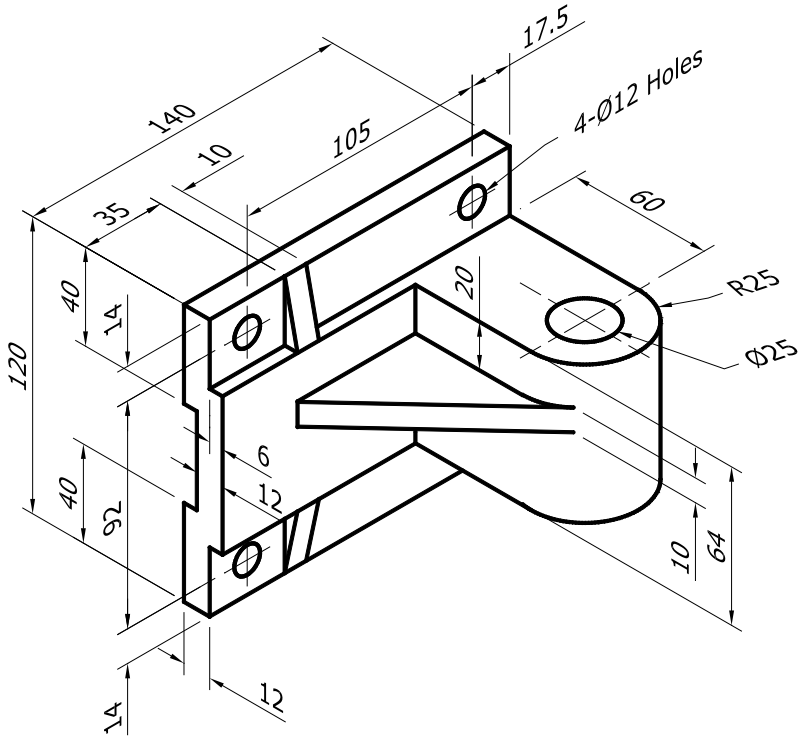
Skill Practice Exercise MEM09002-SP-0102

Print this page and add the missing lines. Write your name on the bottom of the sheet.



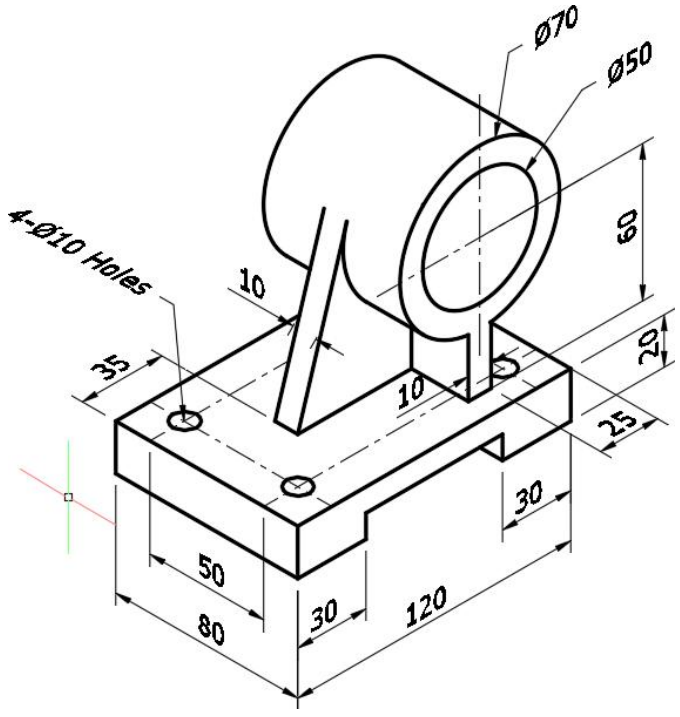
Skill Practice Exercise MEM09002-SP-0103

Produce a drawing of the Shaft Bracket in Third Angle Projection. Fully dimension and include a completed A3 sheet. Save the drawing in your work folder as MEM09005-SP-0103 if produced on CAD. Print the drawing and submit for marking. Any missing dimensions can be estimated.



Skill Practice Exercise MEM09002-SP-0104

Produce a drawing of the Guide Bracket in Third Angle Projection showing a full sectional Front and End Views where the cutting plane passes through the centre of the webs. Fully dimension and include a completed A3 sheet. Save the drawing in your work folder as MEM09005-SP-0104 if produced on CAD. Print the drawing and submit for marking. Any missing dimensions can be estimated.



Skill Practice Exercise MEM09002-SP-0105

Produce a drawing of the Guide Bracket in Third Angle Projection showing a full sectional Front and End Views where the cutting plane passes through the centre of the webs. Fully dimension and include a completed A3 sheet. Save the drawing in your work folder as MEM09005-SP-0105 if produced on CAD. Print the drawing and submit for marking Any missing dimensions can be estimated.