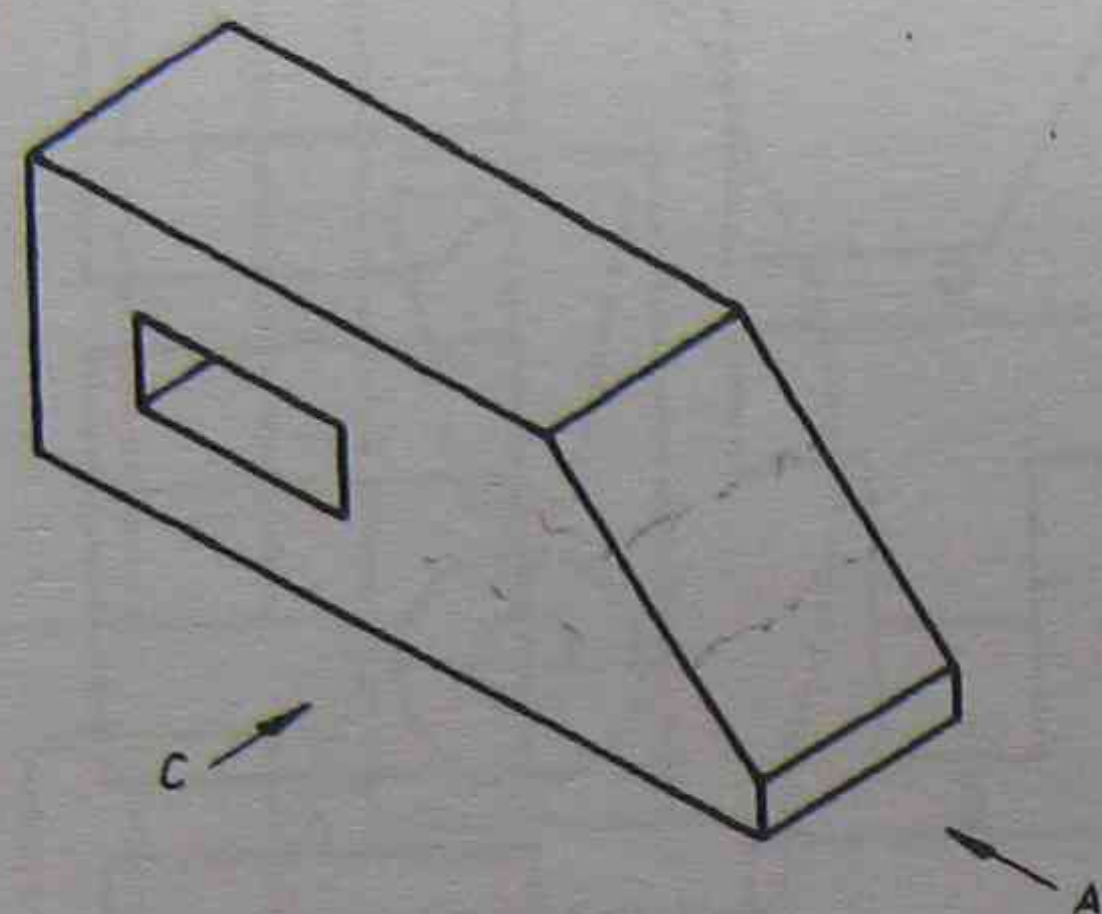


Type

EXERCISE: 2

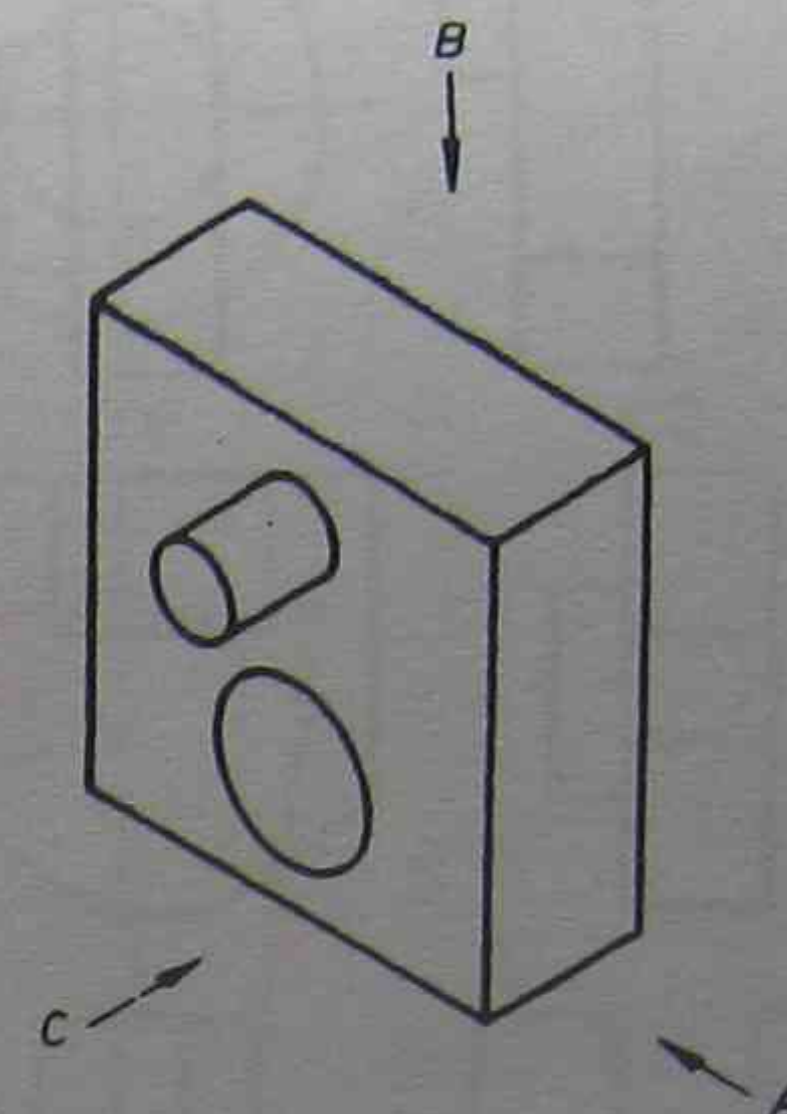
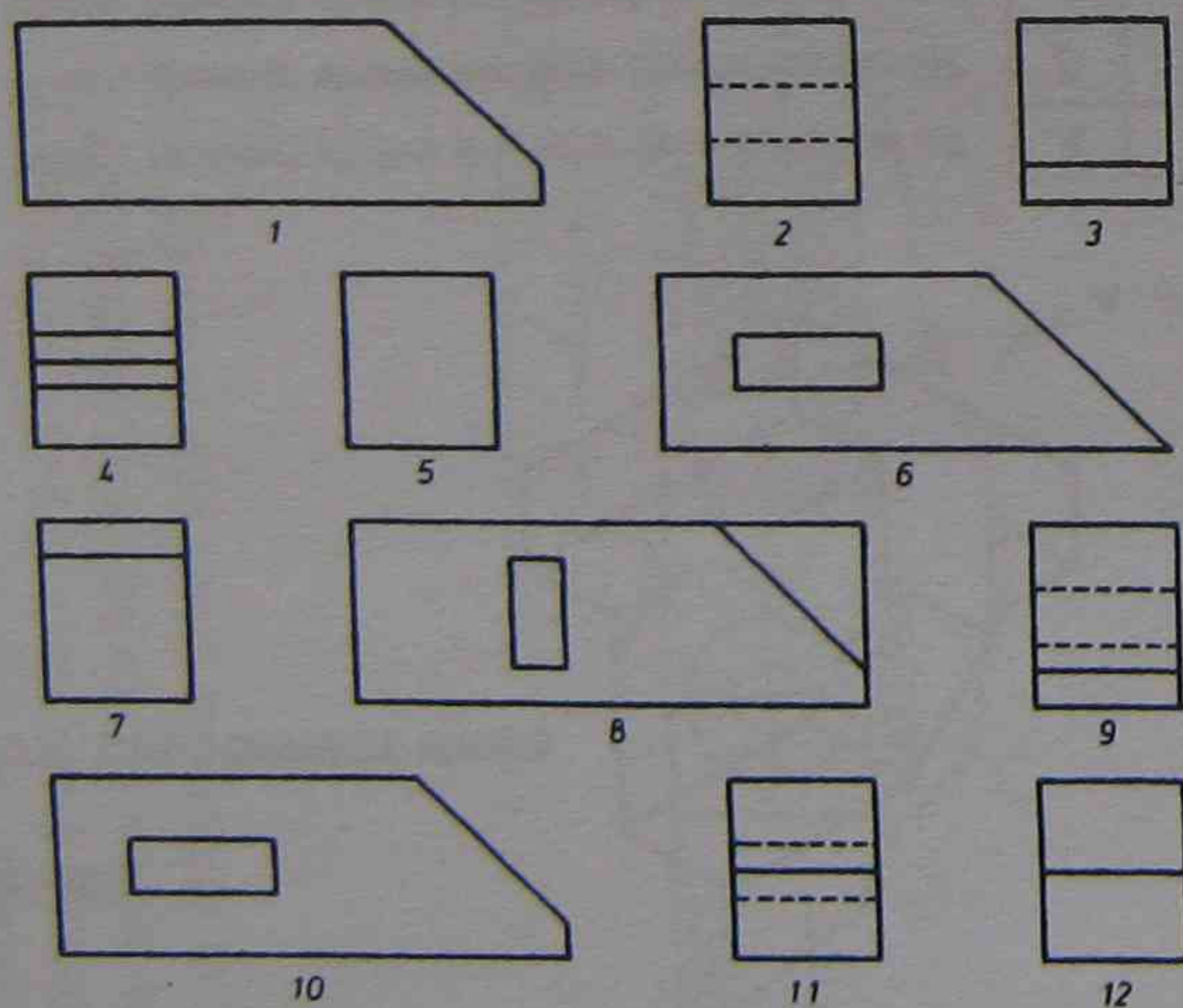
SELECT THE CORRECT VIEWS



Which drawing shows the view from Direction A?

Which drawing shows the view from Direction C?

A	9
C	10

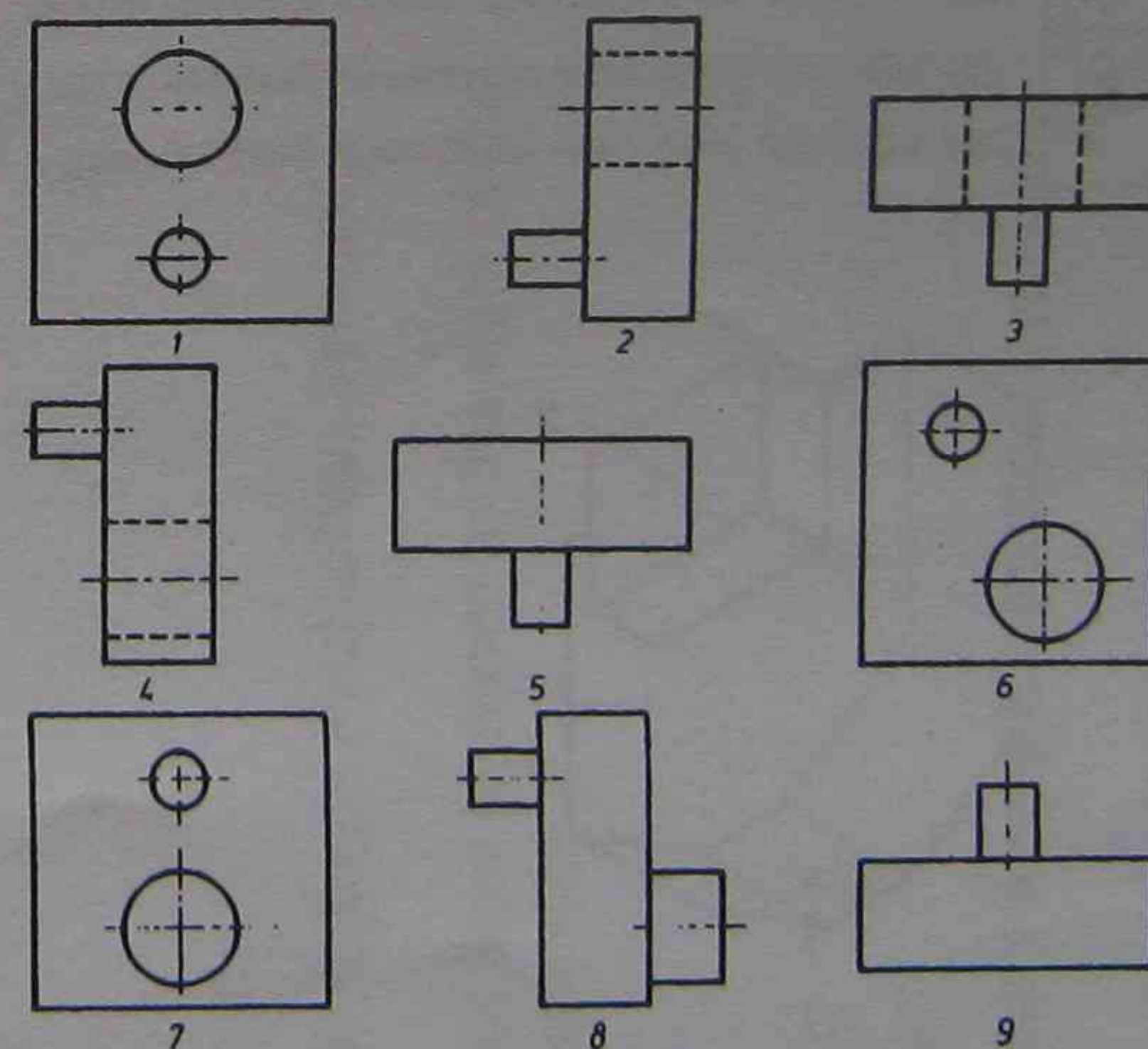


Which drawing shows the view from Direction A?

Which drawing shows the view from Direction B?

Which drawing shows the view from Direction C?

A	4
B	3
C	7



INTRODUCTION

1. MECHANICAL DRAWING INTERPRETATION

REVIEW QUESTIONS

2. ORTHOGONAL AND PICTORAL DRAWING

REVIEW QUESTIONS

3. BUILDING STRUCTURES, MATERIALS AND SEQUENCING

REVIEW QUESTIONS

4. ARCHITECTURAL DRAWINGS

REVIEW QUESTIONS

Resources and references

Engineering Drawing Handbook SAA HB7 – (latest edition)
Electrical and Electronic Drawing Practice for Students HB 3:1996
A W Boundy. *Engineering Drawing 5th Edition*, McGraw Hill, 1996
J.F. Lowe, *Drawing for Electrical Trades 2nd Edition*, McGraw Hill, 1988
Basic Training Manual 16-11 *Electrical Trades Building Structures*, 1982
NBB12 Engineering Drawing Interpretation, Manufacturing & Engineering Division
EA061 Engineering Graphics, Manufacturing & Engineering Division
EA701 Engineering Drawing (Detail) Manufacturing & Engineering Division
Australian Standard 1100 – Technical Drawing series
Australian Standard 1101 – Graphical Symbols series
Australian Standard 1102 – Graphical Symbols for Electrotechnical Documentation series

Introduction

This resource manual contains learning exercises, review questions and sample assessment instruments. It is designed to assist students achieve the outcomes and purpose described in the national module descriptor *NUE* and is an example of the depth and breadth of learning expected.

The topics listed in the content are arranged in the preferred learning sequence. It is recognised that this is not the only sequence in which the material could be learnt. Assessment arrangements and sample assessment instruments are based on the sequence of topics listed above. A teacher may decide that for a particular student or group of students it is more effective to present the topics in a different sequence. In this case the students must be informed in writing of the resulting changes in the assessment events before starting the module.

Learning plan

The following topic weighting will help you plan and allocate the effort needed to achieve the purpose and outcomes of the module.

Topic

1. Mechanical drawing interpretation
2. Orthogonal and pictorial presentation
3. Building structures, materials and sequencing
4. Architectural drawing

1. Mechanical Drawing Interpretation

Purpose

In this topic you will learn how to use engineering drawings and the importance of standards and conventions used to allow the interpretation of the information they contain

Objectives

At the end of this topic you should be able to:

- State the reasons for technical drawing standards
- Apply conventions and specifications to AS 1100
- List the types and functions of engineering drawings
- List drawing sheet types and sizes
- State the information contained in a typical title block
- Identify and produce line types used on engineering drawings
- Dimension a drawing using common dimensioning features
- Determine the correct scale to use for drawing objects of various sizes.
- Identify welding symbols used on engineering drawings

Purpose of Drawings in Industry

There are three main reasons for drawing in industry:

- **Communication**

Engineering drawing is the main method of communication between all people concerned with the design and manufacture of components, building and constructions, and engineering projects

- **Discussion**

Developing ideas and theories and discussing them with colleagues. For instance a manufacturer might discuss the problems of a manufacturing process with an engineer

- **Records**

Drawings are kept for:

- a) extra orders of components
- b) recording previous specifications
- c) records of current job specifications in case of faulty manufacture or design

Types and functions of engineering drawings

The basic engineering drawings are:

- assembly
- sub-assembly
- detail assembly
- detail
- Pictorial

Assembly drawings

Assembly drawings show a general overview of the complete job, with arrangements of parts and a list of parts. They are sometimes called general assemblies. They only show overall dimensions.

Sub-assembly drawings

Sub-assembly drawings only show the arrangement of a particular part, or a few parts, of the general assembly. They do not show any fabrication details. Sub-assembly drawings show how a part of the job is assembled, not fabricated

Detail assembly drawings

Detail assembly drawings show how the job is assembled, together with all the details you need to manufacture it.

Detail drawings

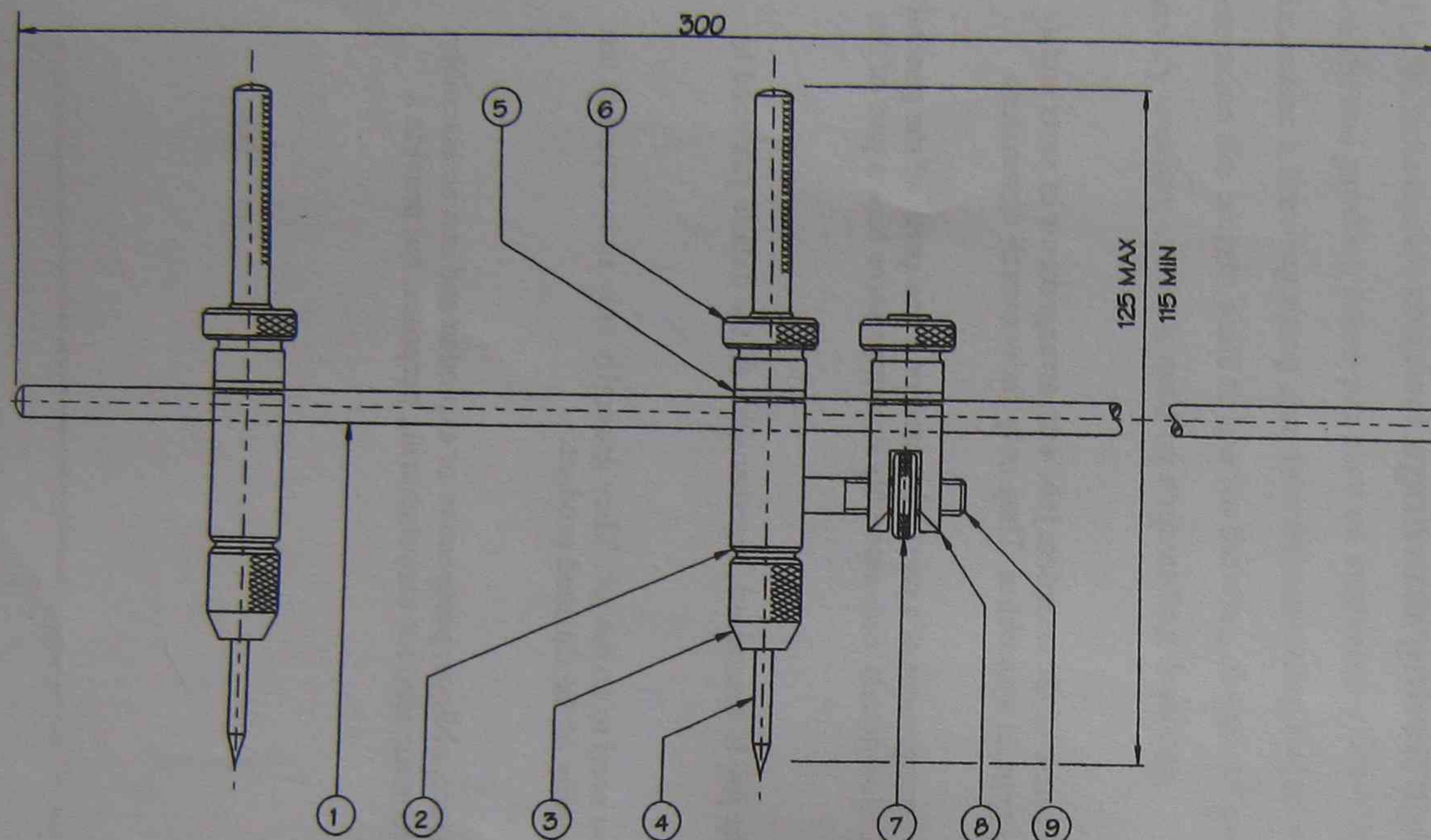
Detail drawings show all the details you need to do the job. They generally only show a part of the job, and do not show the complete assembly of the finished product.

Pictorial drawings

These can take the form of either isometric, oblique, perspective or exploded and can be assembly, sub-assembly or detail. They are not recommended for manufacturing purposes, but provide a picture.

AN ASSEMBLY DRAWING

THE SHEET CONTAINS A PARTS/MATERIAL LIST. IT IS SHEET 1 OF 2, INDICATING THAT THERE IS A SECOND SHEET THAT CONTAINS THE DETAIL DRAWINGS.



ASSEMBLY

9	ADJUSTING SCREW	1	124 SHT 2 ITEM 9	
8	" BLOCK	1	124 SHT 2 ITEM 8	
7	" NUT	1	124 SHT 2 ITEM 7	
6	NUT - TRAVERSE LOCKING	3	124 SHT 2 ITEM 6	
5	WASHER	3	124 SHT 2 ITEM 5	
4	SCRIBER	2	124 SHT 2 ITEM 4	
3	NUT	2	124 SHT 2 ITEM 3	
2	LEG	2	124 SHT 2 ITEM 2	
1	BEAM	1	124 SHT 2 ITEM 1	
ITEM	DESCRIPTION	No OFF	REF DRWG No	MATERIAL

[illegible]

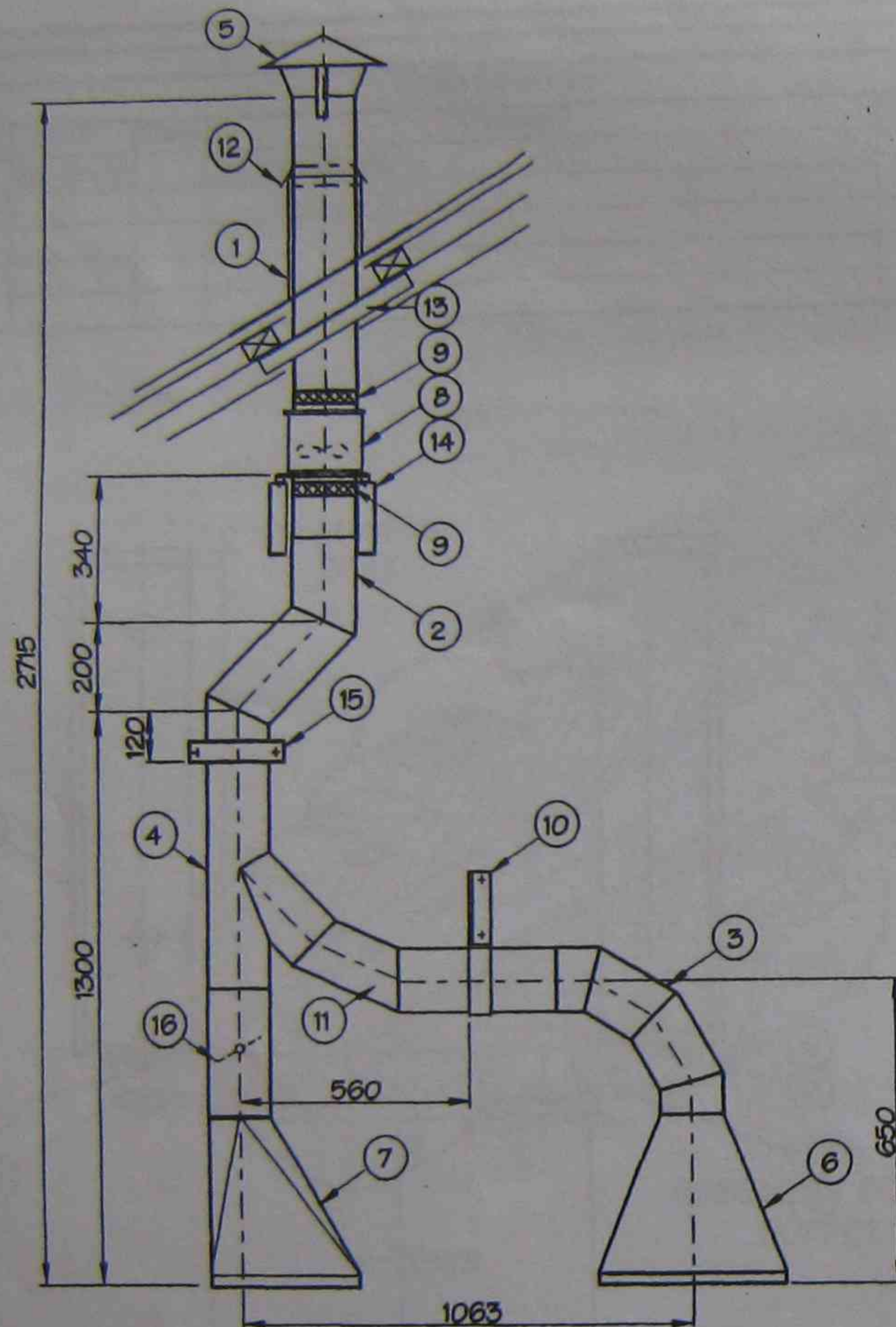
DO NOT SCALE
ALL DIMENSIONS IN MILLIMETRES

THIS IS AN EXAMPLE OF A GENERAL
ASSEMBLY DRAWING SHOWING A
DUCT SYSTEM.

IT GIVES A LIST OF THE PARTS AND
THE OVERALL DIMENSIONS
NECESSARY TO INSTALL THE DUCT
FULLY.

NOTE: DIMENSIONS GIVEN DO NOT
ENABLE YOU TO MANUFACTURE
THE PARTS.

NOTE: AXIAL FAN WESTINGHOUSE 9497-1 AVAILABLE
FROM CREST ENGINEERING, STANDARD HOT DIP
GAL FINISH

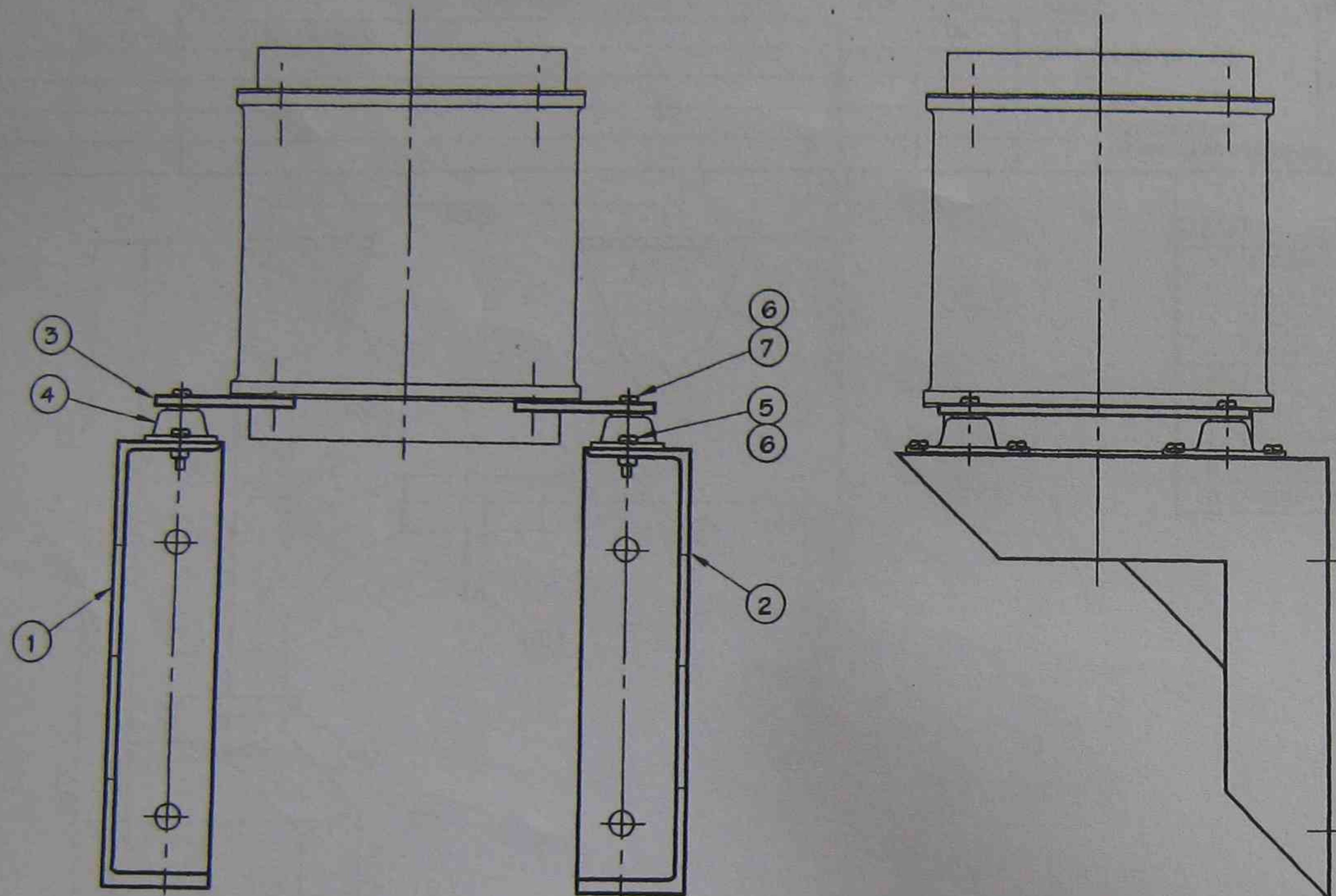


9	FLEXBLW JOINT	1	DRG 382 ITEM 1				
8	AXIAL FAN	1	PURCHASE BEE NOTE				
7	RECTANGULAR ROUND HOOD	1	DRG 380 ITEM 1	18	DAMPER	1	DRG 330 ITEM 2
6	CONICAL HOOD	1	DRG 330 ITEM 3	18	DUCT SUPPORT	1	DRG 382 ITEM 3
5	COWL	1	DRG 381 ITEM 1	14	FAN SUPPORT SUB-ASSY	1	DRG 325
4	ANGULAR BRANCH	1	DRG 329 ITEM 1	15	DUCT SUPPORT	1	DRG 333
3	4-PIECE, 90° ROUND ELBOW	1	DRG 326 ITEM 3	12	APRON	1	DRG 332 ITEM 4
2	ROUND OFFSET	1	DRG 326 ITEM 2	11	DUCT	1	DRG 329 ITEM 2
1	CYLINDRICAL FLASHING	1	DRG 326 ITEM 1	10	DUCT SUPPORT	1	DRG 332 ITEM 2
PART No	DESCRIPTION	QTY	REMARKS	PART No	DESCRIPTION	QTY	REMARKS

PARTS LIST

				UNLESS NOTED OTHERWISE TOLERANCES ARE:		DRAWN BS		MANUFACTURING & ENGINEERING ESD			
				LINEAR N/A		TRACED		TITLE:			
				ANGULAR N/A		CHECKED WW		EXHAUST DUCTING ASSEMBLY			
						APPROVED ID					
						ISSUED					
						RECORD OF ISSUE					
1	05-01-97	FIRST ISSUED		BS	WW	A		SCALE	SIZE	DRAWING No.	SHT
ISSUE	DATE	ZONE	CHANGES	ECN	BY	CKD		NT9	A3	324	1
AMENDMENTS				DRAWN TO AS100							

DO NOT SCALE
ALL DIMENSIONS IN MILLIMETRES



THIS IS AN EXAMPLE OF A

SUB ASSEMBLY DRAWING

IT GIVES SUB ASSEMBLY INFORMATION FOR THE FAN SUPPORT, ITEM NUMBER 14 SHOWN ON DRAWING NUMBER 324. IT LISTS THE PARTS NEEDED AND ILLUSTRATES THE METHOD FOR CONNECTING THE FAN TO ITS SUPPORT BRACKETS.

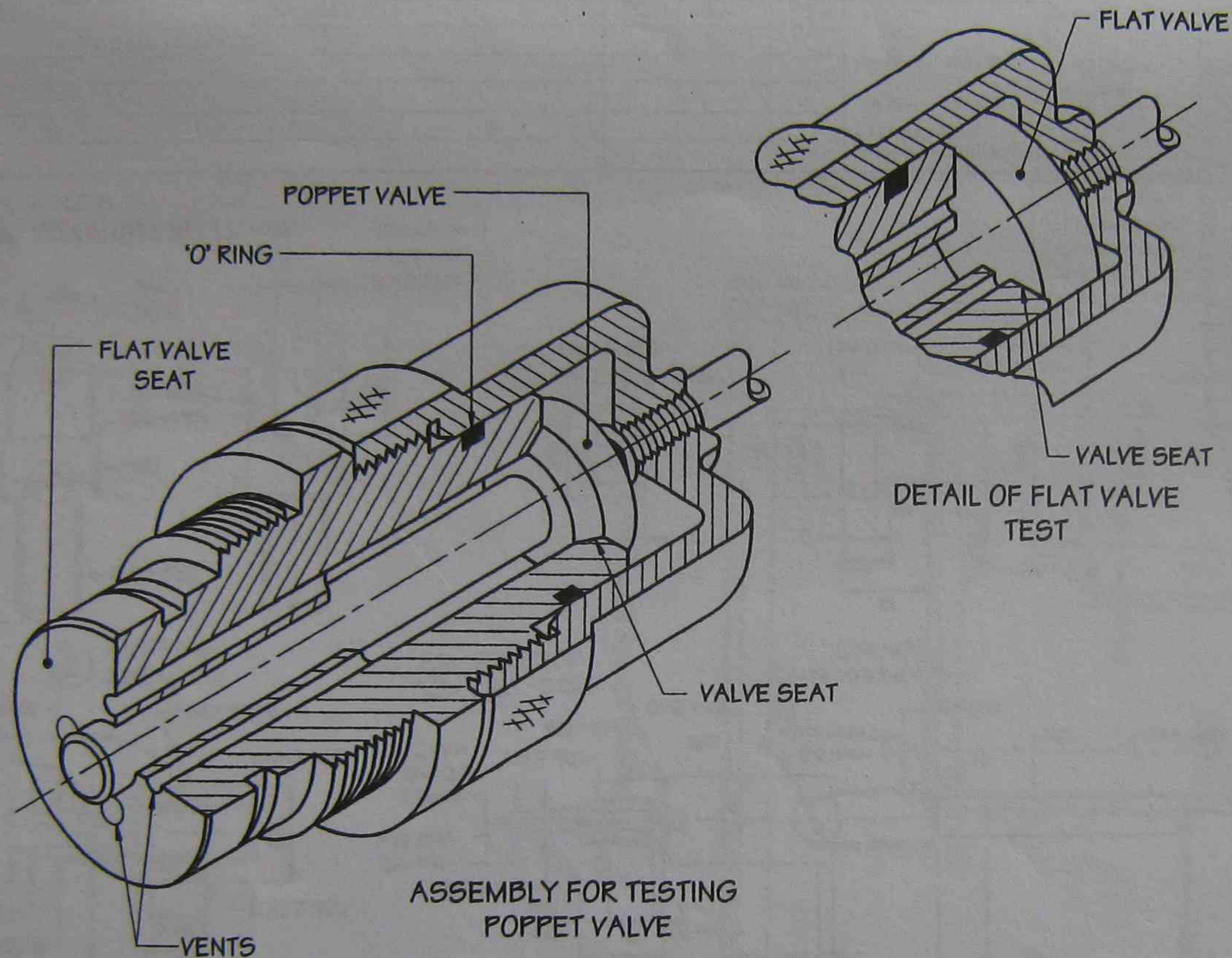
NOTE: NO DIMENSIONS ARE NECESSARY

7	BOLT	4	MS	MS. HEX HD x 20 LG
6	NUT	12	MS	MS. HEX
5	SCREW	8	MS	MS. HEX HD x 15 LG
4	ANTI-VIBRATION MOUNTING	4	—	TYPE 6/47 SCRUTTONS
3	MOUNTING PLATE	2	MS	SEE DRAWING 328
2	BRACKET R.H.	1	MS	SEE DRAWING 327/2
1	BRACKET L.H.	1	MS	SEE DRAWING 327/1
ITEM No	DESCRIPTION	QTY	MATL	SIZE

MATERIAL LIST

1 25-10-97 ORIGINAL ISSUED				JD WL		UNLESS NOTED OTHERWISE TOLERANCES ARE: LINEAR N/A ANGULAR N/A	MATERIAL N/A FINISH N/A	DRAWN JB TRACED CHECKED WW APPROVED IB ISSUED 25-10-97 RECORD OF ISSUE	MANUFACTURING & ENGINEERING ESD			
1 25-10-97 ORIGINAL ISSUED				JD WL				TITLE: EXHAUST DUCT FAN SUPPORT ASSEMBLY				
ISSUE	DATE	ZONE	CHANGES		ECN	BY	CKD	A	SCALE	SIZE	DRAWING No.	SHT
			AMENDMENTS						NTS	A3	325	1 OF 1

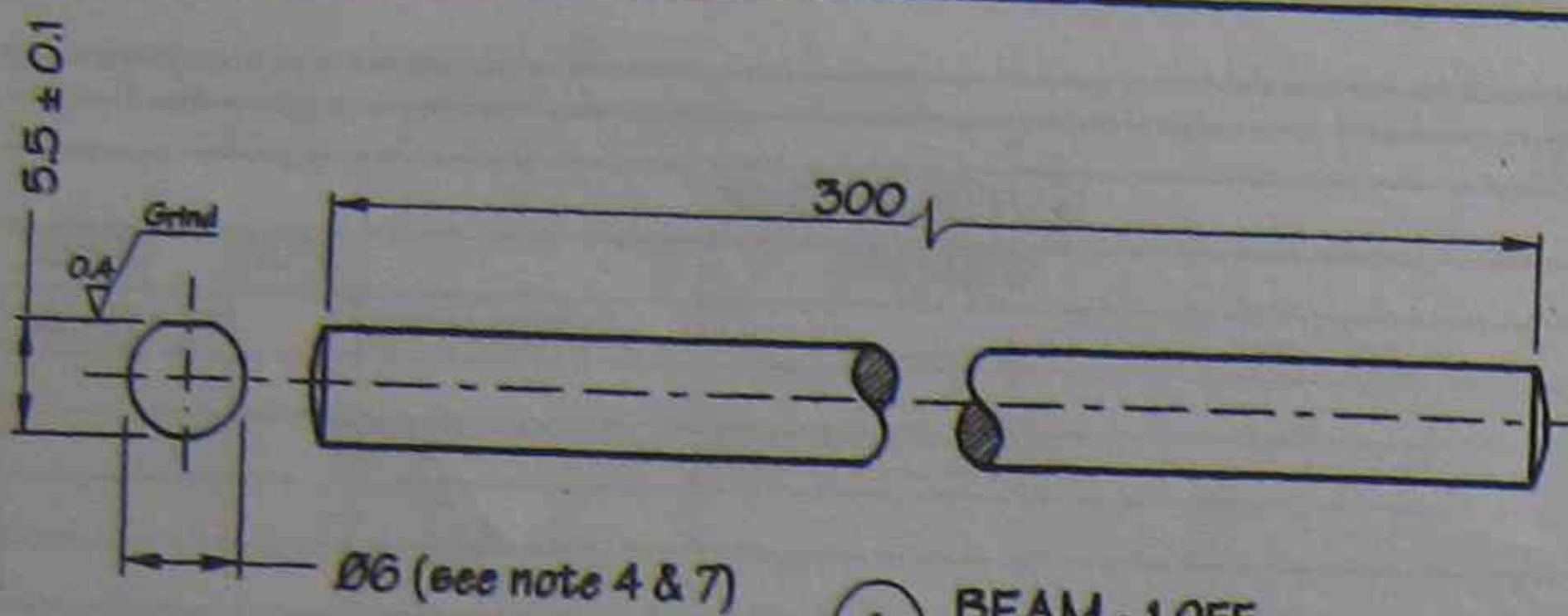
DO NOT SCALE
ALL DIMENSIONS IN MILLIMETRES



This is an example of a pictorial drawing.

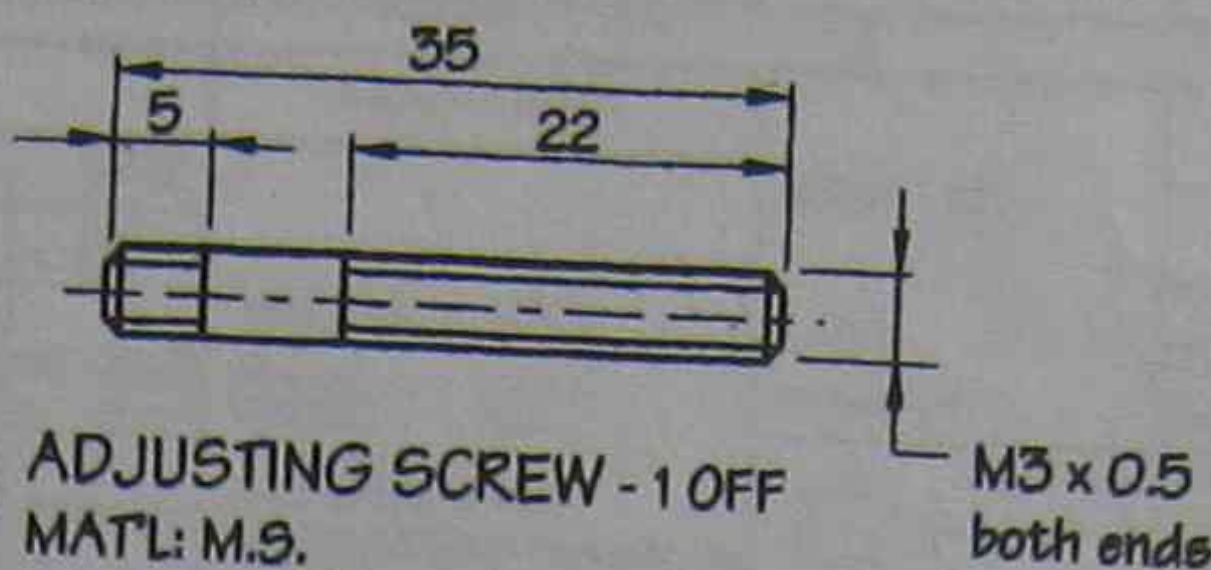
Note: Some parts are shown 'cut away' or 'in section'. Ask your teacher to identify the cross hatching and its purpose.

				UNLESS NOTED OTHERWISE TOLERANCES ARE:				DRAWN JB		MANUFACTURING & ENGINEERING ESD						
				LINEAR N/A				TRACED		TITLE: POPPET VALVE						
				ANGULAR N/A			CHECKED LR									
							APPROVED PW									
							ISSUED 12-01-88									
							RECORD OF ISSUE									
A	25-01-88		FIRST ISSUED		JB	LR			A				SCALE	SIZE	DRAWING No.	SHT
ISSUE	DATE	ZONE	CHANGES	ECN	BY	CKD							NTS	A3	99-641	1 OF 1
			AMENDMENTS				DRAWN TO A3100									

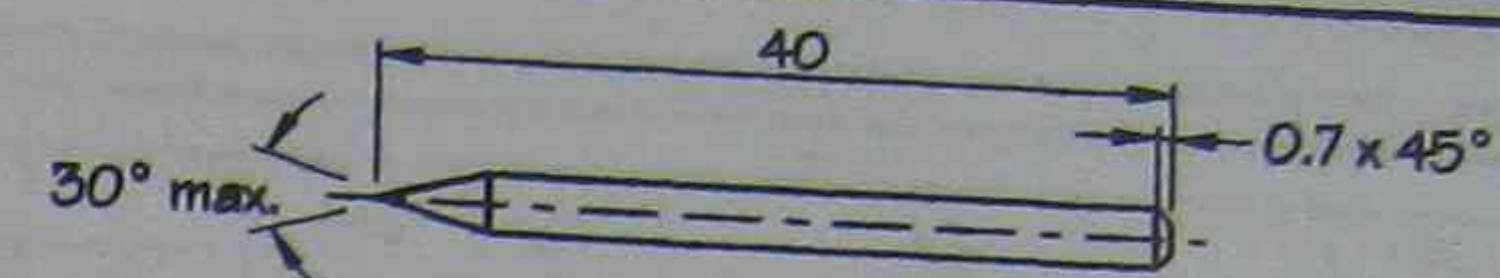


1 BEAM - 1 OFF
MATL: SILVER STEEL

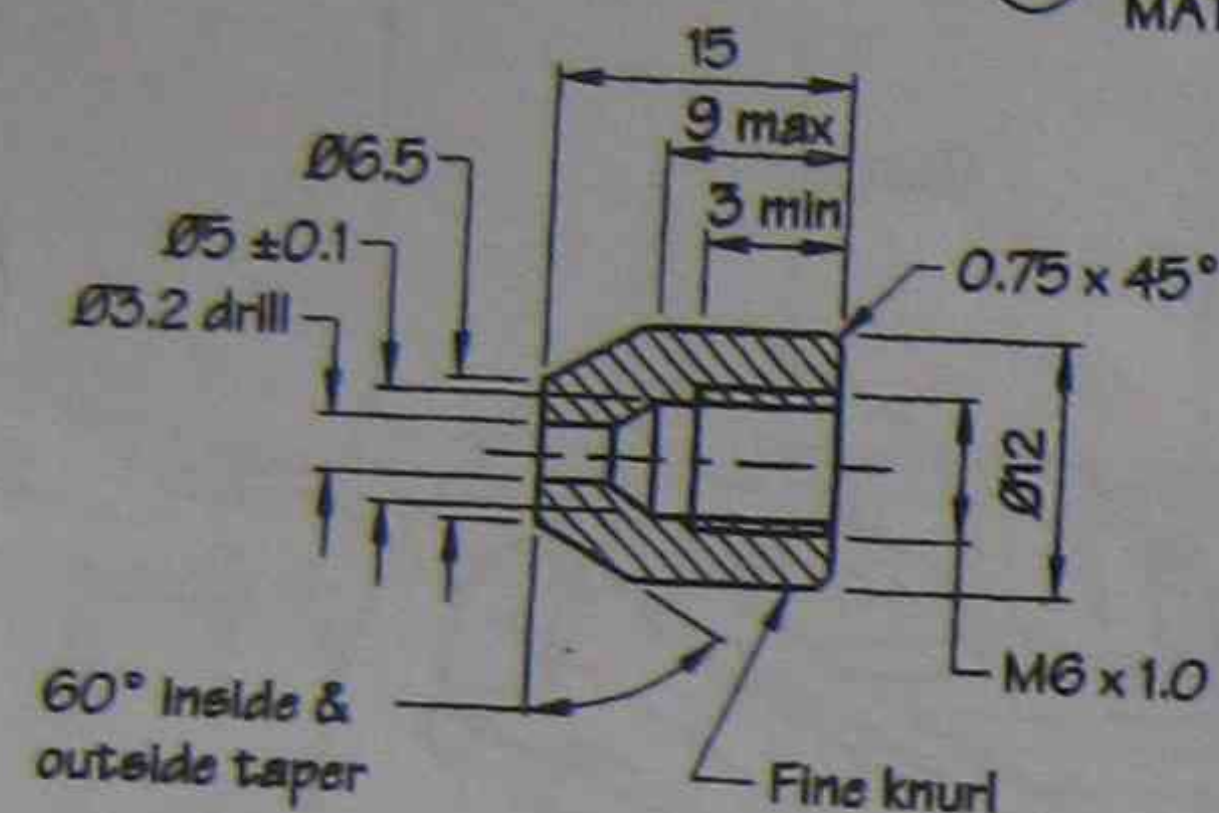
DO NOT SCALE



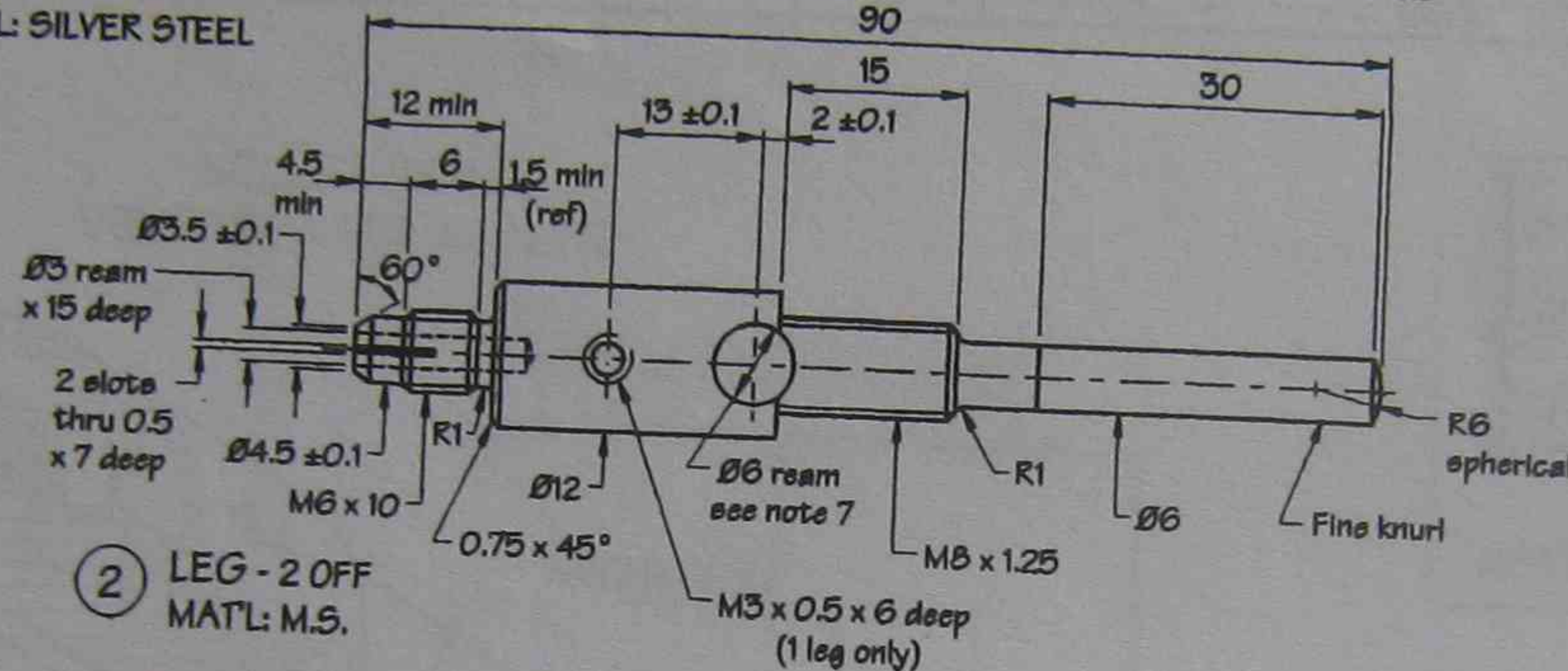
9 ADJUSTING SCREW - 1 OFF
MATL: M.S.



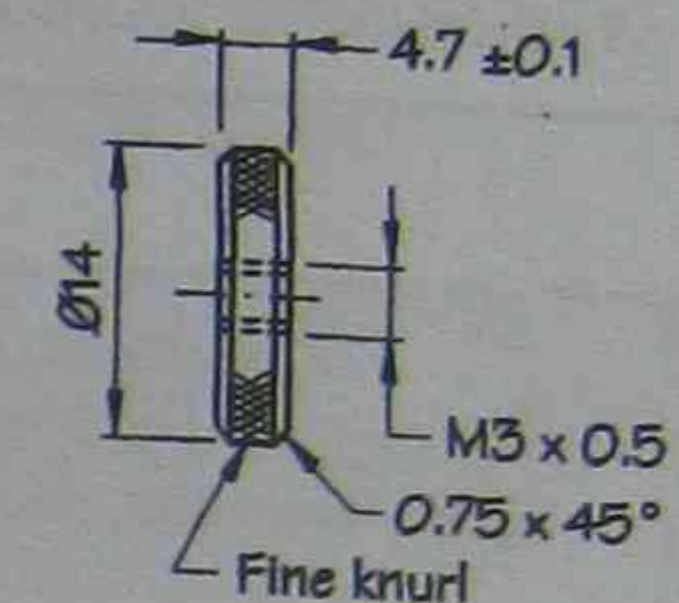
4 SCRIBER - 2 OFF
MATL: Ø3 H.S.S. OR SILVER STEEL
HARDEN AND TEMPER



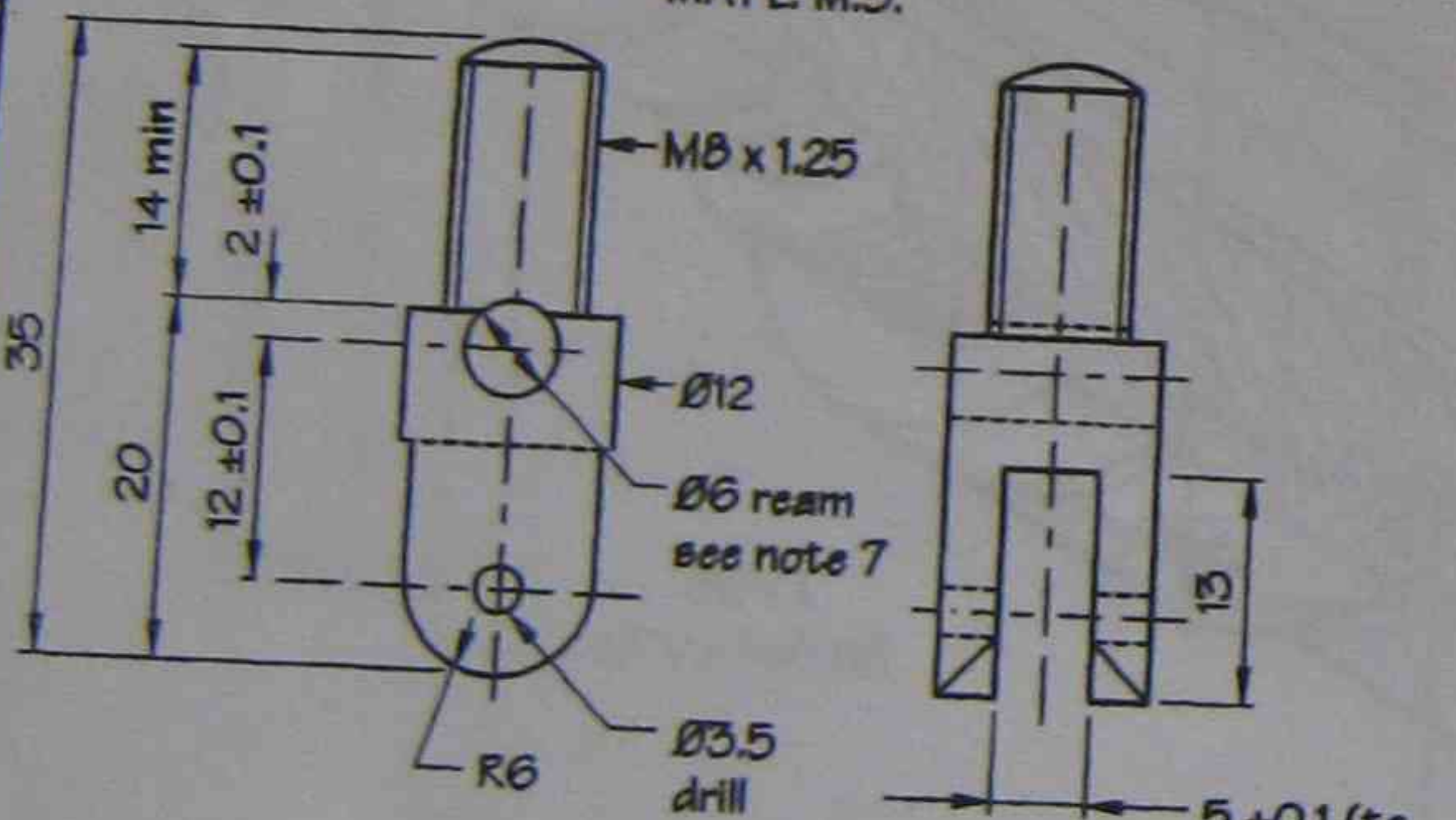
3 NUT - 2 OFF
MATL: M.S.



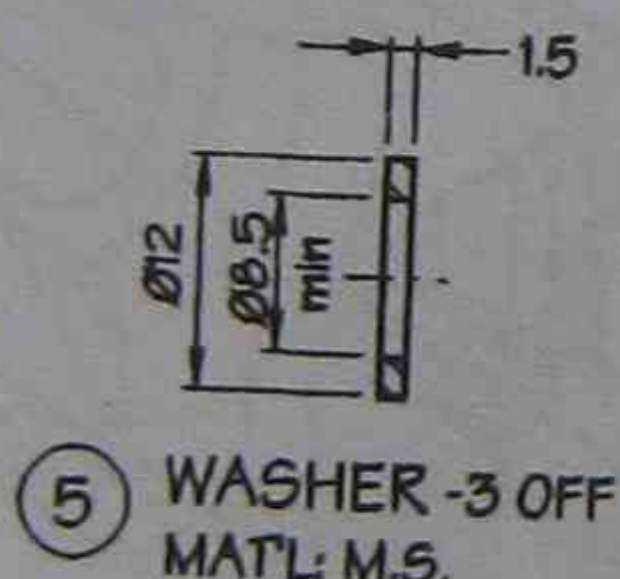
2 LEG - 2 OFF
MATL: M.S.



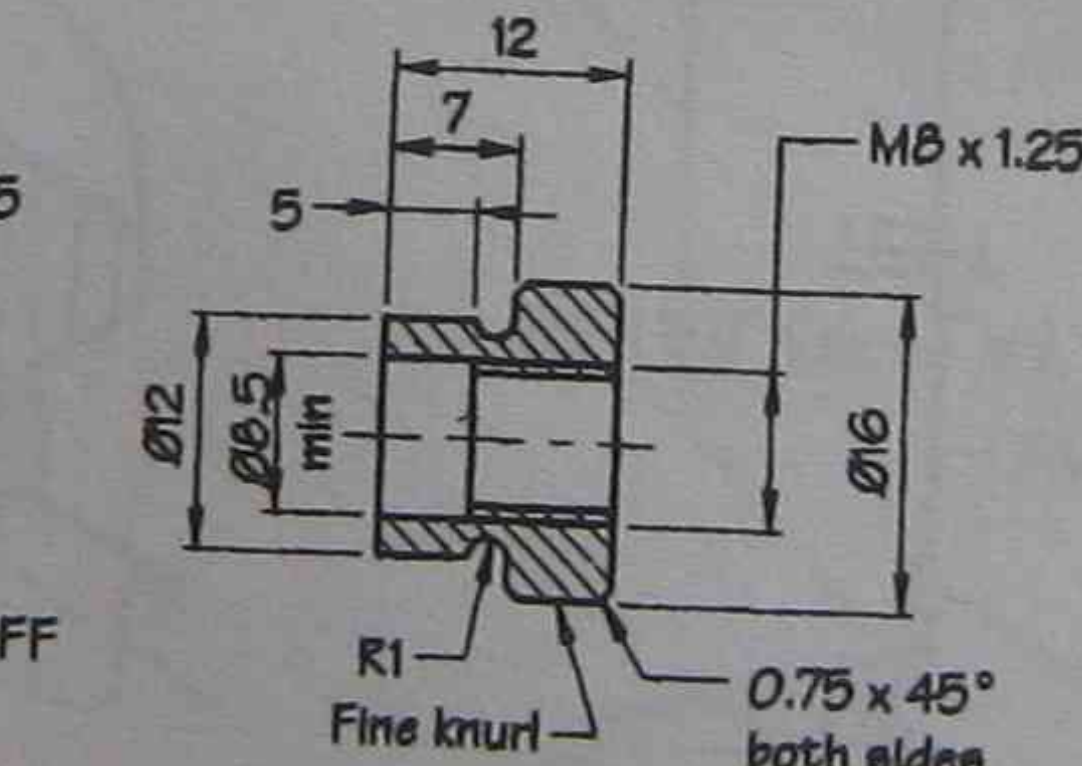
7 ADJUSTING NUT - 1 OFF
MATL: M.S.



8 ADJUSTING BLOCK - 1 OFF
MATL: M.S.



5 WASHER - 3 OFF
MATL: M.S.



6 NUT TRAVERSE LOCKING - 3 OFF
MATL: M.S.

NOTES

- UNLESS SHOWN OTHERWISE DIMENSIONS IN MILLIMETRES.
- ALL M.S. TO BE PER A.S. 1442-1973/S1020.
- TOLERANCES TO BE WITHIN ±0.5 UNLESS SHOWN OTHERWISE.
- SURFACE FINISH GENERAL TO BE 1.6/0.4/0.2.
- BEARING SURFACES (ITEM 1) TO BE 0.4/0.2.
- REMOVE ALL SHARP CORNERS WITH A SMOOTH FILE.
- DO NOT SCALE OFF DRAWING - WORK TO DIMENSIONS.
- ITEM 1 TO BE A "SLIDE FIT" IN ITEMS 5 & 8. THIS CAN BE PRODUCED BY REAMING TO SUIT THE Ø6 BEAM, OR BY BUFFING THE BEAM WITH FINE EMERY TO SUIT A Ø6 REAMED HOLE.

ITEM	DESCRIPTION	QTY	MATERIAL
9	ADJUSTING SCREW	1	35 x Ø3.5 M.S. BAR
8	" BLOCK	1	35 x Ø12 M.S. BAR
7	" NUT	1	4 x Ø14 M.S.
6	NUT - TRAVERSE LOCKING	3	12 x Ø16 M.S.
5	WASHER	3	12 O.D. x Ø5 I.D. x 1.5 M.S.
4	SCRIBER	2	Ø3 H.S.S. OR SILVER STEEL
3	NUT	2	15 x Ø12 M.S.
2	LEG	2	90 x Ø12 M.S.
1	BEAM	1	300 x Ø6 SILVER STEEL BAR

SAMPLE DETAIL
DRAWING WITH
A NUMBER OF
PARTS SHOWN

UNLESS NOTED OTHERWISE
TOLERANCES ARE:
LINEAR ±0.5 UNO
ANGULAR ±0° 15'



MATERIAL
AS LISTED

FINISH

SEE NOTES

DRAWN JD
TRACED WP
CHECKED WL
APPROVED JRP
ISSUED 15-05-97
RECORD OF ISSUE

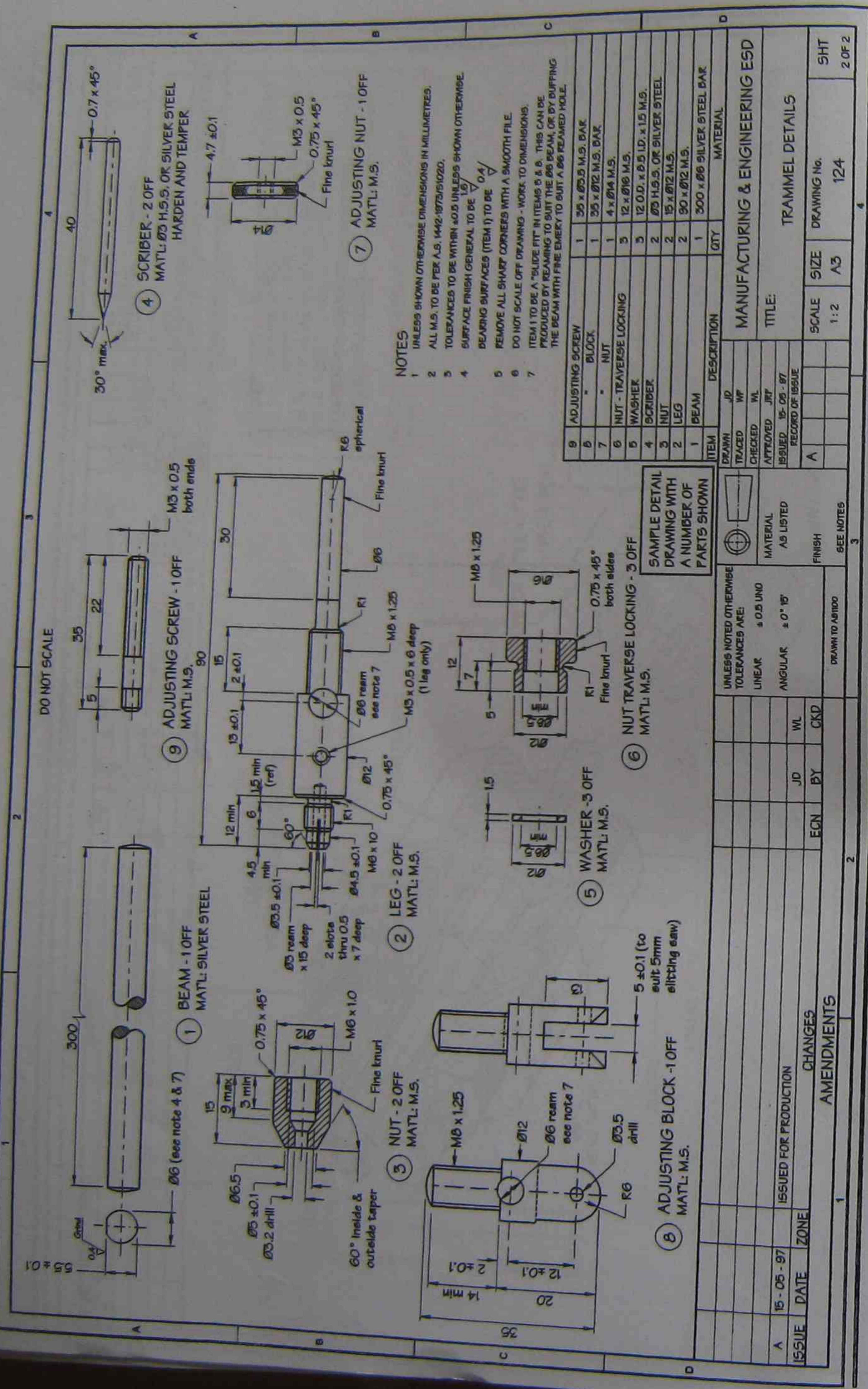
MANUFACTURING & ENGINEERING ESD

TITLE:
TRAMMEL DETAILS

SCALE 1:2
SIZE A3
DRAWING No. 124
SHT 2 OF 2

ISSUE	DATE	ZONE	CHANGES	AMENDMENTS	ECN	BY	CKD
A	15-05-97		ISSUED FOR PRODUCTION			JD	WL

DRAWN TO AS1100



Producing drawings

Drawings are done on standard size sheets, ranging from A0 to A4. This not only aids storage but also is important in the photocopying of drawings. The area of the basic sheet is one square metre and is designated A0. An A0 sheet can be divided up evenly into the various other sizes simply by halving the sheet along the long side in each case.

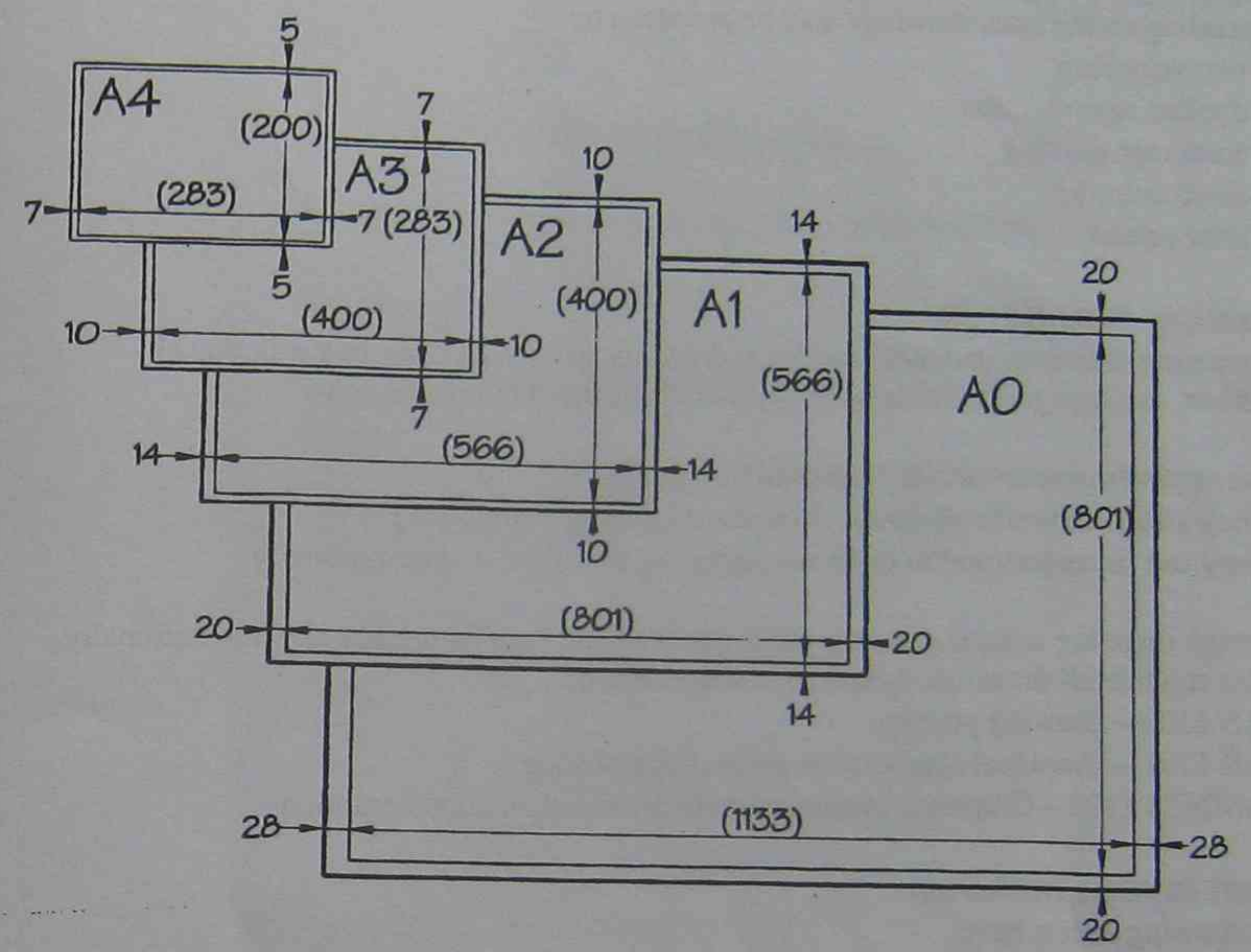


Figure 5- Preferred series sheets

Drawings may be made in three ways:

- freehand sketching
- by hand using drafting equipment
- computer assisted (computer aided design – CAD)

Copying or reproducing drawings

Depending on the size, drawings may be produced by:

- photocopying
- dyeline reproduction
- computer plotting
- inkjet printing
- laser printer

Drawing Standards

Engineering drawings and other technical drawings have to be done in a way that all engineers can recognise. These ways are called standards or conventions.

Drawings are made to standard conventions so that:

- they all use the same symbols, lines, dimensioning techniques etc.
- they can be understood in different places, eg interstate or internationally

Although there are several drawing standards available both nationally and internationally, for this module all drawings should follow the rules of:

- AS 1100 – Drawing practice
- AS 1101 – Graphical symbols for general engineering
- AS/NZS 1102 – Graphical symbols for electrotechnical documentation

Sheet layout features

Most drawing sheets have:

- a margin or boarder
- a title block
- a list of materials and parts
- a format that can be revised when necessary

Drawings by themselves are not enough to tell the reader everything they need to know. Each drawing needs information about materials, joining methods, tolerances and instructions for the manufacturer.

Lines in drawings are different in thickness and different in the way they are drawn, depending on the size of the paper and the job to be done. However, each kind of line and each thickness must conform to national and international standards.

Written information on a drawing is always in standard lettering. The standard regulates the shape and size of letters and numerals. Symbols are used for items such as dimensions, radius, diameter, tolerancing, surface textures, weld details, and methods of projection.

Title block information

The title block identifies a range of data relating to the drawing. It may include:

- the name of the company
- the name of what is drawn
- the drawing number for storage and reference purposes
- the sheet number in a set of drawings
- who drew the drawing
- who checked the drawing
- the issued date
- the size of the original sheet that the drawing was drawn on
- the scale
- any changes that have been made since the drawing was originally drawn
- projection symbols
- material that the object is made from
- finish
- tolerance to state the allowable size range acceptable for the parts

Drawing sheets may also include zones for finding the location on the drawing – similar to a street directory – for example D1 and a parts list and description of the parts shown on the drawing.

ALL DIMENSIONS ARE IN MILLIMETRES
DONOT SCALE

MAIN FEATURES OF A DRAWING SHEET

1. Border to highlight the drawing area.
2. Zones for finding a location on the drawing - similar to a street directory - for example D1.
3. Amendments Chart this shows any changes made to a drawing. It is important for a tradesperson to have the latest drawing to work from.
4. Title Block for identifying the drawing and filling it. It also contains other useful information.
5. Projection Symbol to show the method of orthographic projection used.
6. Material to specify the type of material used, eg. aluminium.
7. Finish the quality or type of finish required.
8. Drawing Standards Number the particular standard the drawing conforms to.
9. Tolerances the allowable size range acceptable for the parts.
10. Parts List list and description of the parts shown on the drawing.

PARTS LIST			
ITEM No	DESCRIPTION	MATERIAL	No. REQUIRED

UNLESS NOTED OTHERWISE TOLERANCES ARE:				DRAWN		TITLE			
LINEAR				TRACED					
ANGULAR				CHECKED					
				APPROVED					
				ISSUED		SCALE			
				RECORD OF ISSUE					
ISSUE	DATE	ZONE	CHANGE	BY	CKD	DRAWING PRACTICE	SIZE	DRG N°	SHT
			AMENDMENTS			AS 1100			

Exercise 1

Referring to the drawing 5210 1A sheet 2 of 4 answer the following questions.

1. How many drawing sheets make up the full set for the hydraulic punch?

4

2. What company owns this set of drawings

MANUFACTURING & ENGINEERING (ESD)

3. To what scale is each component drawn?

1.2

4. What size sheet was the original drawing drawn on?

A2

5. When were the drawings first issued?

12-12-97

6. Where do you find out what material each component is made from?

ARE LISTED

7. In the finish box are the letters UNO. What do the letters stand for and what do they mean?

UNLESS NOTED OTHERWISE

8. The punch diameter 'C' of the punch can be made to different diameters. Referring to the chart, how many different diameters can be ordered?

6

9. What is the tolerance on all linear dimensions?

$$+ 0.25$$

10. What material is the cup seal made from?

MODIFIED NITRINE

11. What is the date of the last issue of the drawing?

22.1.48

[illegible]

12. The material for the cup seal has been changed since the original issue of the drawing.
What material was it originally made from?

LEATHER

13. What component is named at zone B5?

CYLINDER HEAD

14. What Australian Standard has the drawing been drawn to?

AS 1100

15. Can you tell if the drawing is first or third angle projection from the information in the title block?

THIRD - ANGLE

16. How many of each of these components is required when assembling the finished hydraulic punch?

1 OFF

17. What angular tolerance applies to angles on the components?

0° 15'

18. What are the initials of the person who approves the original drawing?

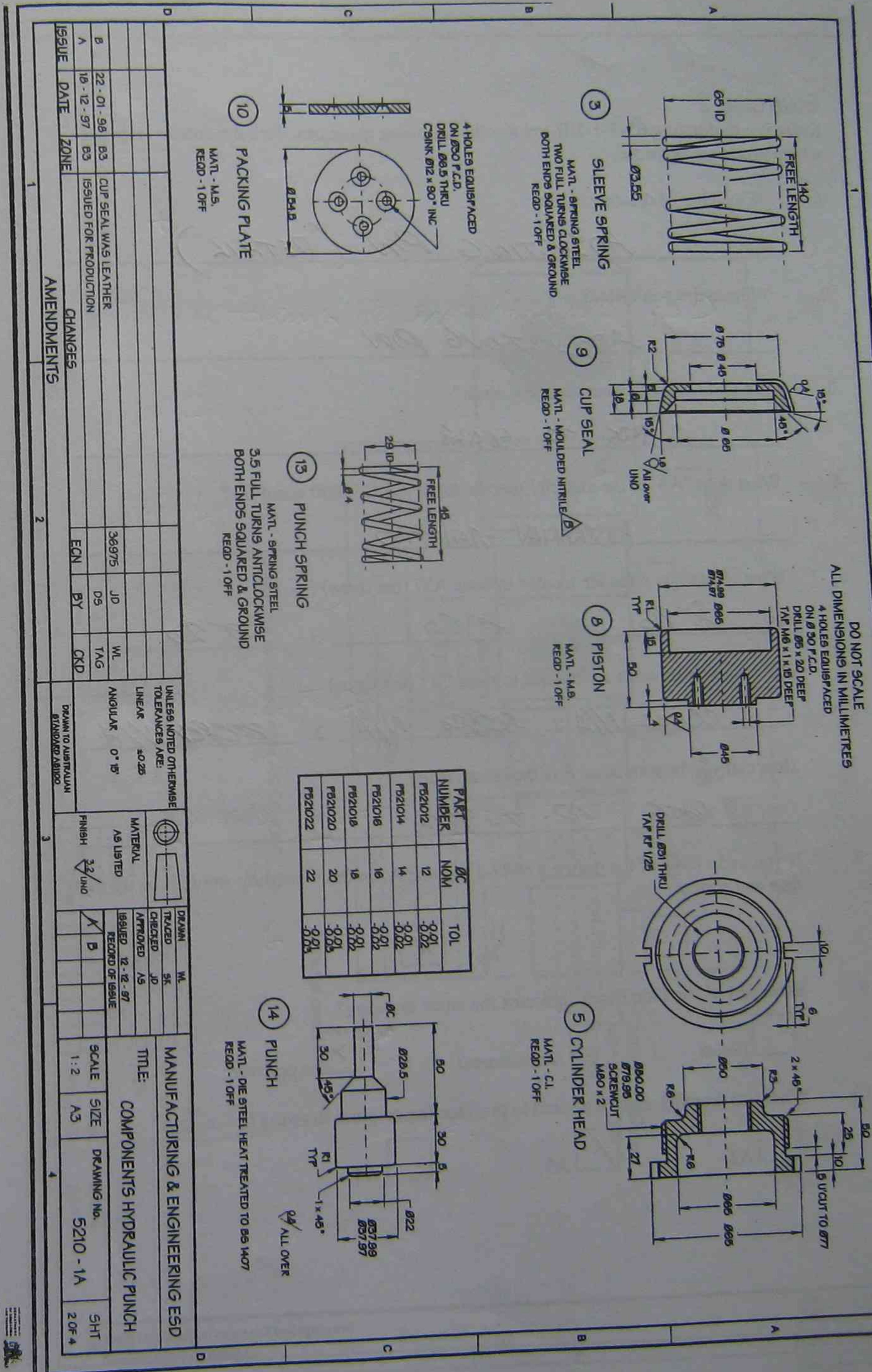
AS

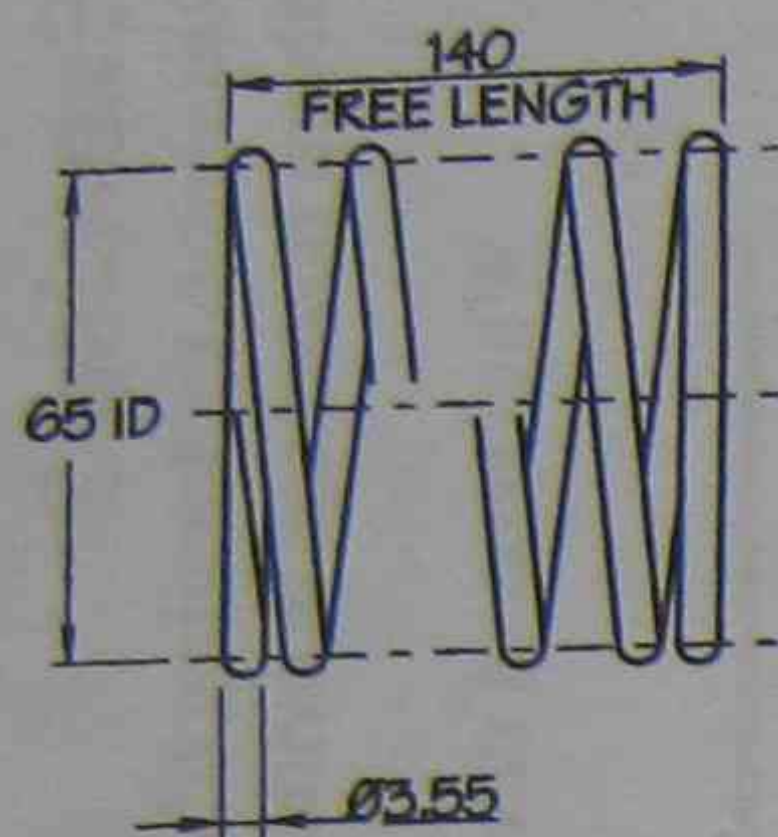
19. How are the ends of the sleeve spring and punch spring to be finished off in manufacture?

BOTH ENDS ~~SQUARED~~ SQUARED & GROUND

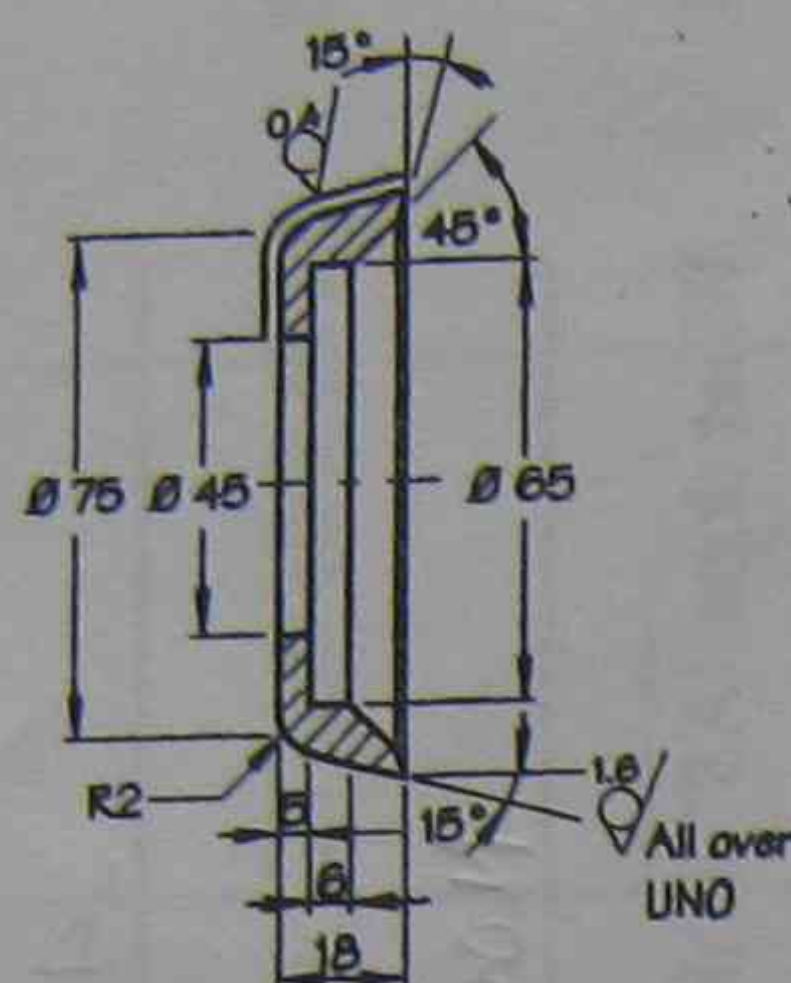
20. What units are all the dimensions in?

MILLIMETRES



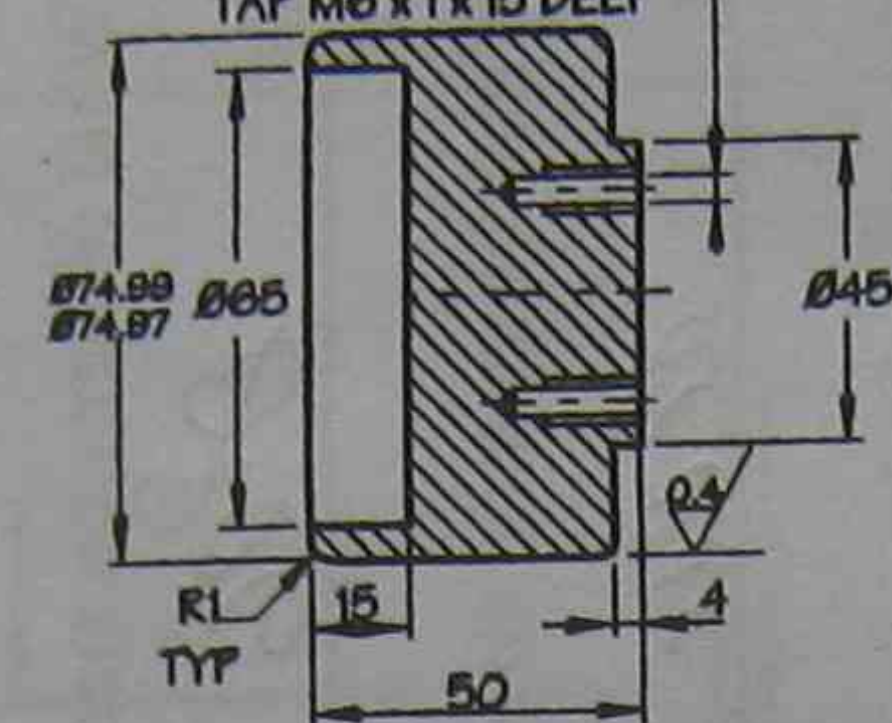


3 SLEEVE SPRING
 MATL - SPRING STEEL
 TWO FULL TURNS CLOCKWISE
 BOTH ENDS SQUARED & GROUND
 REQD - 1 OFF

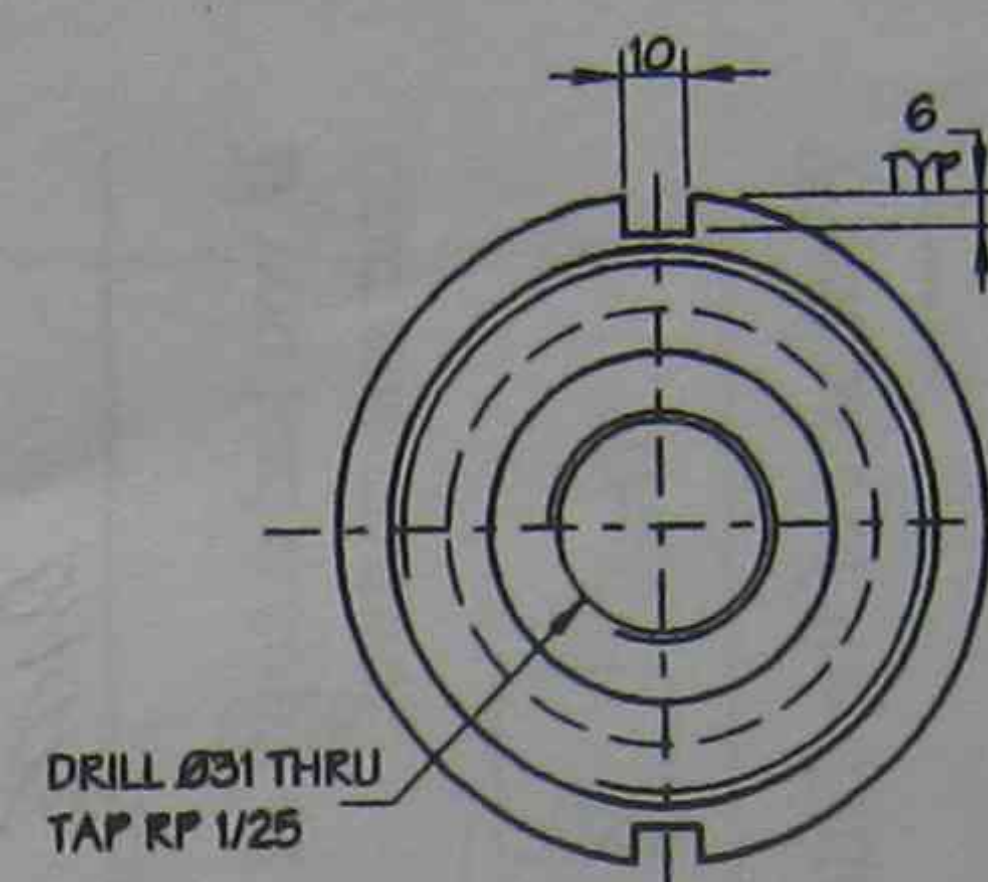


9 CUP SEAL
 MATL - MOULDED NITRILE
 REQD - 1 OFF

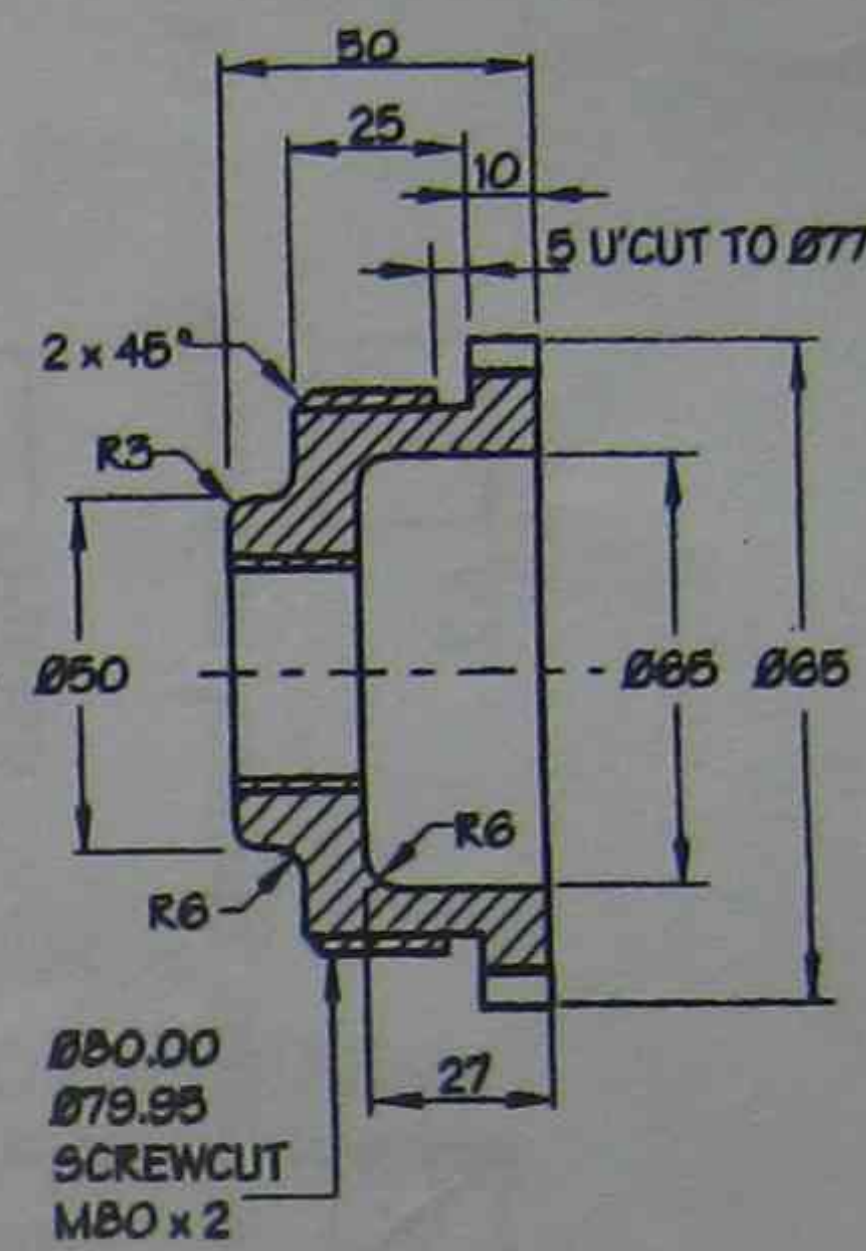
DO NOT SCALE
 ALL DIMENSIONS IN MILLIMETRES
 4 HOLES EQUISPACED
 ON 30 P.C.D.
 DRILL 5 x 20 DEEP
 TAP M6 x 1 x 15 DEEP



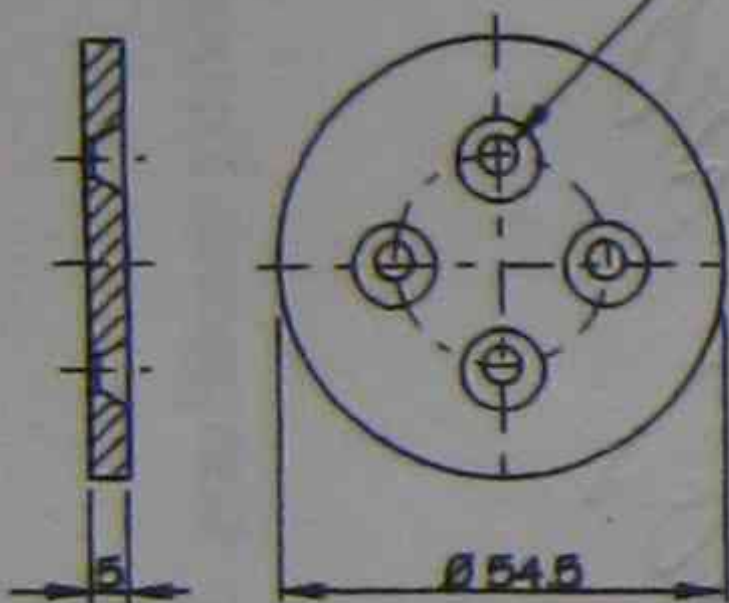
8 PISTON
 MATL - M.S.
 REQD - 1 OFF



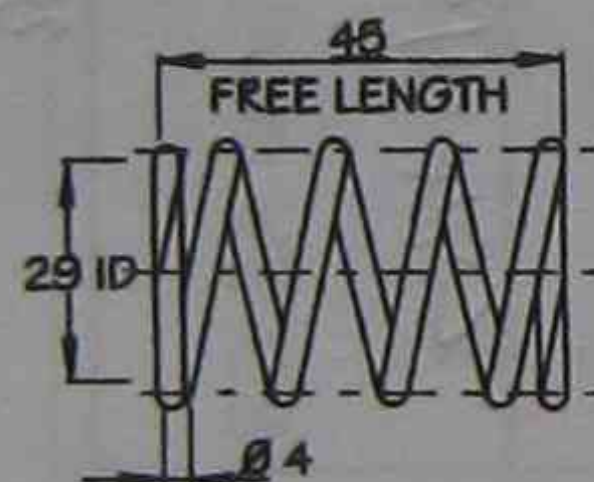
5 CYLINDER HEAD
 MATL - C.I.
 REQD - 1 OFF



4 HOLES EQUISPACED
 ON 30 P.C.D.
 DRILL 5 x 20 THRU
 C'SINK 12 x 90° INC

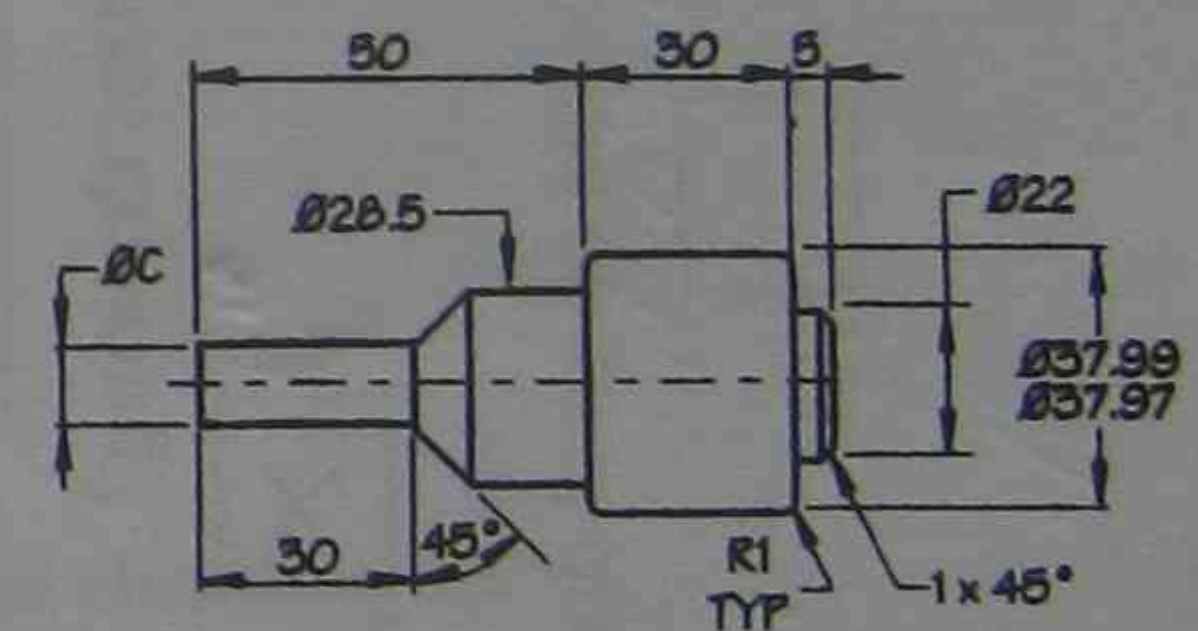


10 PACKING PLATE
 MATL - M.S.
 REQD - 1 OFF




13 PUNCH SPRING
 MATL - SPRING STEEL
 3.5 FULL TURNS ANTICLOCKWISE
 BOTH ENDS SQUARED & GROUND
 REQD - 1 OFF

PART NUMBER	ØC NOM	TOL
P521012	12	-0.01 -0.02
P521014	14	-0.01 -0.02
P521016	16	-0.01 -0.02
P521018	18	-0.01 -0.02
P521020	20	-0.01 -0.03
P521022	22	-0.01 -0.03



14 PUNCH
 MATL - DIE STEEL HEAT TREATED TO BS 1407
 REQD - 1 OFF

							UNLESS NOTED OTHERWISE TOLERANCES ARE:		DRAWN WL	MANUFACTURING & ENGINEERING ESD							
							LINEAR ±0.25	MATERIAL AS LISTED	TRACED SK	TITLE: COMPONENTS HYDRAULIC PUNCH							
							ANGULAR 0° 15'		CHECKED JD								
									APPROVED AS								
									ISSUED 12 - 12 - 97								
									RECORD OF ISSUE								
B	22 - 01 - 98	B3	CUP SEAL WAS LEATHER	36975	JD	WL		FINISH 32/UNO	<input checked="" type="checkbox"/> A	B				SCALE 1:2	SIZE A3	DRAWING No. 5210 - 1A	SHT 2 OF 4
A	18 - 12 - 97	B3	ISSUED FOR PRODUCTION		DS	TAG											
ISSUE	DATE	ZONE	CHANGES	ECN	BY	CKD											
AMENDMENTS							DRAWN TO AUSTRALIAN STANDARD AS1100										
1				2				3				4					

Exercise 2

Exercise 2
Referring to drawing 6547-1-1/B, answer the following questions. Tick the correct response where boxes are provided.

1. What type of drawing is it?

ADJUSTING PIN (DETAIL)

2. What is the part called?

ADJUSTING PIN

3. The scale is NTC, what does that mean?

NOT TO SCALE

4. What does 'AS' in the material specifications AS CS1040 stand for?

AUSTRALIAN STANDARD

5. What dimension sizes are located in zone A3? (list three)

1. $\theta 26$ 2. $\theta 24$ 3. $\theta 20$

6. What dimension sizes are located in zone C4? (list three)

1. ~~Ques~~ N/A 2. ~~Ques~~ N/A 3. ~~Ques~~ N/A

7. How can you be sure Issue B is the latest issue?

DATE 10-7-97

8. If you had a copy of the drawing 6547-1-1(issue A) in the workshop would it be up to date and correct?

Yes

No

9. What part of the Title Block indicates the latest drawing?

Finish



Amendments

X

Approved

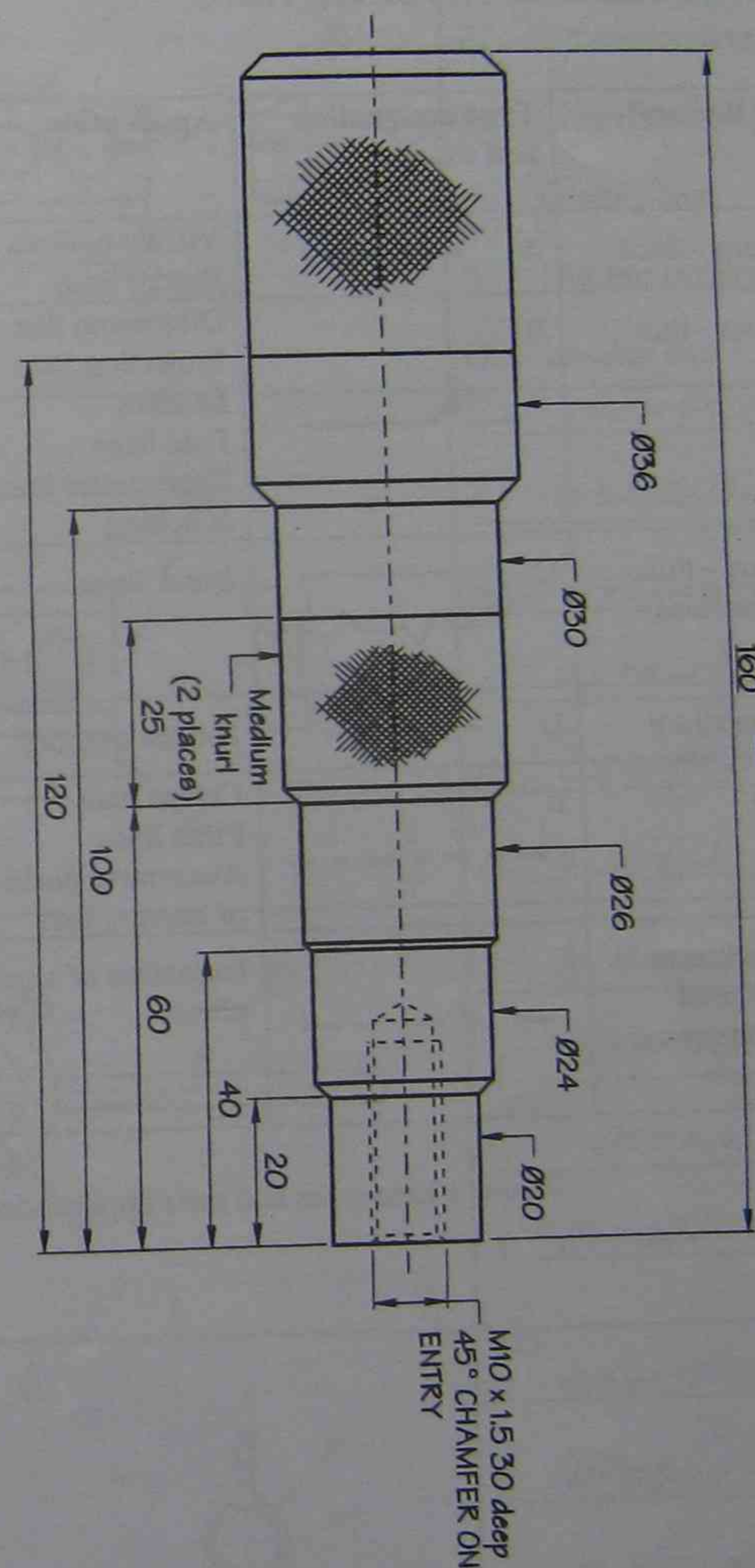
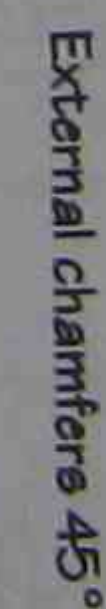
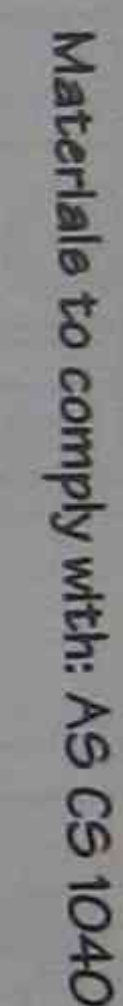
10. What size drawing sheet was used to produce the original drawing?


A2





A3

A4

[illegible]

160 



							UNLESS NOTED OTHERWISE TOLERANCES ARE:		DRAWN JD TRACED WF CHECKED WL	MANUFACTURING & ENGINEERING ESD								
							LINEAR ± 0.1		MATERIAL	APPROVED KA	TITLE: ADJUSTING PIN							
B	10-07-97	A3	180 was 155	36975	JD	WL	ANGULAR 0.5°	AS LISTED	ISSUED 18-08-97									
A	15-05-97		ISSUED FOR PRODUCTION		JD	WL			RECORD OF ISSUE									
ISSUE	DATE	ZONE	CHANGES	ECN	BY	CKD		FINISH	3.2/UNO 	A	B				SCALE NTS	SIZE A3	DRAWING No. 6547-1-1/B	SHT 1 OF 1
AMENDMENTS							DRAWN TO AS1100											

Line types – Identification

If all lines on a drawing were equally thick, the drawing is confusing and difficult to interpret, as the outlines do not stand out from the dimension lines. By varying the thickness and construction lines on a drawing you can express meaning that is otherwise difficult to express. To make sure everyone interprets drawings the same way, the use of each type and thickness is defined in AS 1100 Drawing Practice.



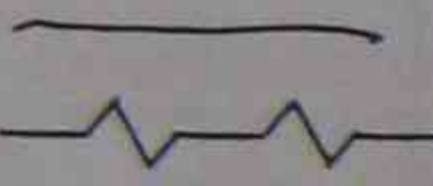



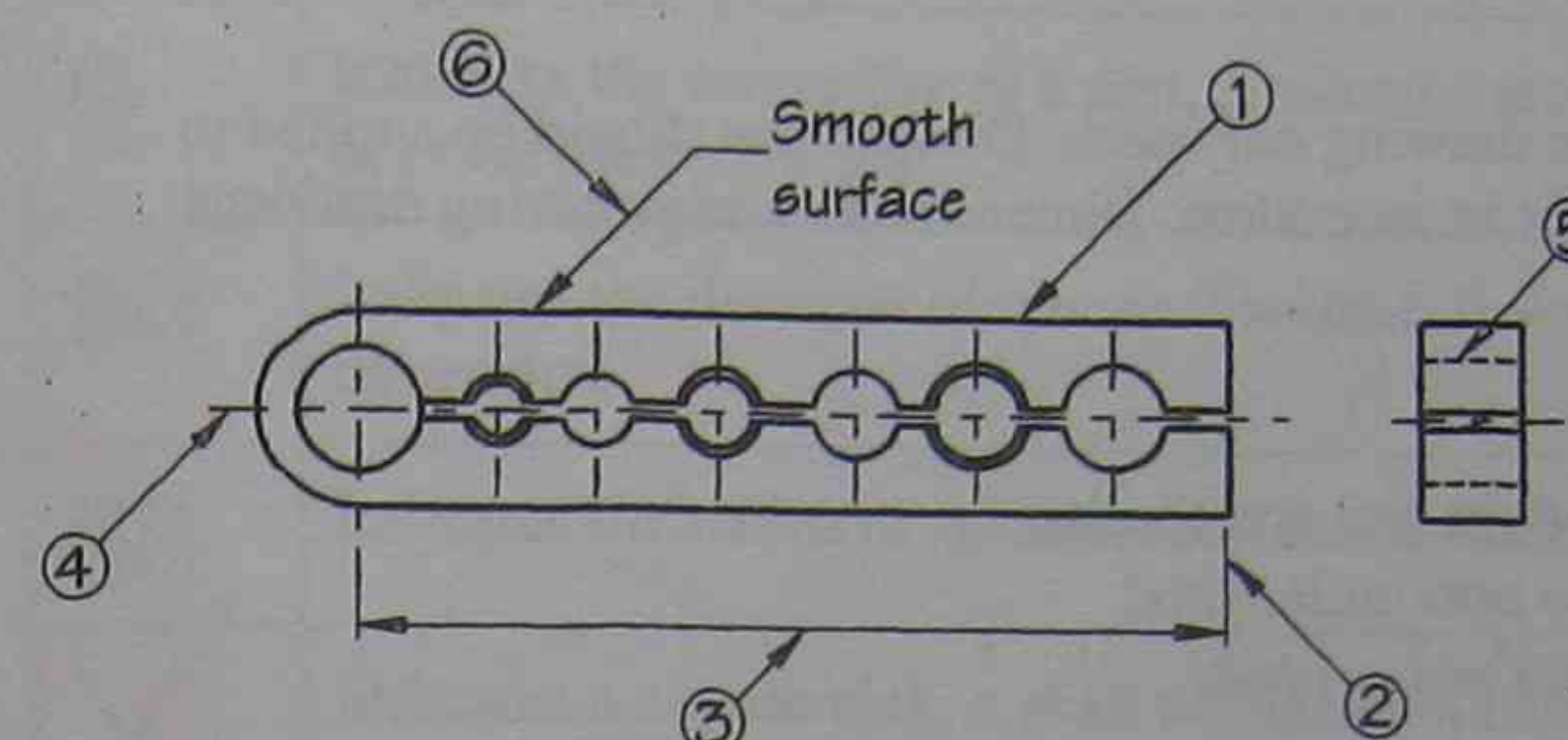
Type of line and weight	Type designation and example	Application	Approximate thickness on A3 size sheet in mm
Continuous - thick	A 	Visible outlines Border lines	0.7
Continuous - thin	B 	Dimension line Projection lines Leaders Fold lines Short centre lines Hatching	0.35
Continuous – thin freehand or rules with zig-zag	C 	Break lines	0.35
Dashed - medium	D 	Hidden outlines	0.5
Chain - thin	E 	Centre lines Pitch lines Alternative position of moving part	0.35
Chain – thick at ends and at change of direction, otherwise thin	F 	Indication of section planes	0.35

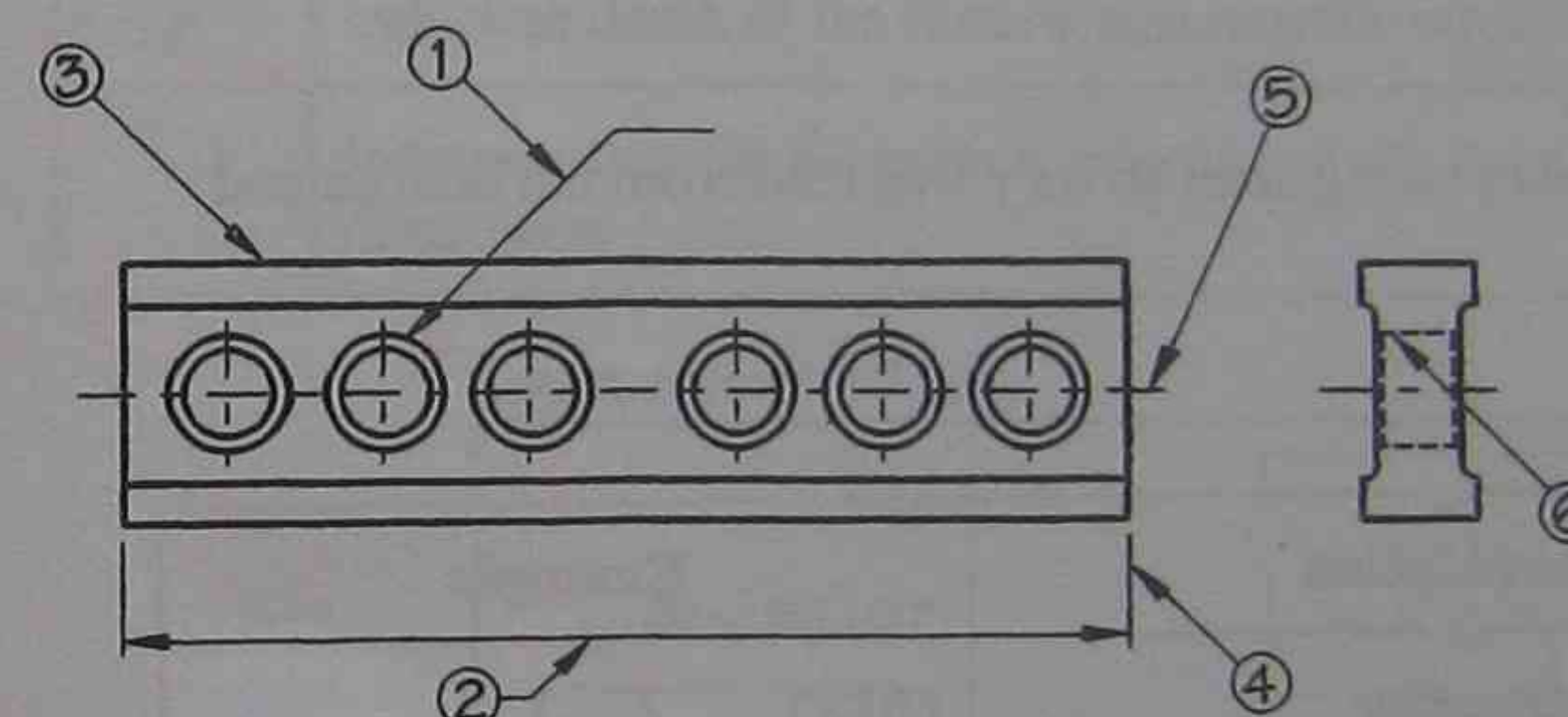
Table 1 Line types and their applications

Exercise 3

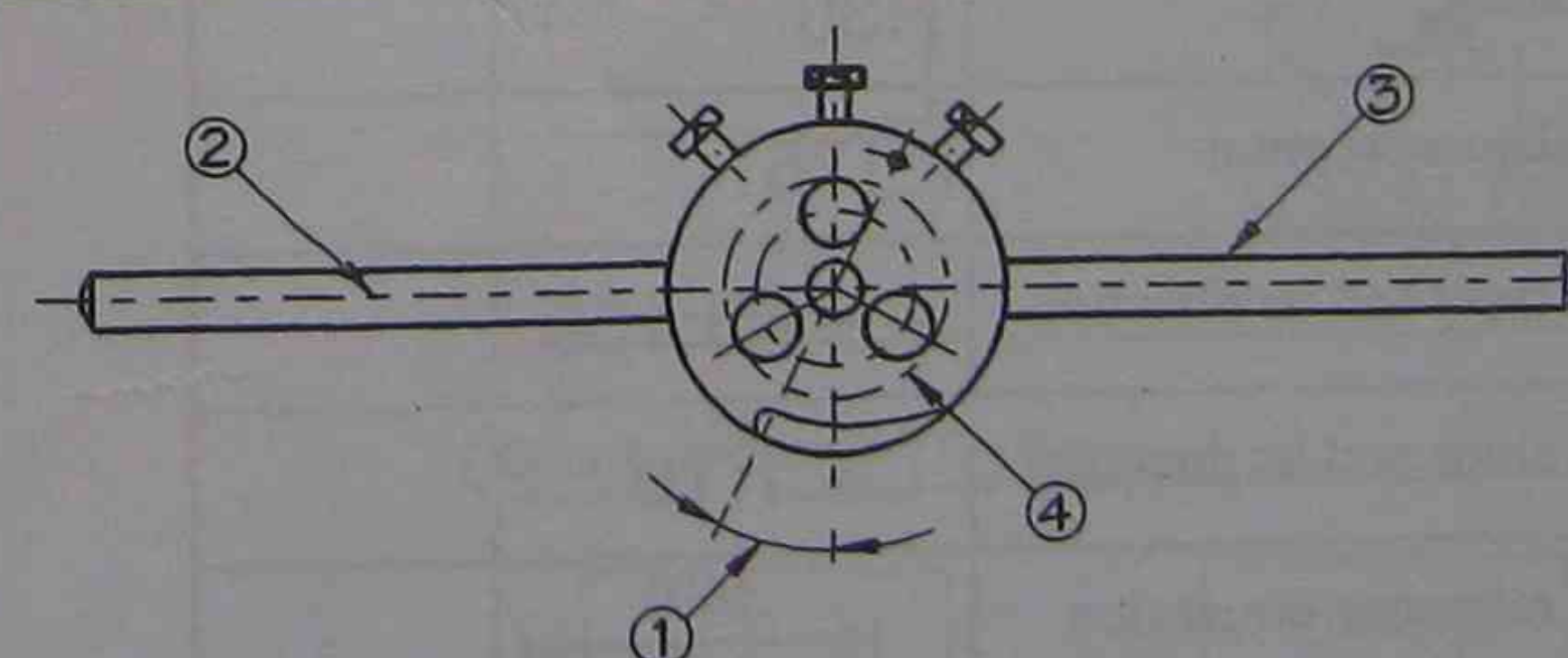
Name the types of line indicate in the space provided.



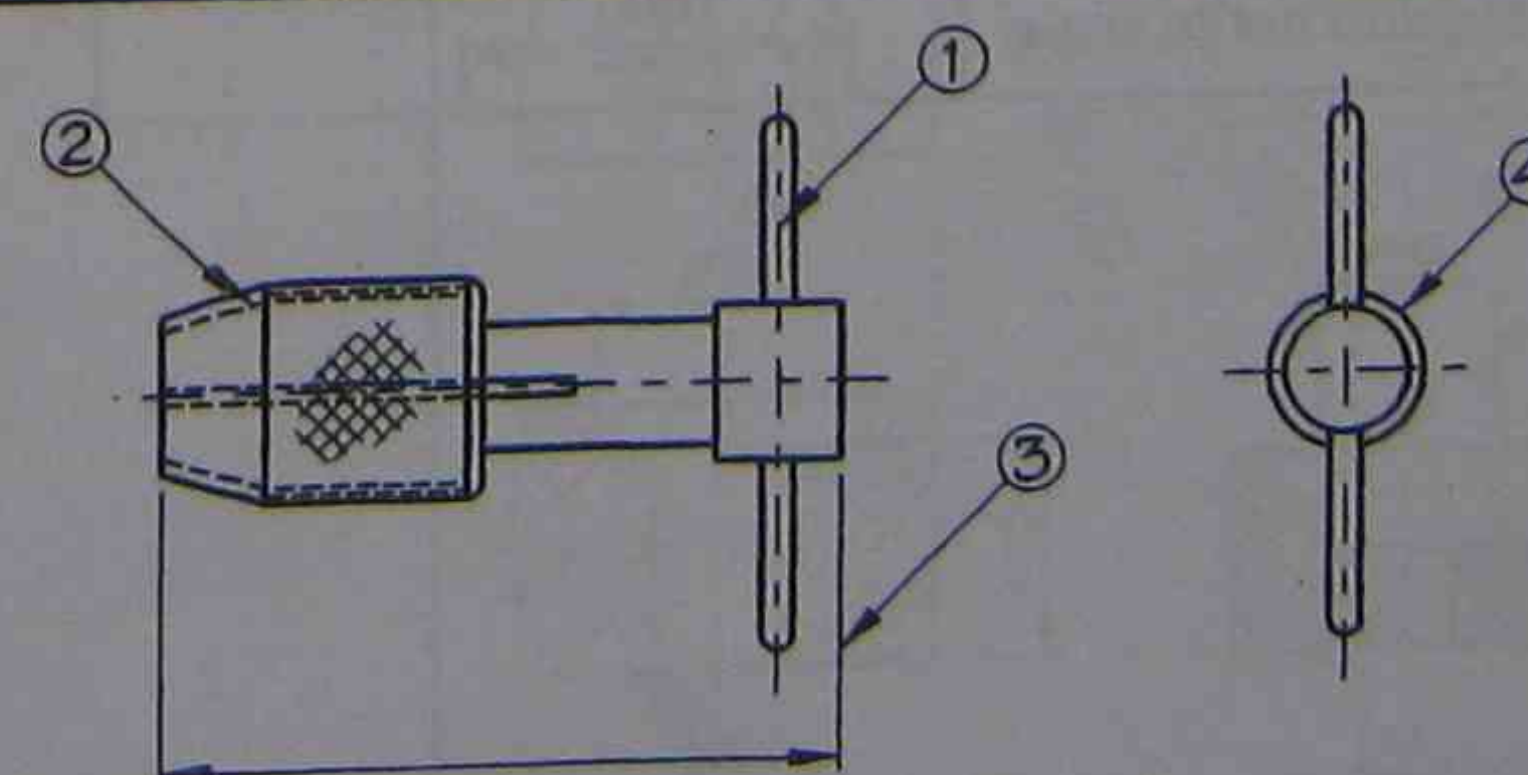
1. Outline
2. Extension line
3. Dimension line
4. Centre line
5. Hidden outline
6. Leader line



1. LEADER LINE
2. DIMENSION LINE
3. OUTLINE
4. EXTENSION LINE
5. CENTRE LINE
6. HIDDEN OUTLINE



1. DIMENSION LINE
2. CENTRE LINE
3. OUTLINE
4. HIDDEN LINES



1. CENTRE LINE
2. HIDDEN LINES
3. EXTENSION LINE
4. OUTLINE

Dimensions

The outline of the object indicates the shape of the object, the dimensions indicate the size of the object. Only those dimensions necessary for the manufacture of the object should be shown on the drawing.

All dimensions should be shown on the drawing only once. Dimensions should be applied to the view where the detail is seen clearest as an outline. Dimensions on engineering drawings are usually expressed in millimetres.

Points to consider:

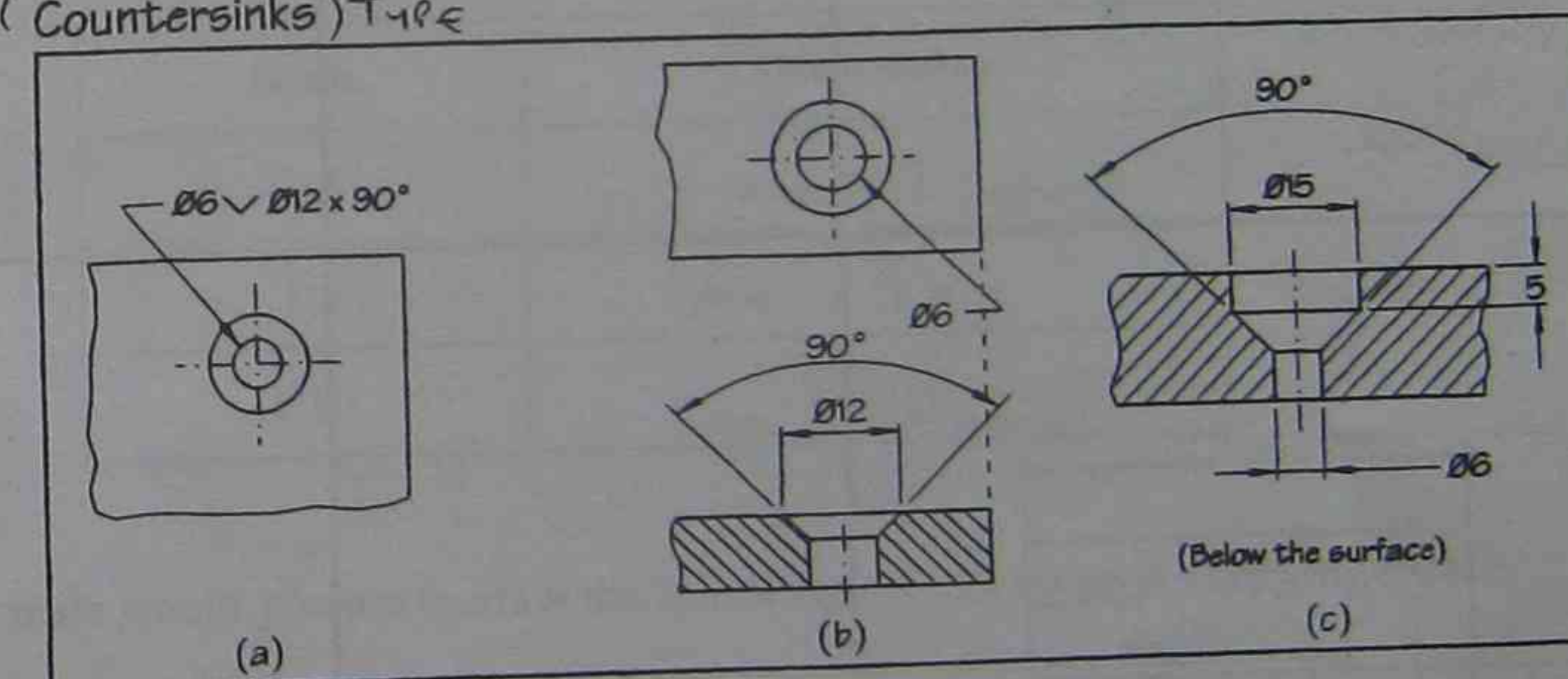
- place dimensions well clear of drawings and one another
- place dimensions where they will be best understood
- use a dark pencil for the numbers and arrow heads
- generally show dimensions only once
- keep dimensions off the actual view
- dimension all circles and arcs radially
- avoid crossing dimension lines
- avoid dimensioning hidden details
- dimension along the dimension lines placing sizes so they will read from the bottom and right hand side of the sheet.

Symbol	Description	Example
Ø	To indicate a diameter	Ø50
R	To indicate radius	R30
□	To indicate a square section	□ 75
→	To indicate a taper and its direction	→ 3:100
△	To indicate a slope and its direction	△ 1:10
()	To indicate a reference dimension	(60)
—	To indicate a dimension not to scale	(60)

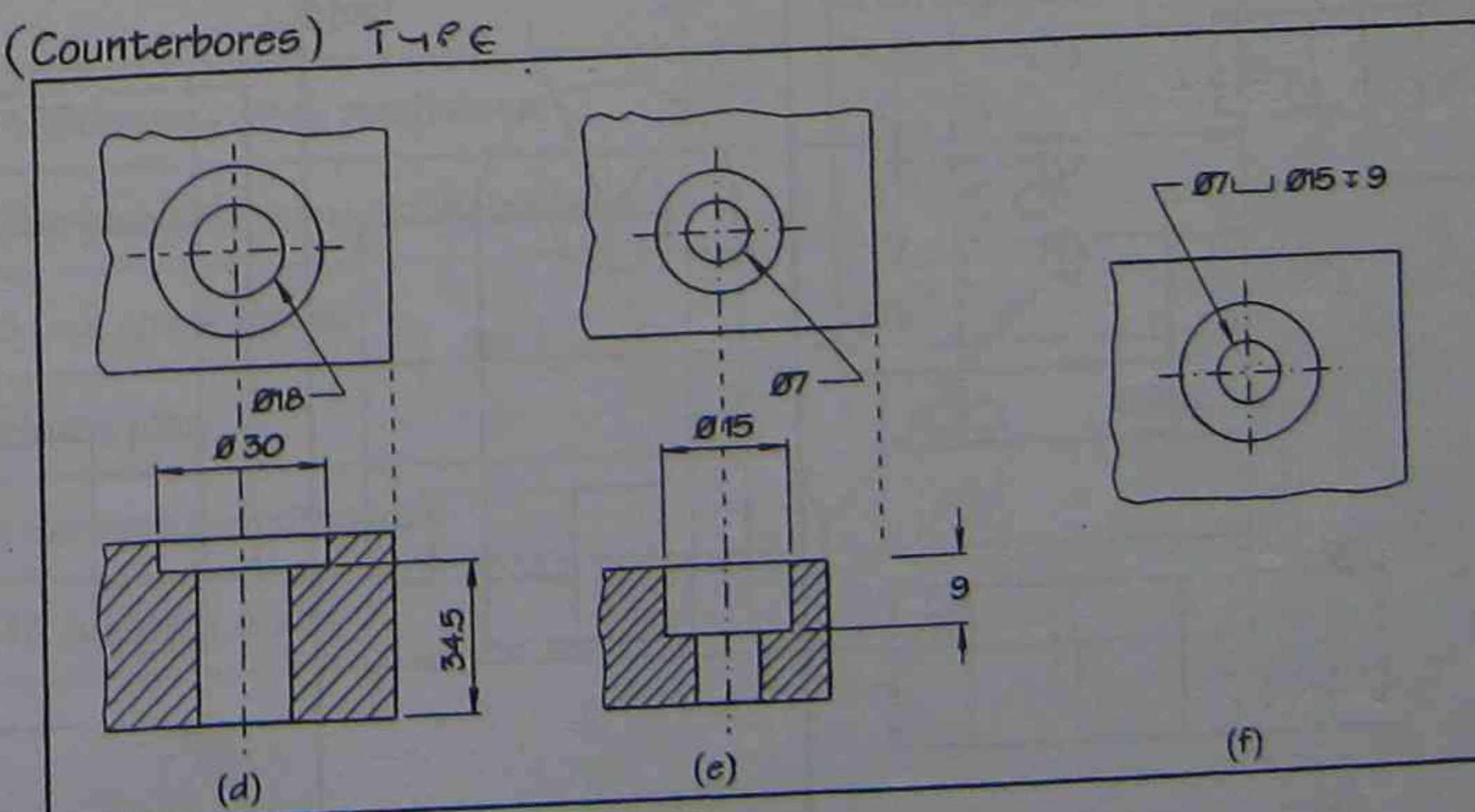
Application of dimensioning symbols

⌀	Indicates the centre-line of a part, feature, or group of features. It shall be located to or on the centre-line
SØ	Indicates the diameter of spherical surface, it shall be placed in front of the dimension
SR	Indicates the radius of spherical surface, it shall be placed in front of the dimension
∇	Indicates a countersink, it shall be placed in front of the dimension
□	Indicates counterbore or spotface, must be placed in front of the dimension
⌞	Indicates depth of the feature, this must be situated in front of the dimension
⌒	Indicates that the dimension refers to an arc length, this must be placed above the dimension

(Countersinks) TYPE

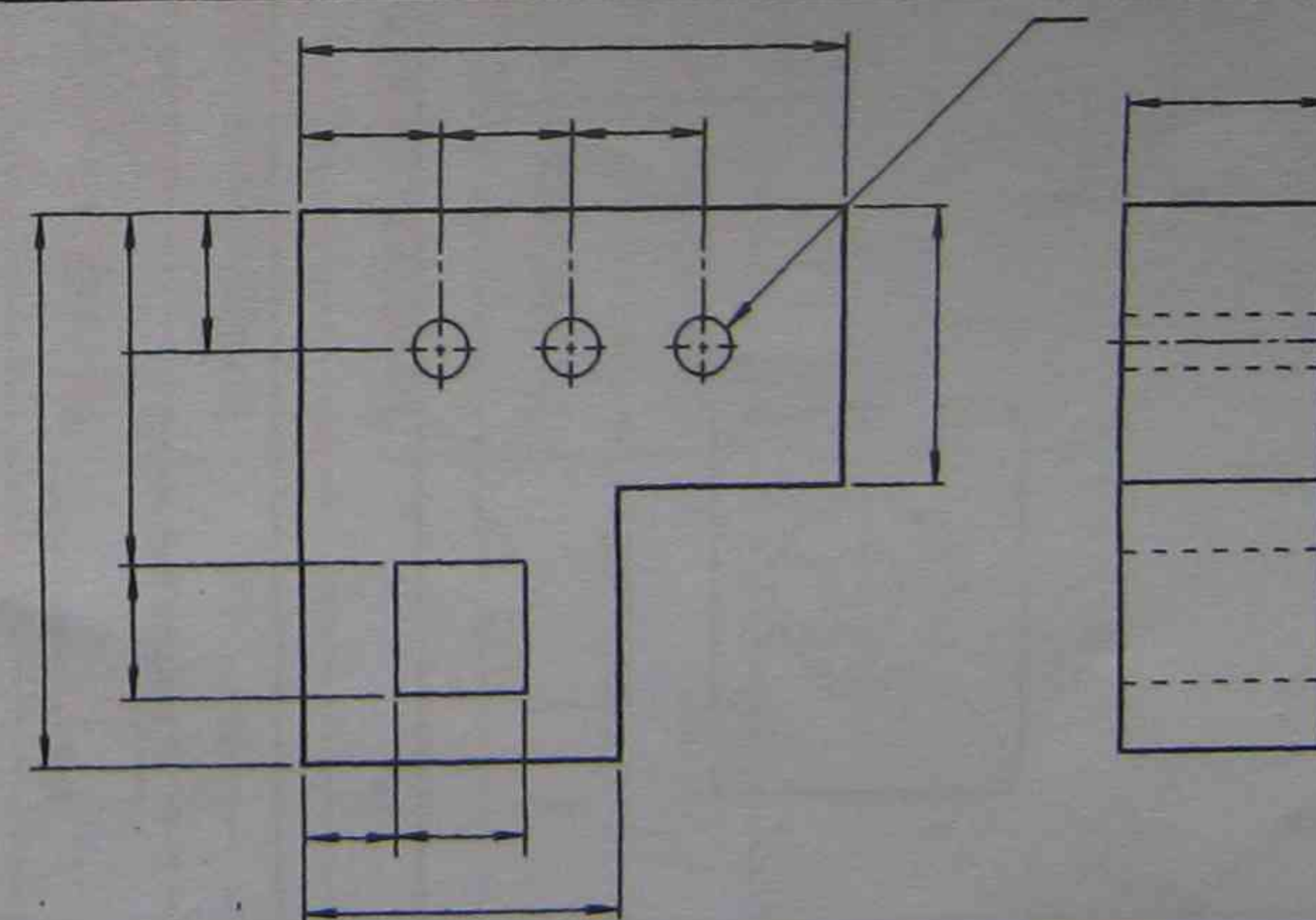
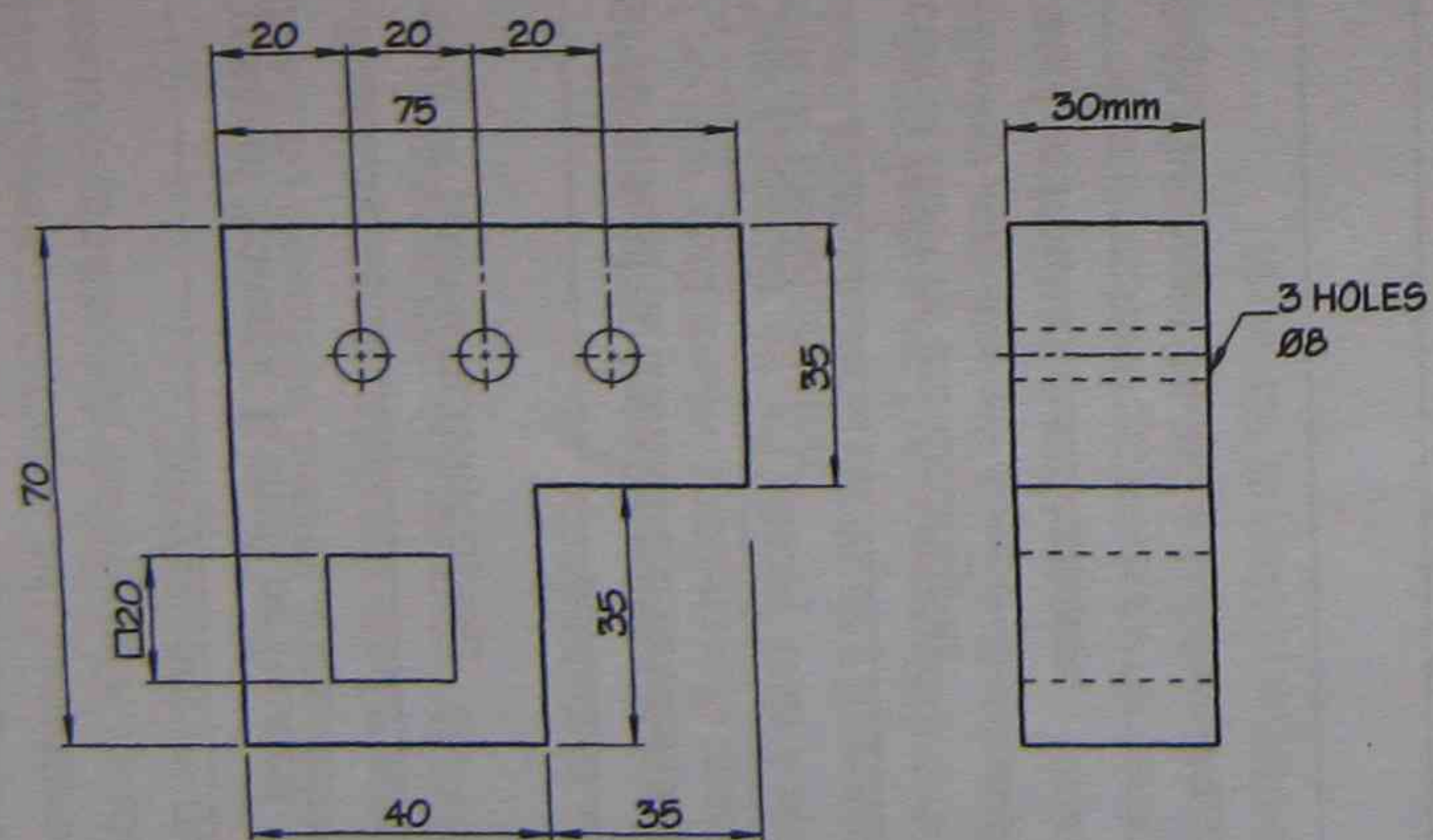
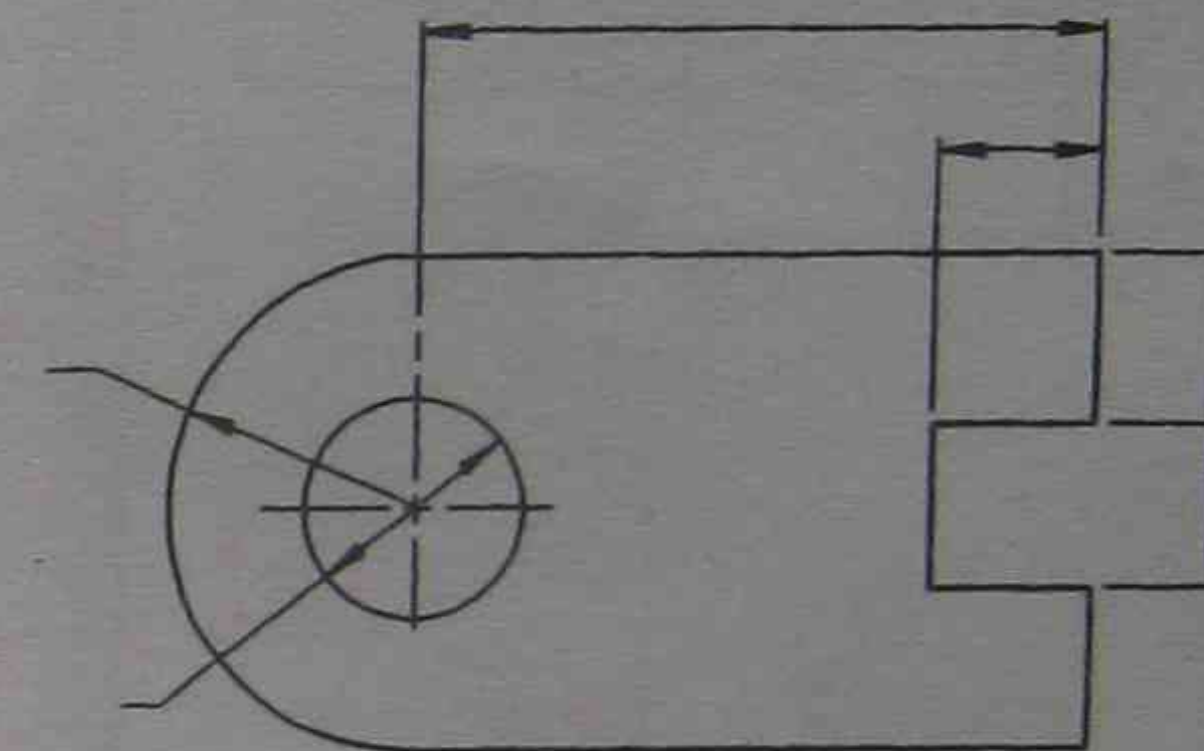
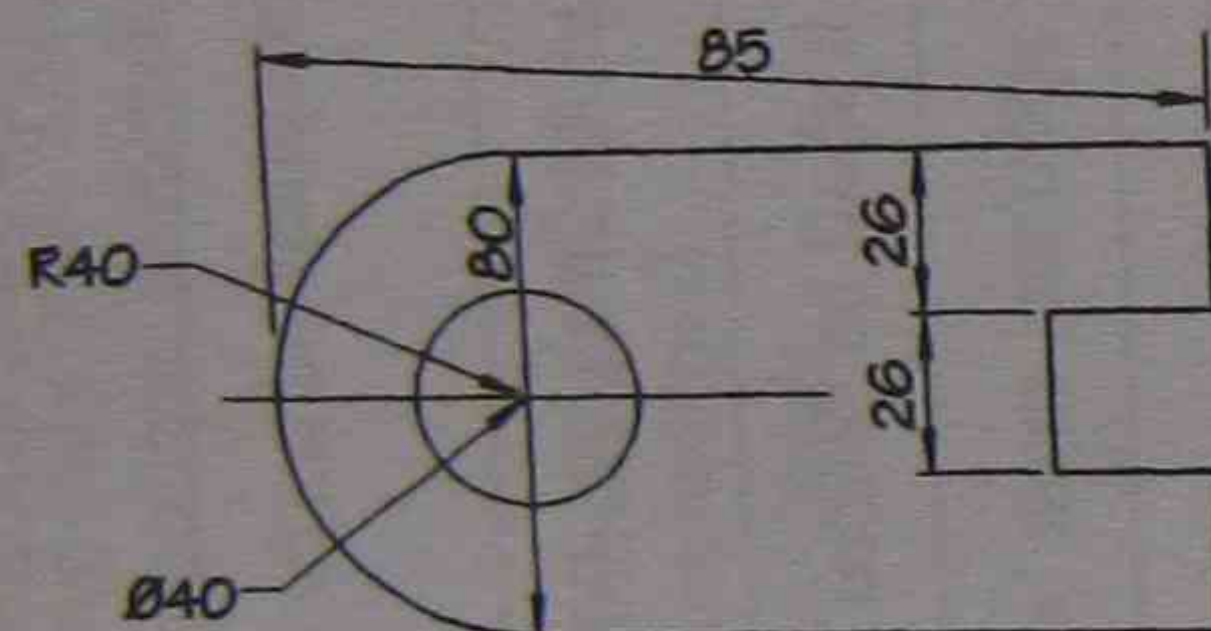
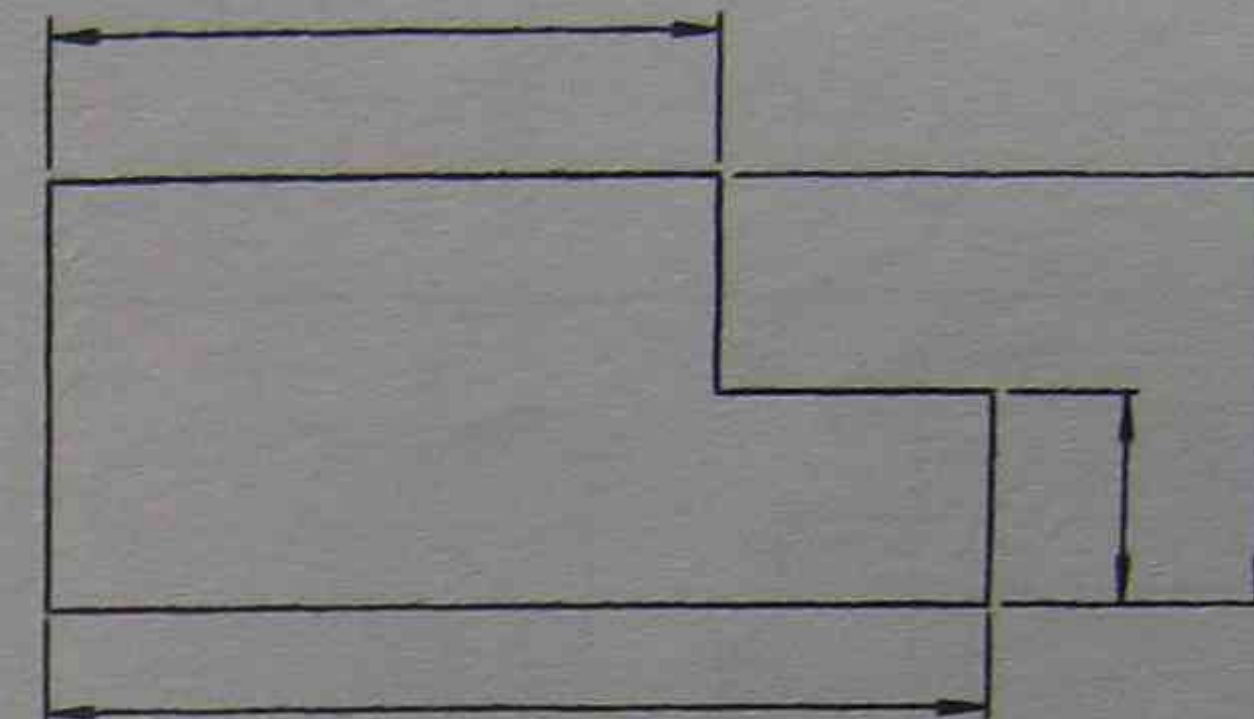
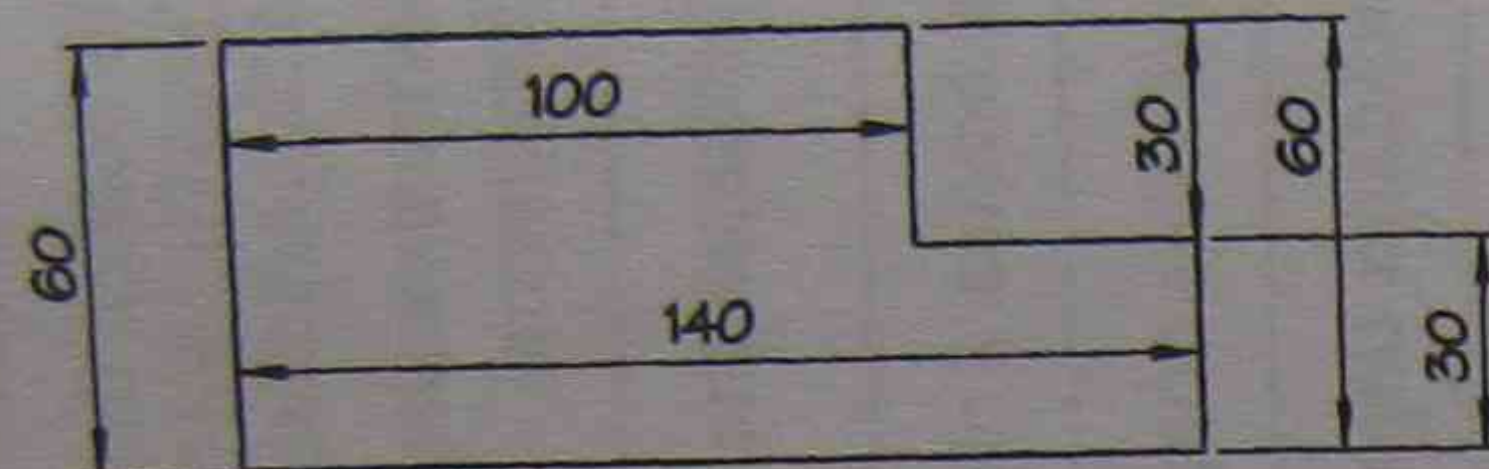


(Counterbores) TYPE



Exercise 4 Dimensioning

Drawings on the left hand side of the sheet are incorrectly dimensioned. Correctly dimension the corresponding drawings on the right side of the sheet.

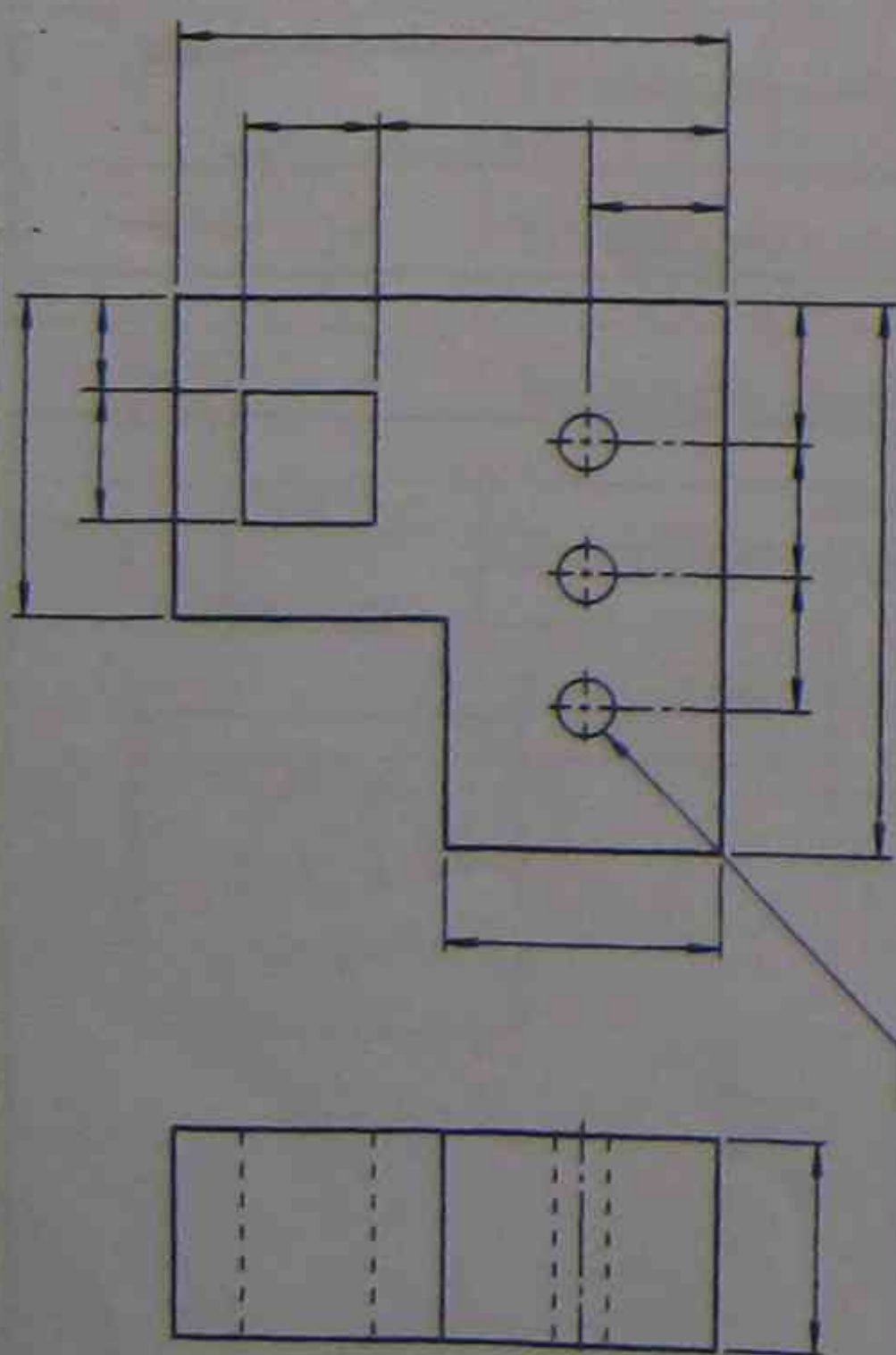
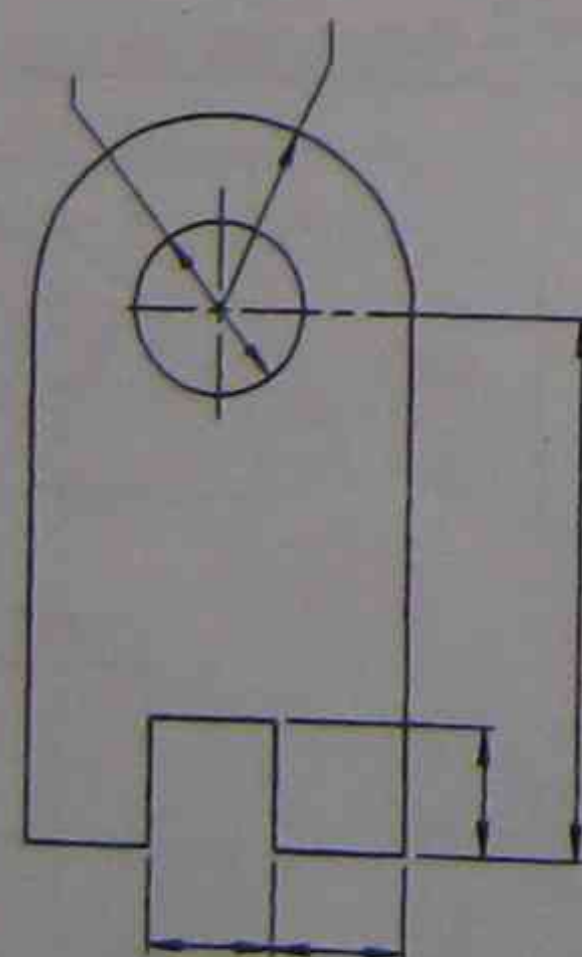
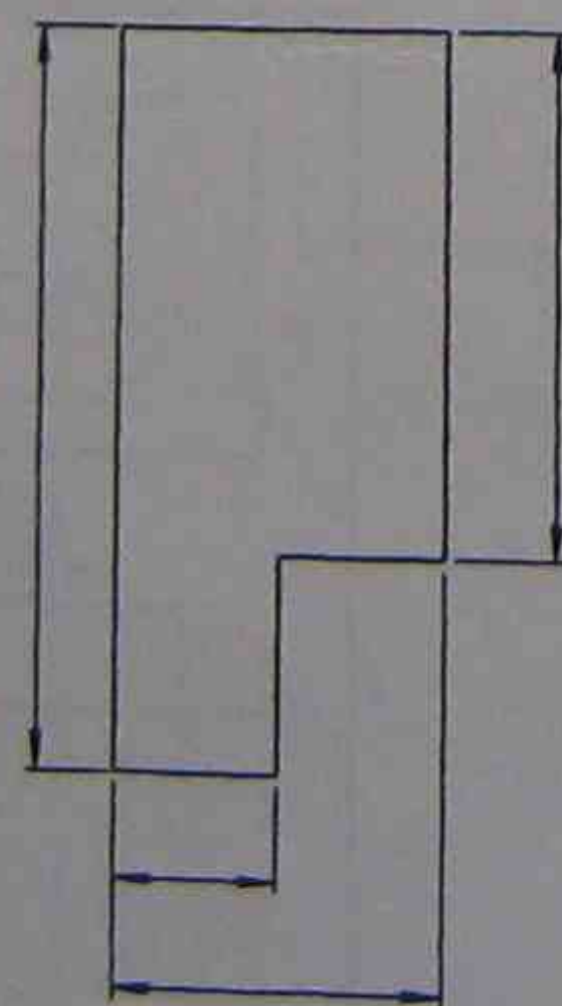
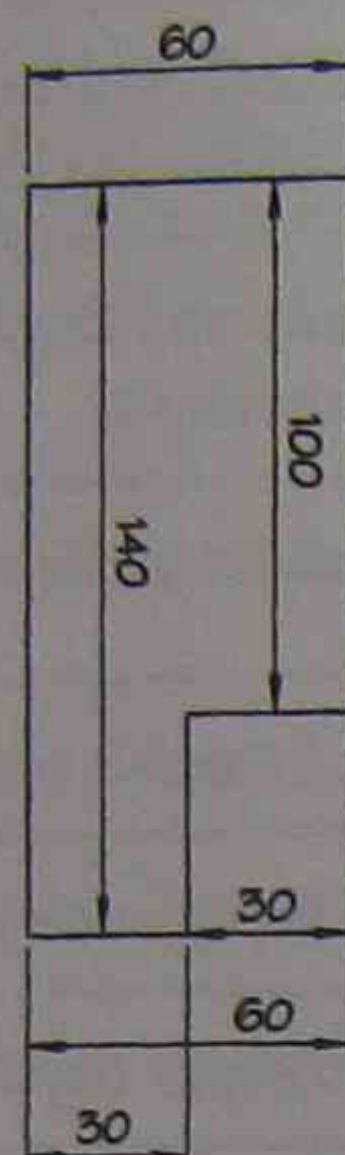
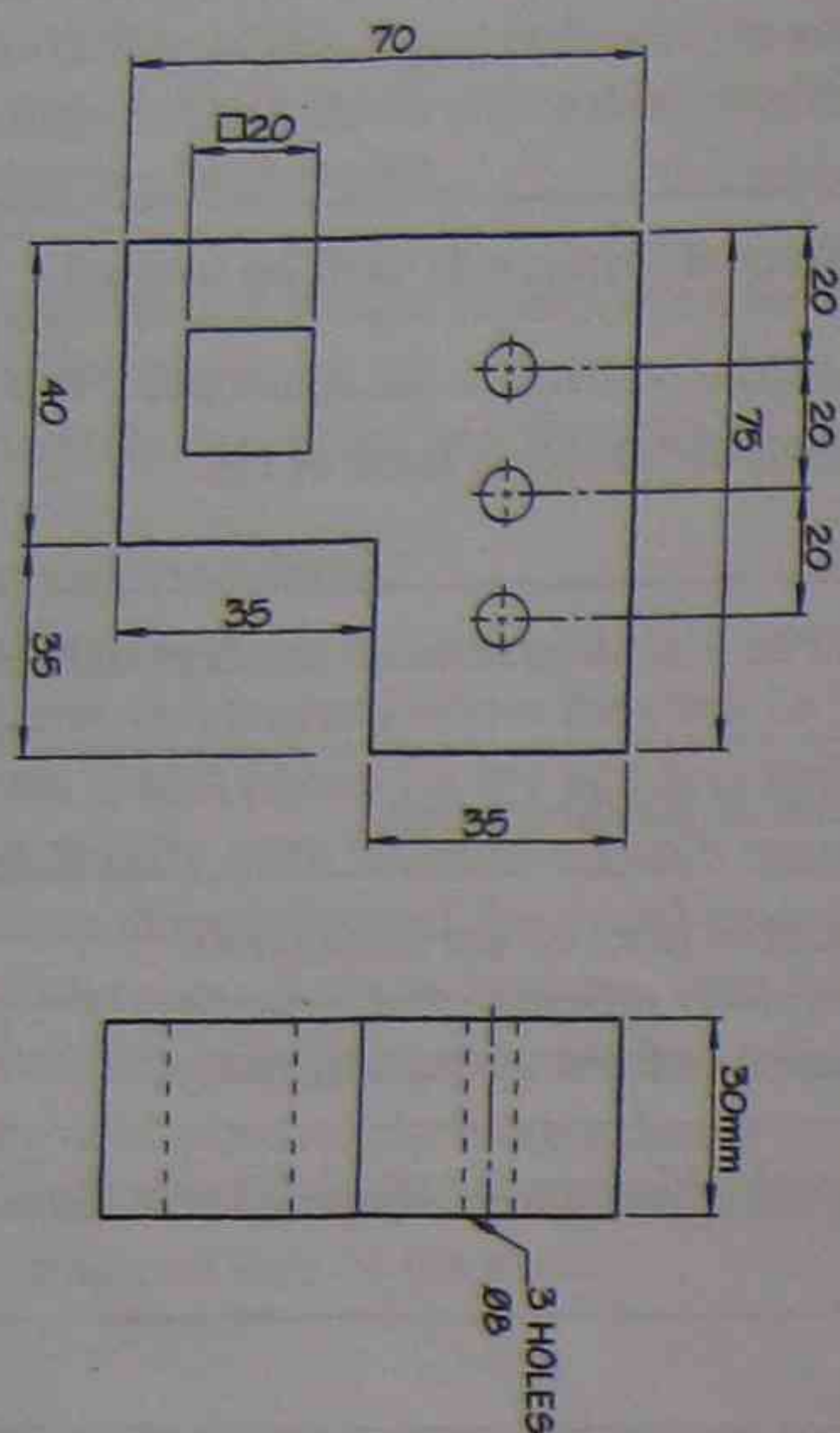


STUDENT'S NAME

MANUFACTURING & ENGINEERING
EDUCATIONAL SERVICES DIVISION

Exercise 4 Dimensioning

Drawings on the left hand side of the sheet are incorrectly dimensioned. Correctly dimension the corresponding drawings on the right side of the sheet.



Scaled drawings

The true size of an object may vary from 1 mm to thousands of mm. Small things should be drawn at their natural size. Larger ones should be drawn to a recognised scale so that they will fit on the drawing sheet.

Large details, structures and machine parts are drawn smaller than actual size, while very small things such as instrument parts are drawn larger than their true size.

Recommended Scales Australian Standard 1100				
Enlargement	Full size	Reduction		
10:1	1:1	1:2	1:5	1:10
5:1		1:20	1:50	1:100
2:1		1:200	1:500	1:1000
		1:2000	1:5000	1:10 000

Example 5

- (a) If an object has a dimension of 525 mm, what would it be drawn if the following scales were used?

Scale	Drawn size
1:2	1 mm = 2 mm
1:5	1 mm = 5 mm
1:10	1 mm = 10 mm

- (b) What scale would you use to draw the following objects on an A3 drawing sheet?

Object	Drawing Scale
Architrave switch mechanism	1:5
Site plan of a domestic installation	1:50
6 mm screw thread	10:1
House plan	1:100
Domestic switchboard	1:10
10 A socket outlet	1:2

Fabrication symbols

Surface texture

Surface texture refers to the roughness of a surface. It can vary from very rough to very smooth, for example an aluminium casting may have the following textures:

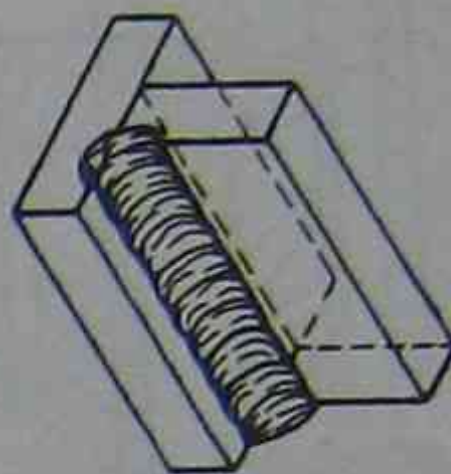

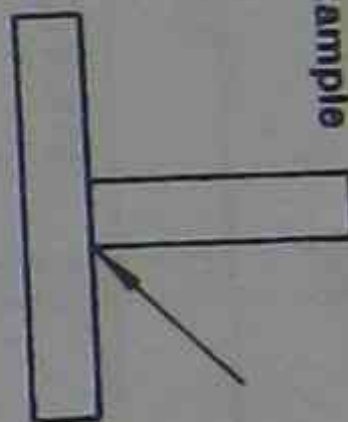
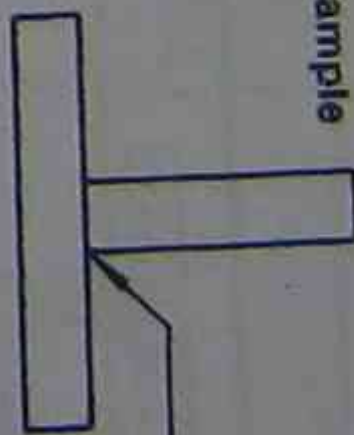
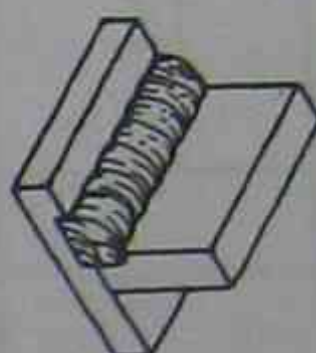

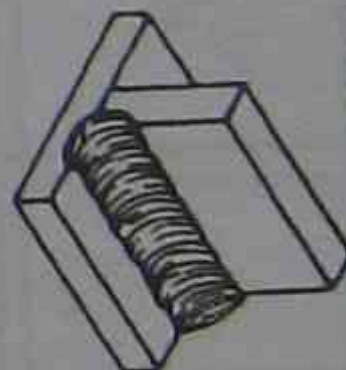
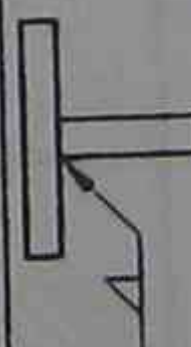
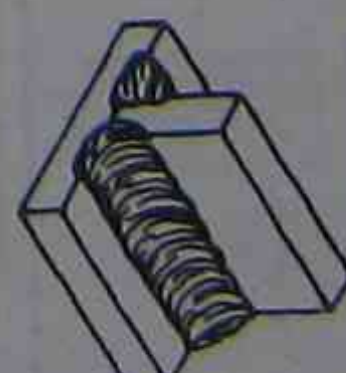
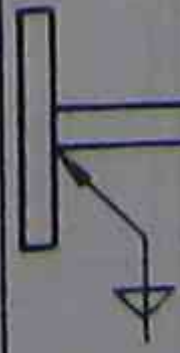

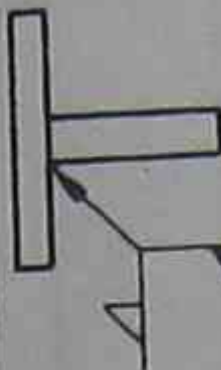
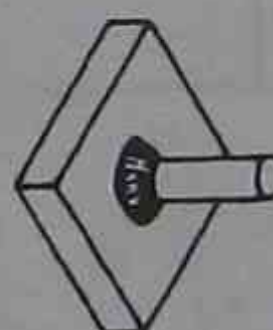
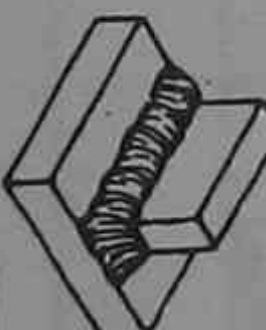
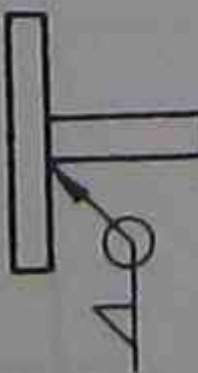

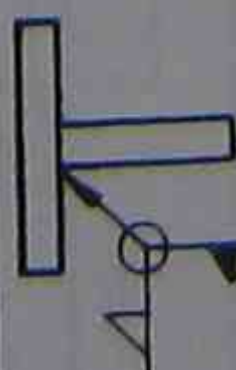
- rough cast
- fine cast
- die cast
- rough machined
- medium machined
- fine machined

Standard symbols

- ✓ Basic symbol: used when surface finish can be produced by an convenient technique
- ✓ Modified symbol: finish done by a machining process
- Modified symbol: indicating a surface finish without removal of material (for example, quality of an initial casting)

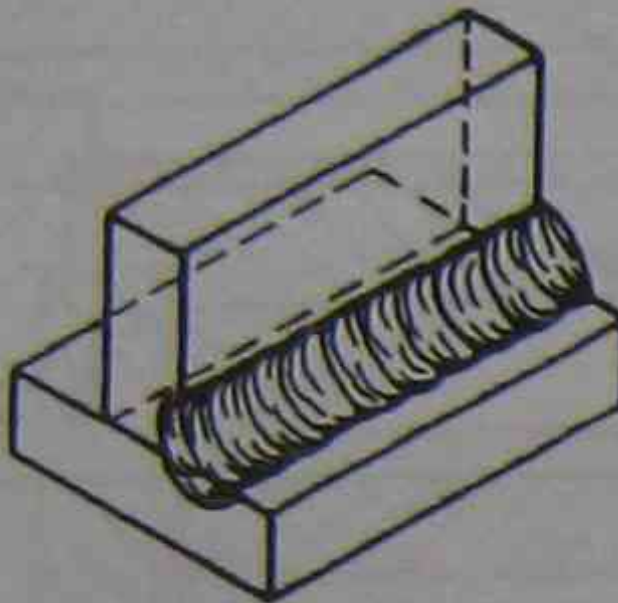
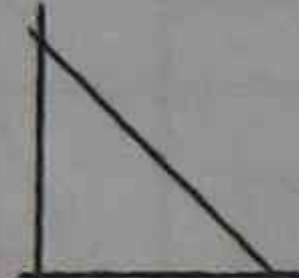

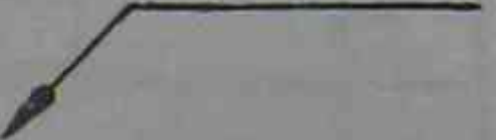
Welding symbols and their application

The standard welding symbol used to represent welds on drawings and some simple examples are shown in the following diagrams.

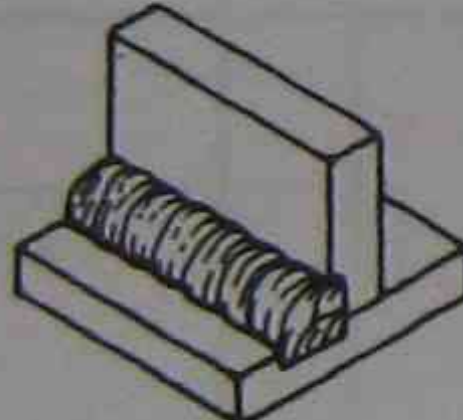
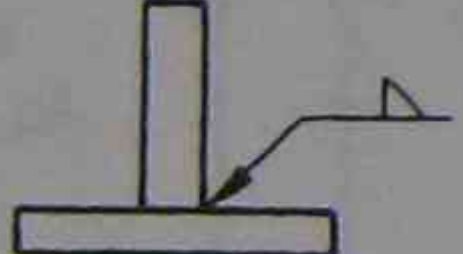
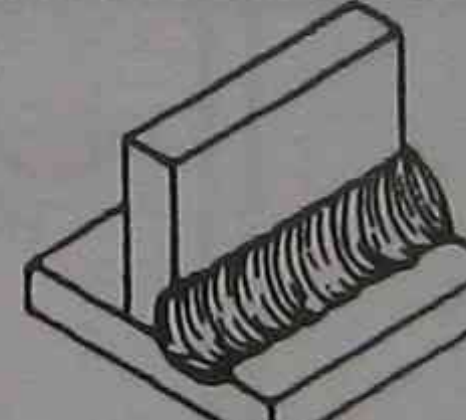
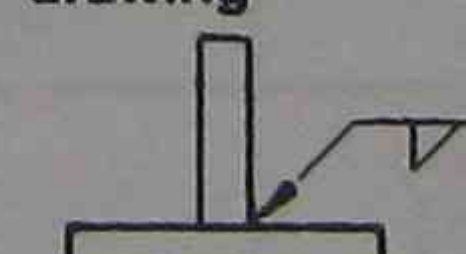
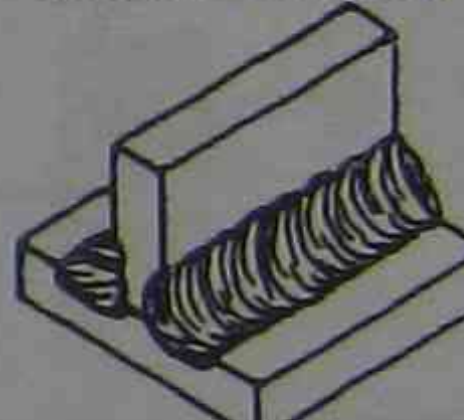
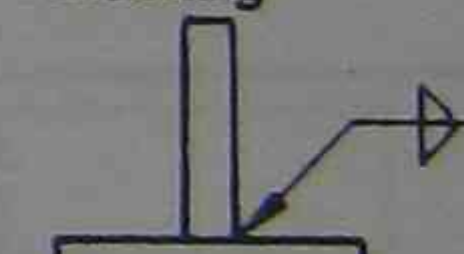
WELDS - FILLET ELEMENTS OF A WELD SYMBOL			
THE SYMBOL		THE ARROW	THE LINE
Type of weld	Sketch of weld	Symbol	
FILLET			
			
		The arrow points to the position of the welded joint	This is a reference line drawn parallel to the base line of a particular view. The position of the symbol above or beneath this line determines the location of the weld.
LOCATION OF WELD SYMBOLS			
Symbol above the line weld joint opposite side to arrow.			
			
Indication on drawing			
			
Symbol beneath the line weld joint, the same side as the arrow.			
			
Indication on drawing			
			
Symbol above the line			
Symbol beneath the line			
Weld both sides			
			
Indication on drawing			
			
SUPPLEMENTARY SYMBOLS			
To be welded on site or site weld			
Symbol			
			
Indication on drawing			
			
Weld all round.			
Sketch of Weld			
			
Sketch of Weld			
			
Indication on drawing			
			
Combination of site weld and weld all round.			
Symbol			
			
Indication on drawing			
			

WELDS - FILLET


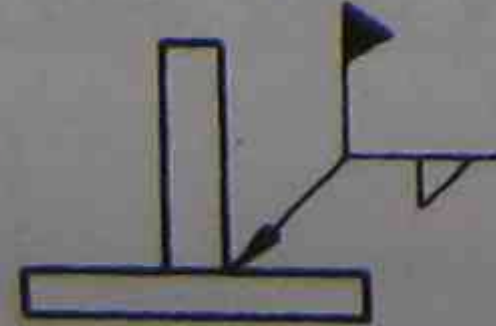
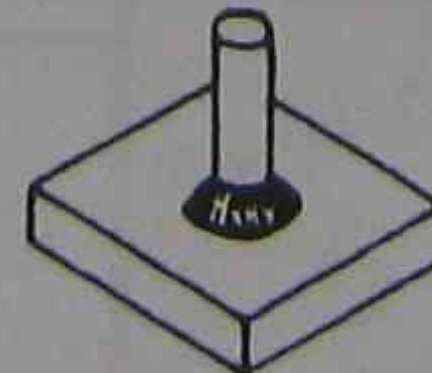
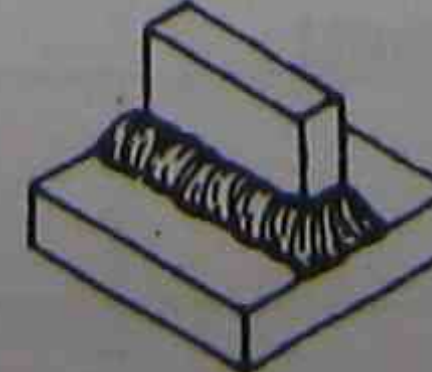

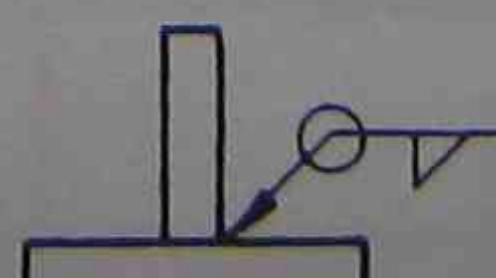

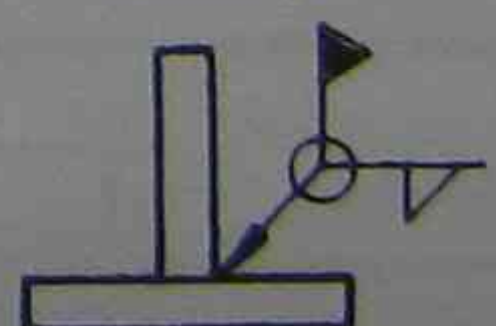
ELEMENTS OF A WELD SYMBOL

THE SYMBOL			THE ARROW	THE LINE
Type of weld	Sketch of weld	Symbol	Example	Example
FILLET			 The arrow points to the position of the welded joint	 This is a reference line drawn parallel to the base line of a particular view. The position of the symbol above or beneath this line determines the location of the weld.

LOCATION OF WELD SYMBOLS

<p>Symbol above the line weld joint opposite side to arrow.</p>  	<p>Symbol beneath the line weld joint, the same side as the arrow.</p>  	<p>Symbol above the line</p> <p>Symbol beneath the line</p> <p>Weld both sides</p>  
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SUPPLEMENTARY SYMBOLS

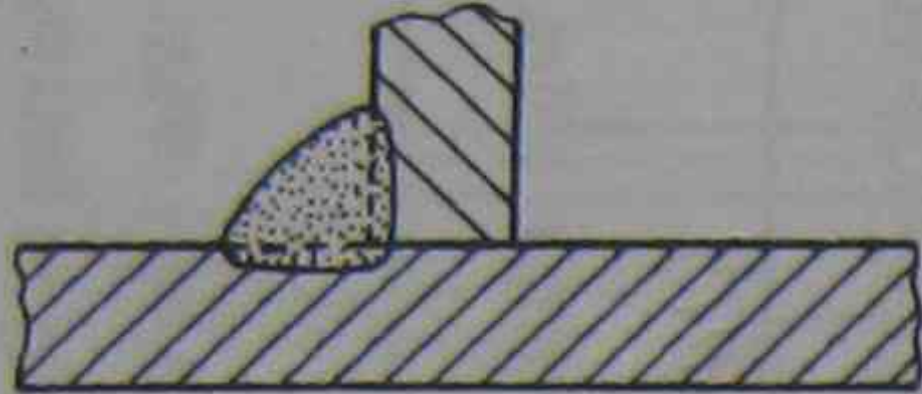
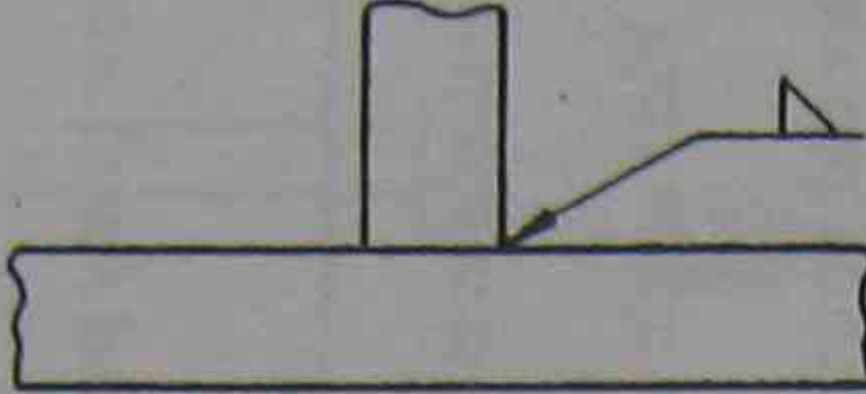
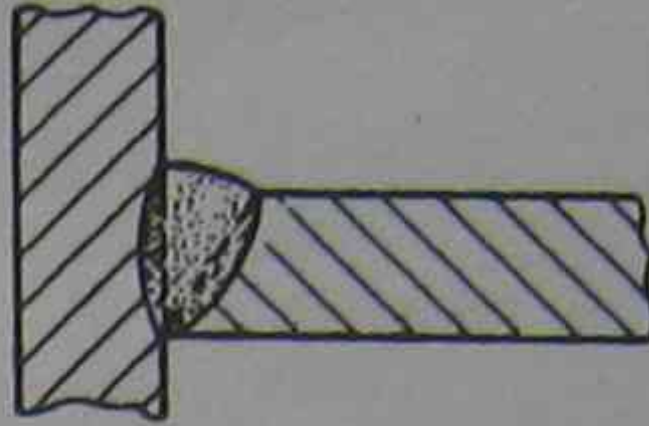
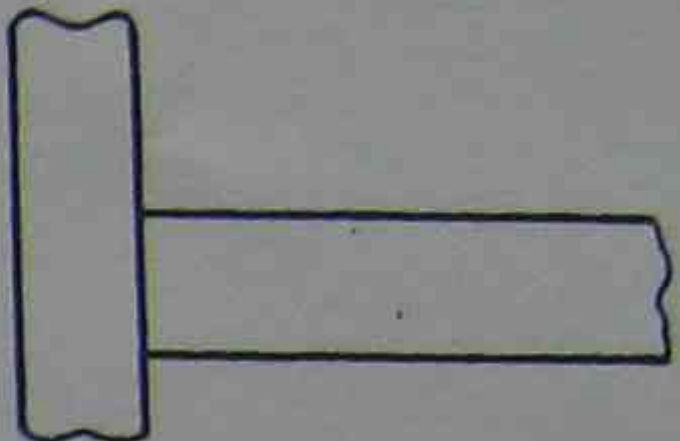
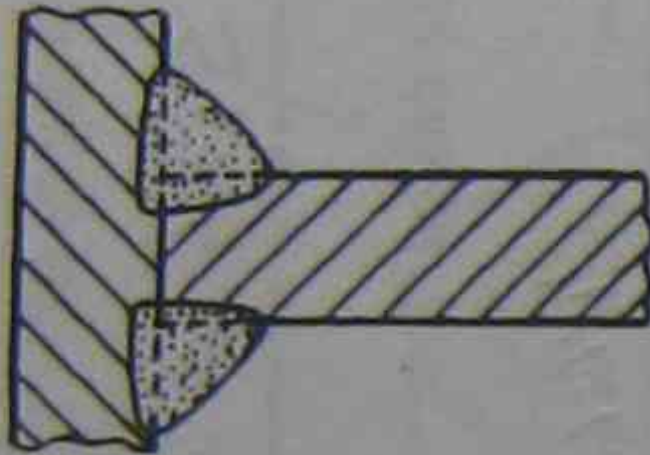
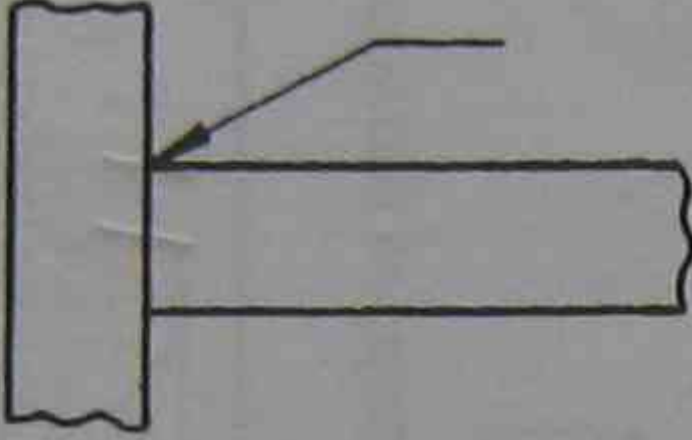

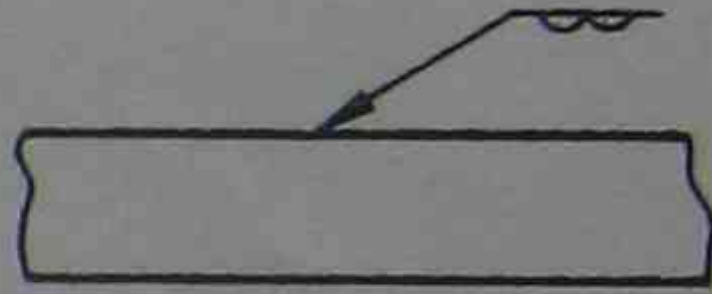

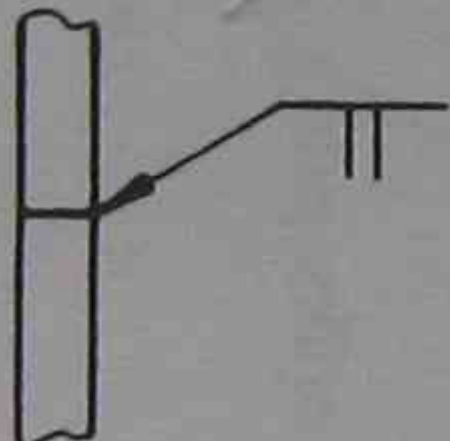

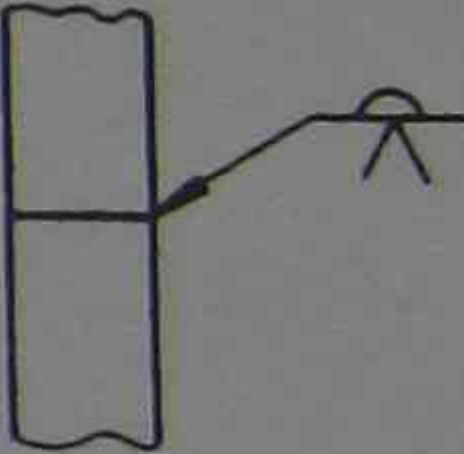

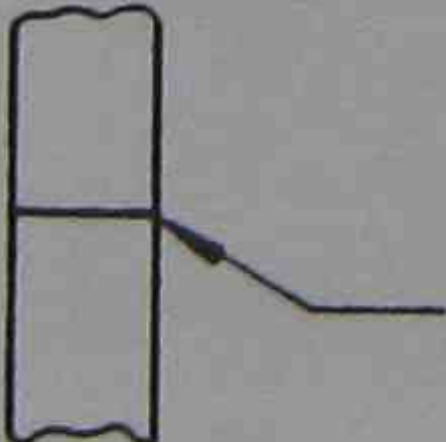


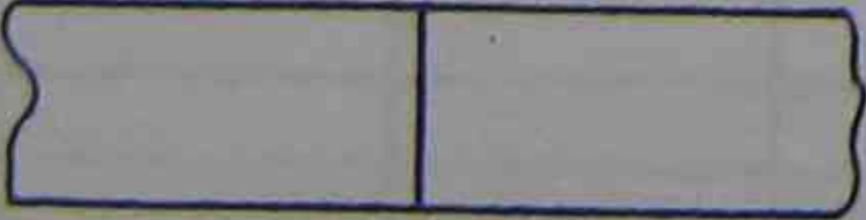
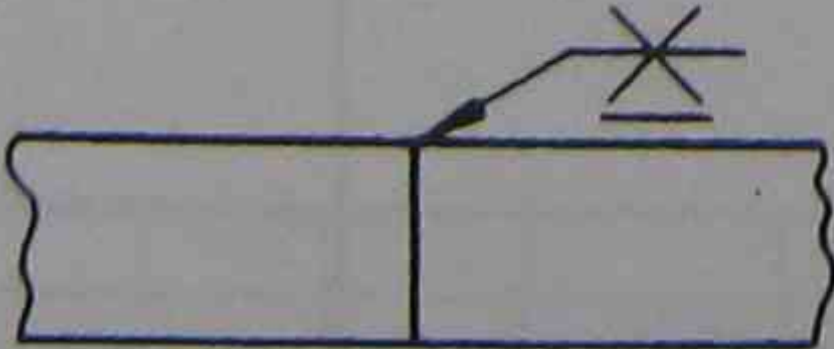
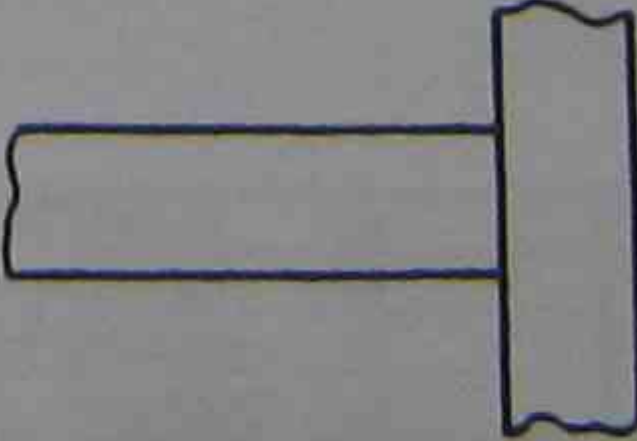
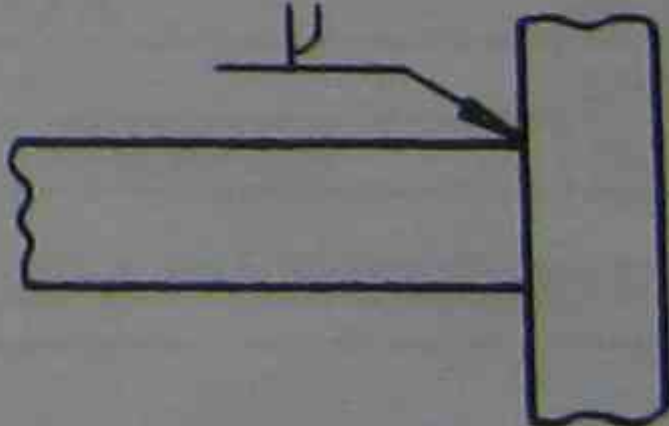

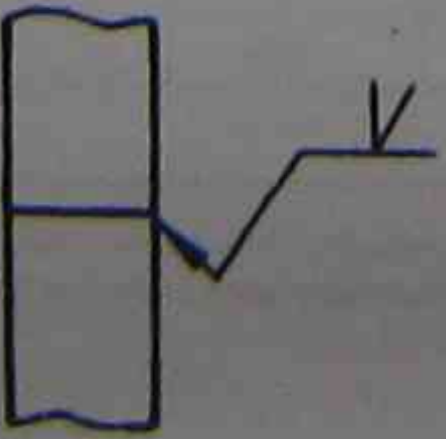

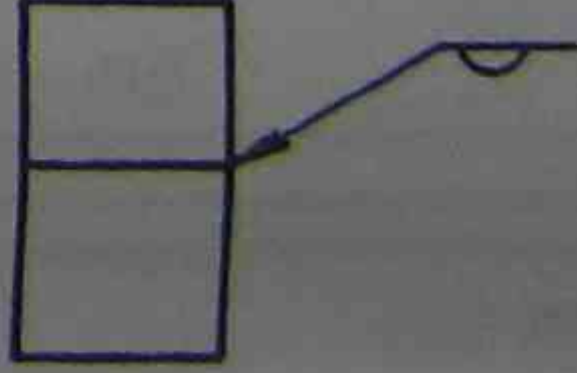
<p>To be welded on site or site weld</p> <p>Symbol</p>  <p>Indication on drawing</p> 	<p>Weld all round.</p> <p>Sketch of Weld</p>  <p>Sketch of Weld</p>  <p>Symbol</p>  <p>Indication on drawing</p> 	<p>Combination of site weld and weld all round.</p> <p>Symbol</p>  <p>Indication on drawing</p> 
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BASIC SYMBOLS FOR ARC AND GAS WELDING

Reference code: 1. Symbols for welding No AS Z6
2. SAA code for welding in building No AS 1554 Part 1

BUTT WELDS				WELD FINISH			
Type of weld	Sketch of weld	Symbol	Indication on drawing	Type of finish	Symbol	Indication of drawing	Sketch of weld
GENERAL BUTT	Full penetration butt weld by a welding procedure to be agreed.	Z		FLUSH CONVEX CONCAVE	— ⌒ ⌒		
SQUARE BUTT							
SINGLE V BUTT		V					
SINGLE BEVEL BUTT		✓					
SINGLE U BUTT		U					
SINGLE J BUTT		J					

Exercise 6

WELD SYMBOLS - COMPLETE THE FOLLOWING BY DRAWING THE WELD OR SYMBOL					
Type of weld	Sketch of weld	Indication on drawing	Type of weld	Sketch of weld	Indication on drawing
FILLET			SINGLE BEVEL BUTT		
DOUBLE FILLET					
SQUARE BUTT			FLUSH		
SINGLE V BUTT			SINGLE U BUTT		
DOUBLE V BUTT			SINGLE S BUTT		
SINGLE V BUTT			CONVEX		

Review questions

These questions will help you revise what you have learnt in this topic.

1. Referring to Drwg 97-416 answer the following questions.

(a) What type of drawing is it?

SUB - ASSEMBLY DRAWING

(b) What is the device called?

WHEEL PULLER

(c) How many items are listed?

7

(d) How many parts are required for one complete assembly?

11

(e) What angle is the drawing produced in?

☐ First angle

☒ Third angle

(f) How did you decide?

(g) What detail drawing number needs to be found to produce Item 2, the side plate?

97-503

(h) When was this drawing first issued?

15-10-97

DO NOT SCALE
ALL DIMENSIONS IN MILLIMETRES

ITEM	QTY	DESCRIPTION	DRG No
7	2	CAP	97-508
6	1	HANDLE	97-507
5	1	BODY	97-506
4	2	LEG	97-505
3	2	PIN	97-504
2	2	SIDE PLATE	97-503
1	1	STEM	97-502

MANUFACTURING & ENGINEERING ESD			
TITLE: WHEEL PULLER			
SCALE	SIZE	DRAWING No.	SHT
NTS	A3	97-416	1 OF 1

DRAWN		CHECKED		APPROVED		RECORD OF ISSUE	
JD	WL	JD	WL	JD	WL	JD	WL

FINISH		MATERIAL		TOLERANCES ARE:		UNLESS NOTED OTHERWISE	
N/A	N/A	N/A	N/A	LINEAR	ANGULAR	N/A	N/A

AMENDMENTS		CHANGES		ZONE		DATE		ISSUE	
1	2	3	4	5	6	7	8	9	10

FIRST ISSUE		DATE		ZONE		ISSUE	
JD	WL	DATE	ZONE	JD	WL	DATE	ZONE
		15-10-97					

2. Referring to Drwg 50882 answer the following questions.

(a) What type of drawing is it?

DETAIL

(b) How many parts are detailed on this drawing?

3 SECTIONS

(c) What are the initials of the person who produced the drawing?

WL

(d) What units are the dimensions?

☐ Centimetres

☒ Millimetres

☐ Metres

(e) How did you decide on your answer in (d)?

(f) What is the drawing standard practice that has been used?

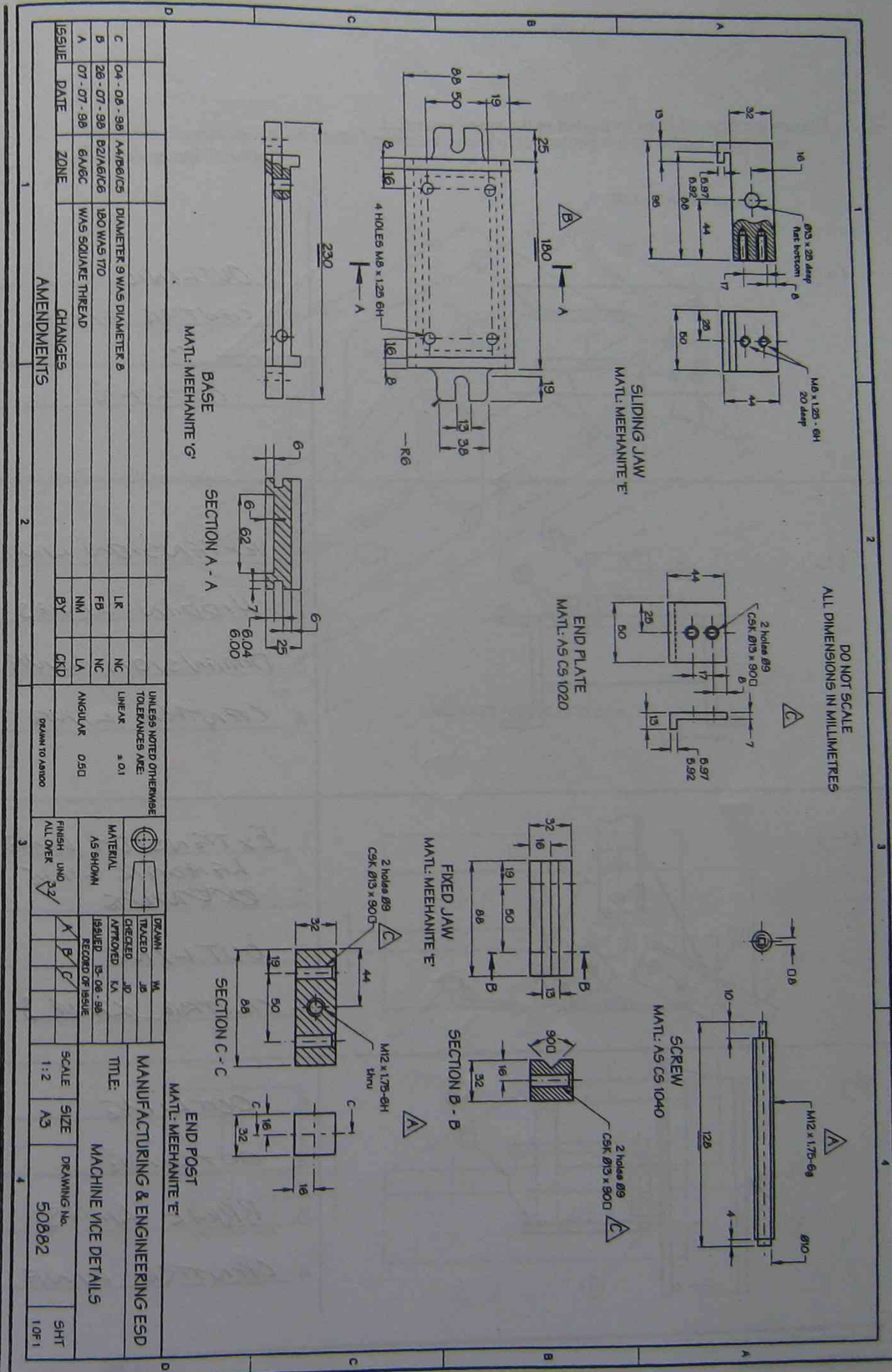
AS1100

(g) Is the latest issue A, B, or C?

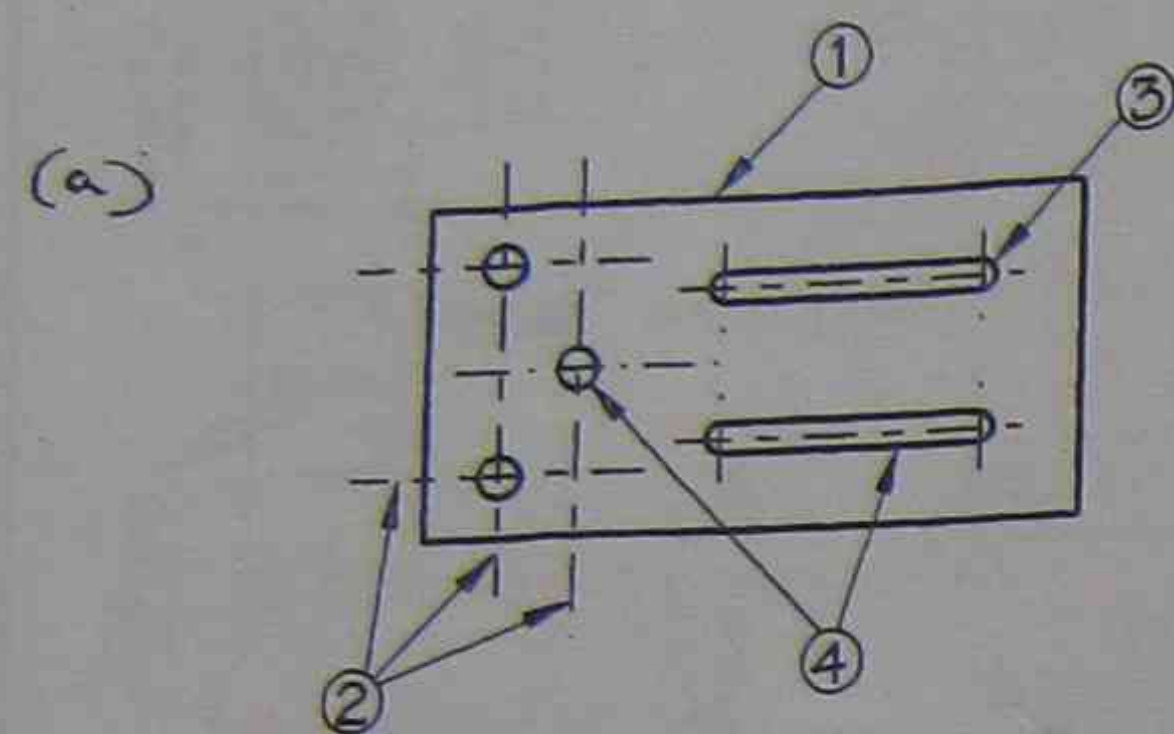
C

(h) How many dimensions were changed on the drawing for issue C?

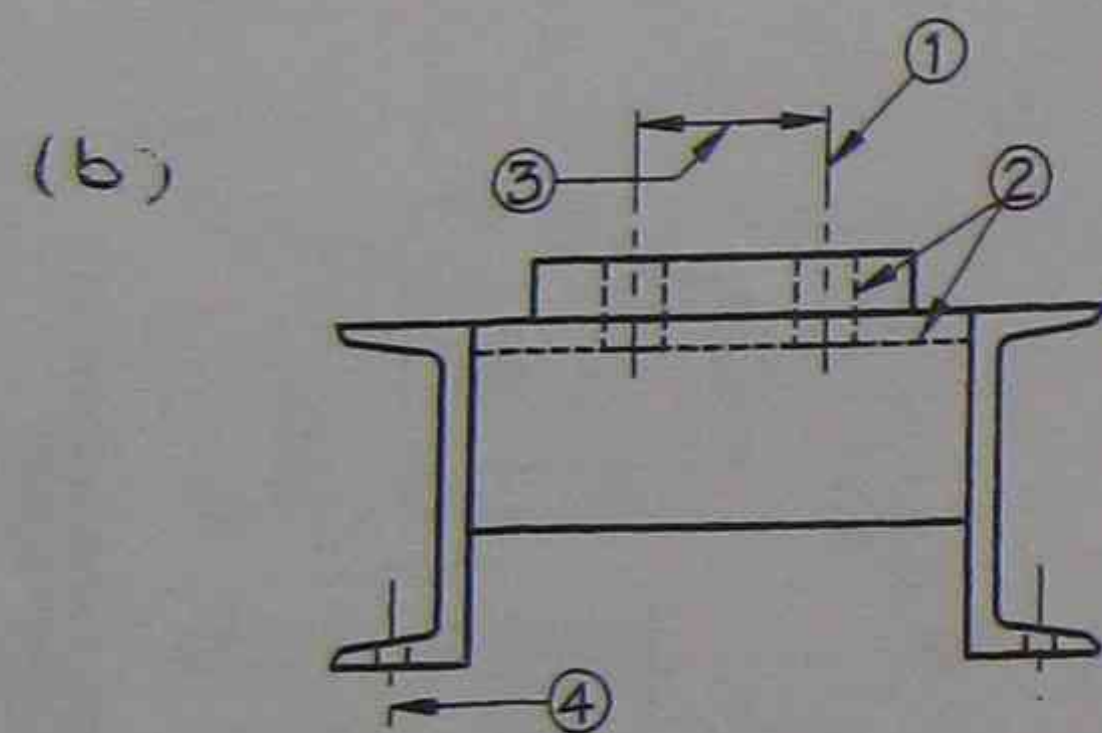
3 A4/B6/C5



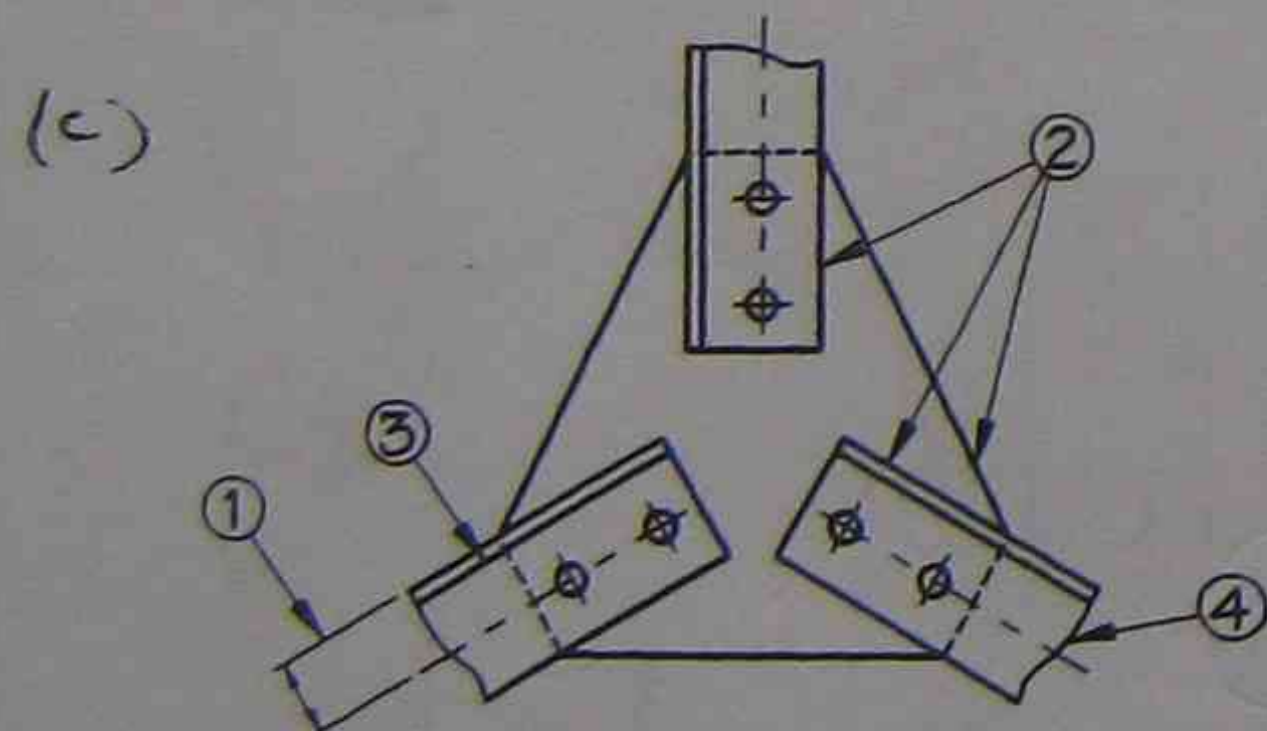
3. Names the type of lines indicated in the space provided.



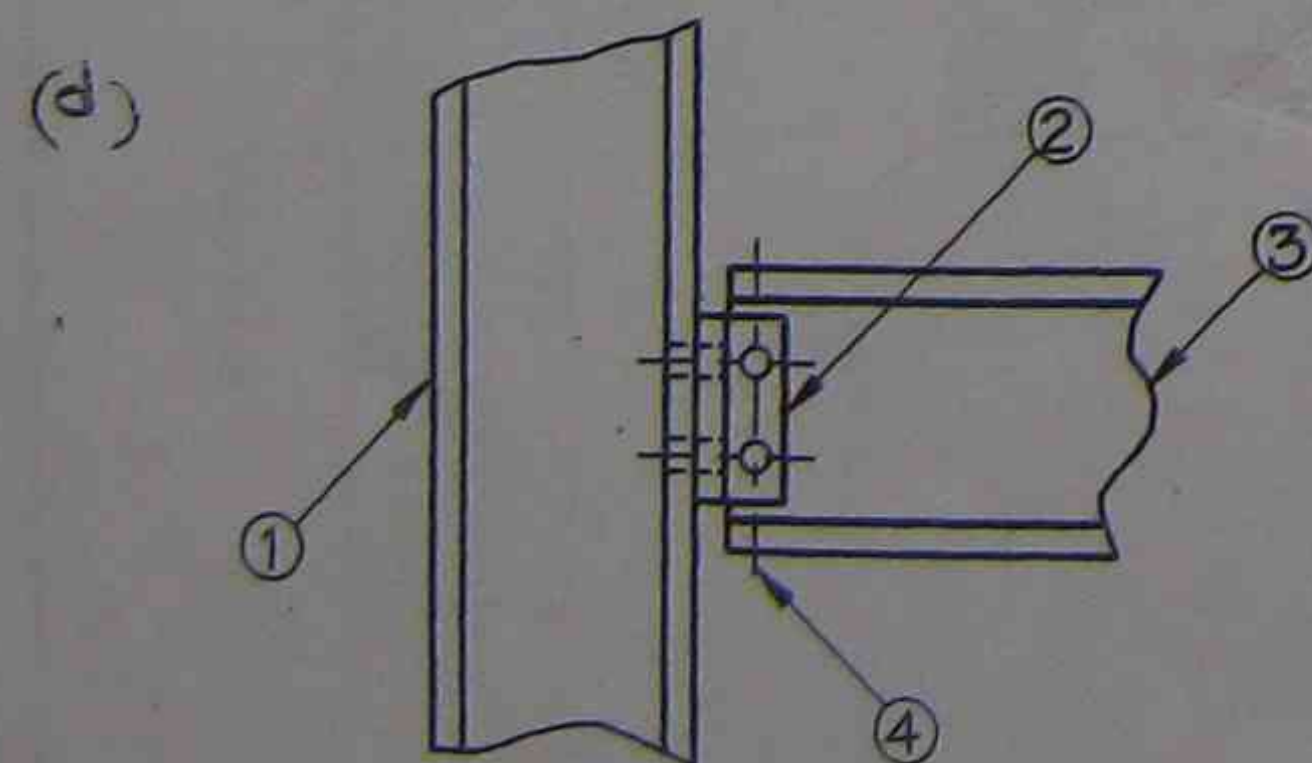
1. OUTLINE
2. CENTRE LINE
3. "
4. OUTLINE



1. EXTENSION LINES
2. HIDDEN LINES
3. DIMENSION LINE
4. CENTRE LINE

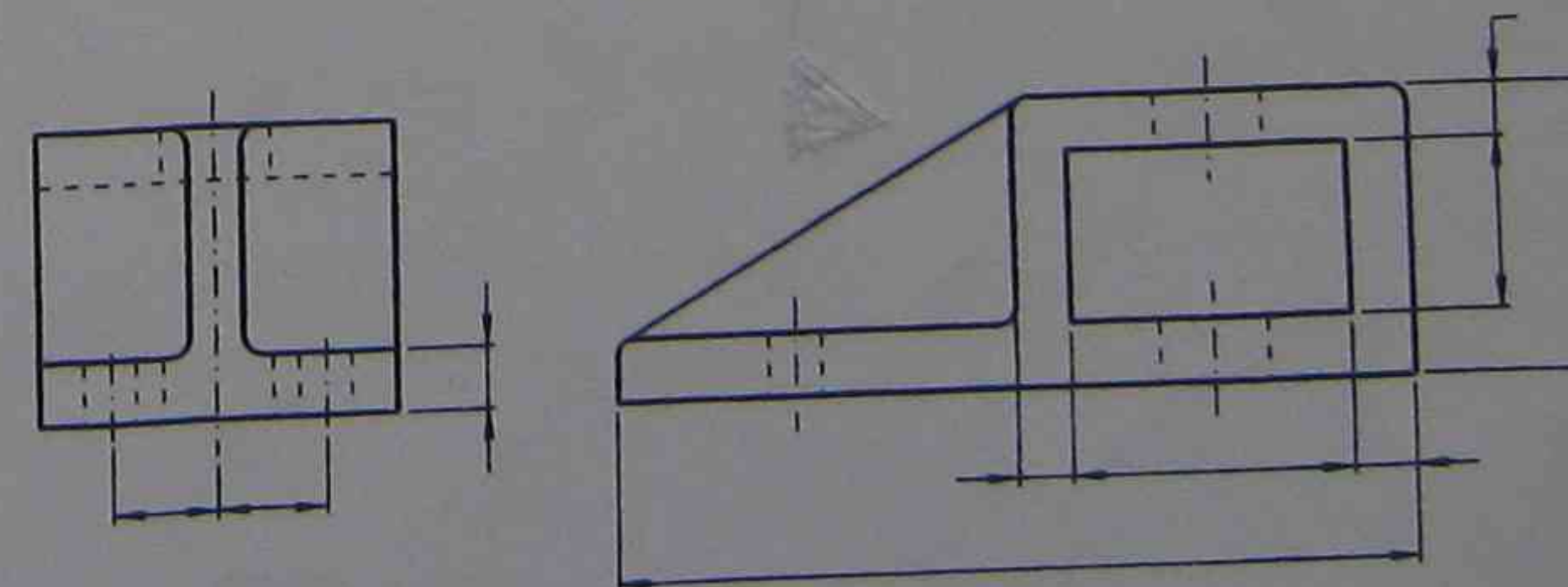
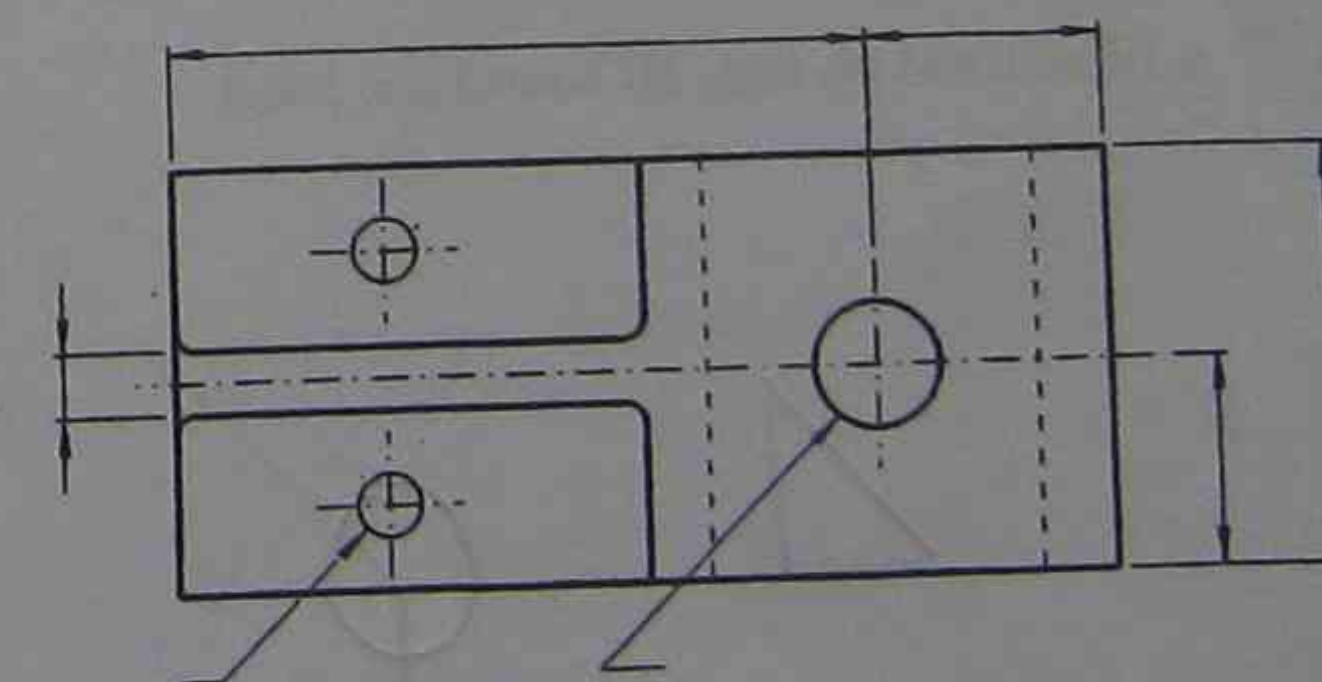
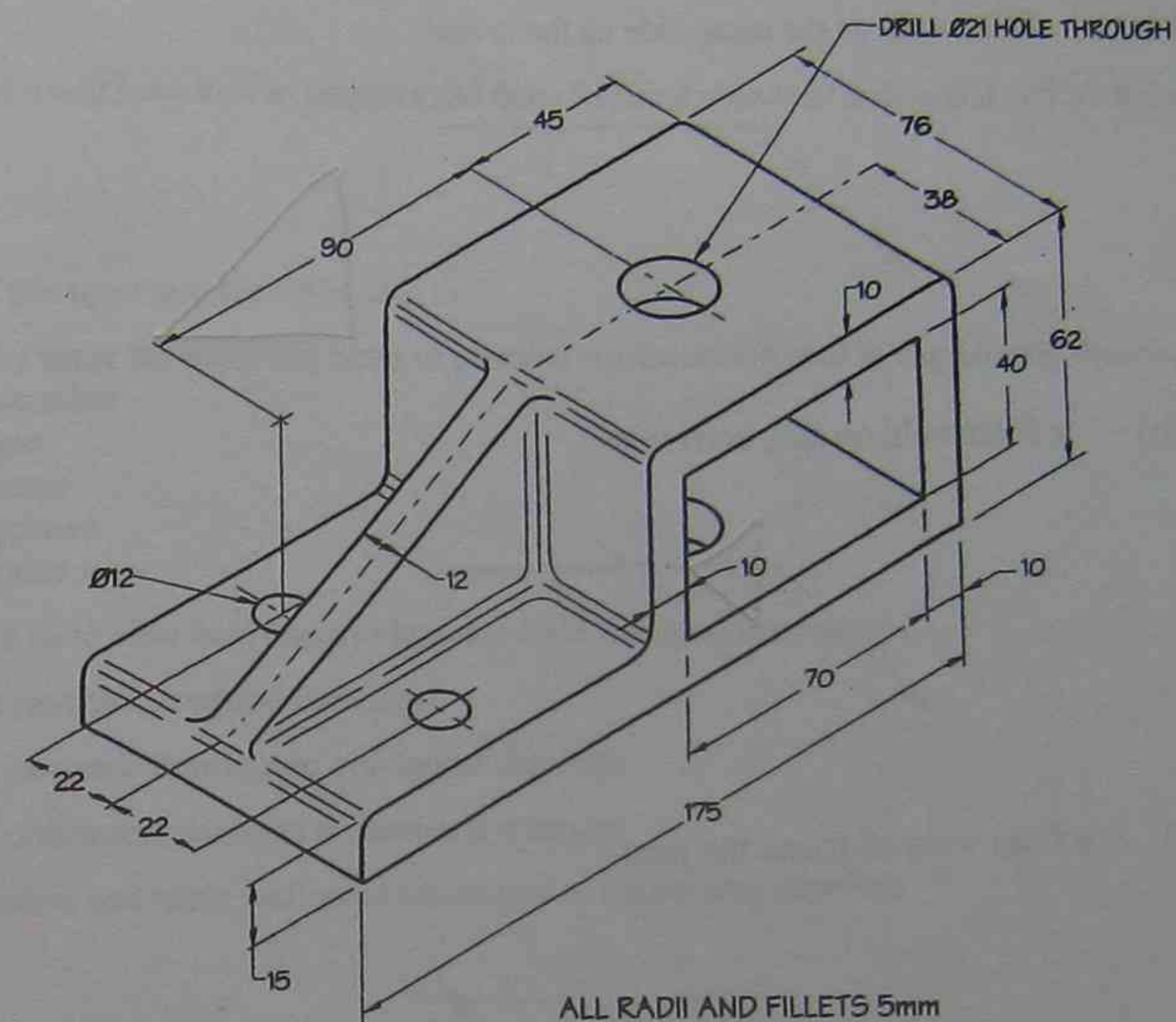


1. EXTENSION LINE
2. LEADER LINE
3. OUTLINE
4. CENTRE LINES



1. OUTLINE
2. OUTLINE
3. BREAK LINES
4. CENTRE LINE

4. Using the dimensions shown on the isometric drawing of the casting shown below, dimension the orthogonal drawing.

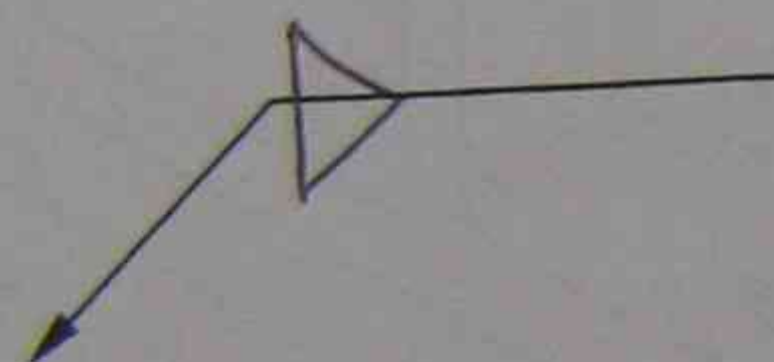


5. Draw the symbols for the following welded joints in the correct position on the reference line.

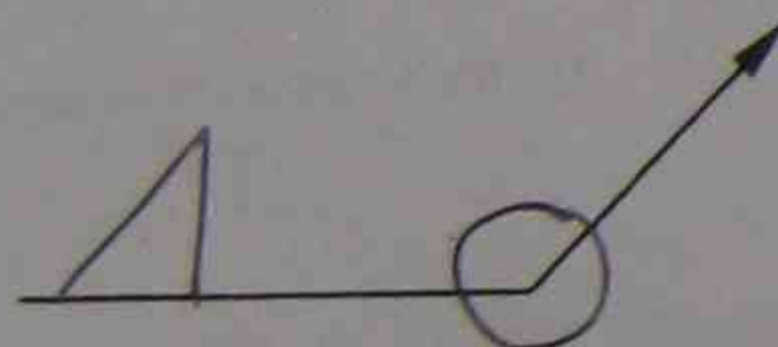
- (a) fillet weld on the same side as the arrow.



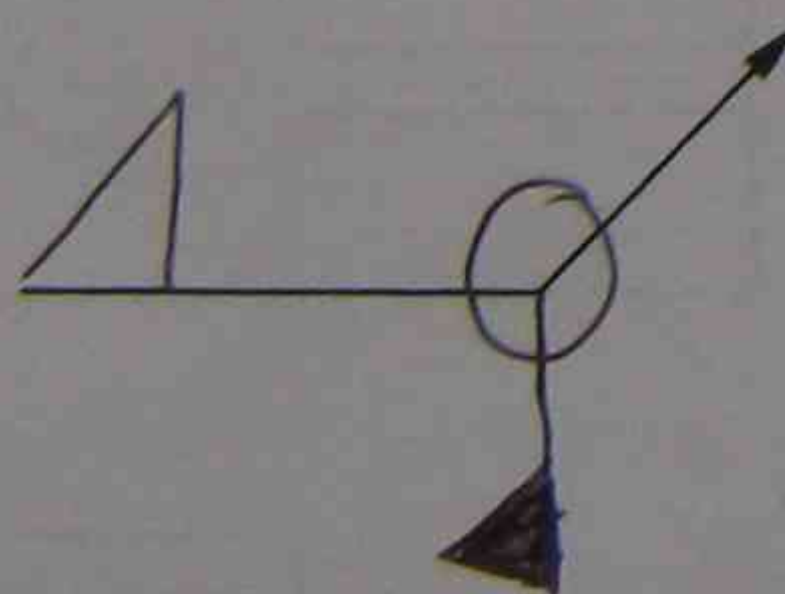
- (b) a fillet weld on site, both sides



- (c) a fillet weld all round the joint



- (d) a fillet weld on site, all round the joint



2. Orthogonal and Pictorial Drawings

Purpose

In this topic you will learn how to interpret and draw freehand objects in orthogonal and pictorial view.

Objectives

At the end of this topic you should be able to:

- Identify by name the following types of pictorial representation used in engineering drawings:
 - orthographic
 - oblique
 - isometric
 - perspective
 - exploded view
- construct three view third angle orthogonal scale free hand drawings
- produce isometric freehand drawings
- convert isometric drawings to orthogonal drawings
- convert orthogonal drawings to isometric drawings
- read, analyse and apply sectioning techniques to engineering drawings

Projection – Methods of drawing

An engineering drawing must ideally show the true shape of an object as well as all necessary sizes to allow it to be made and interpreted correctly.

A pictorial drawing (axonometric, oblique or perspective) may give an instant impression of an object and its use, but be ineffective in showing correct proportions and dimensions as an orthogonal drawing would.

Distinctive features	Projection method		Application
	Generic	Particular	
Parallel lines of sight (Orthographic)	Orthogonal	Third angle (preferred) First angle	Generally a multiview drawing
	Axonometric	Isometric Dimetric Trimetric	Single view "Pictorial" drawings
	Oblique	Cavalier Cabinet General	
Converging Lines of sight	Perspective	One-point (parallel) Two-point (angular) Three-point (oblique)	

Orthogonal Projection

Multi-view orthogonal projection is used to describe the shape of an object. The resulting drawing consists of a number of systematically arranged views of the faces of the object. The views you get from the five different positions indicated on figure 1, are shown on figure 2.

The Australian Standard for drawing practice (AS1100) recommends third angle projection. This is the name given to the arrangement of the views relative to the **Front View**. The rule for third angle projection:

1. A view from the **Left** of the **Front View** is drawn on the left side (**Left Side View B**)
2. A view from the **Right** of the **Front View** is drawn on the right (**Right Side View E**)
3. A view from the **Top** of the **Front View** is drawn on the top (**Top View C**)
4. A view from the **Underside** of the **Front View** is drawn on the Underside (**Bottom View D**)

Advantages of orthogonal projection are:

- all sides are visible independently
- dimensioning is made easier
- all features are drawn in proportion

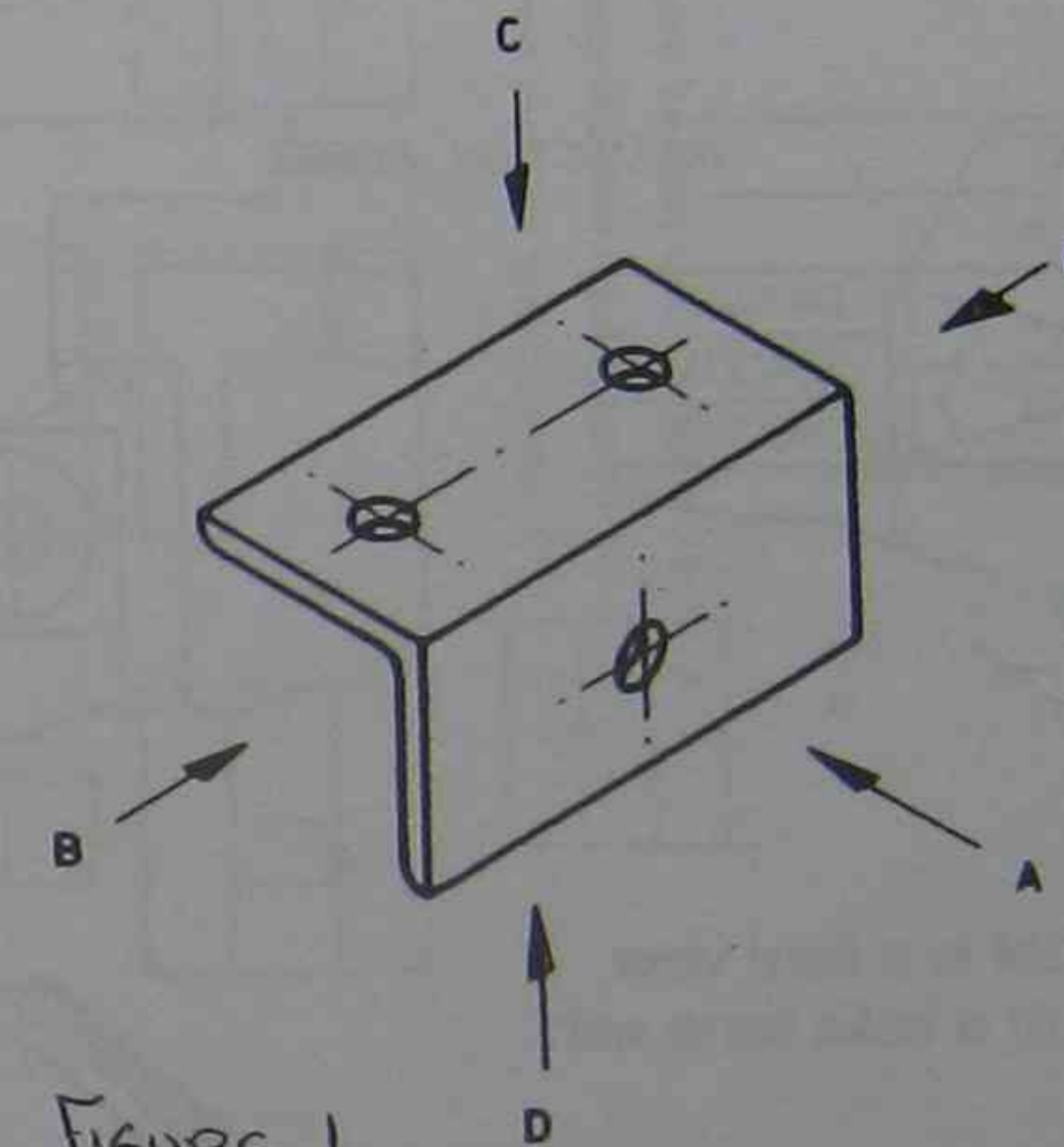


Figure 1

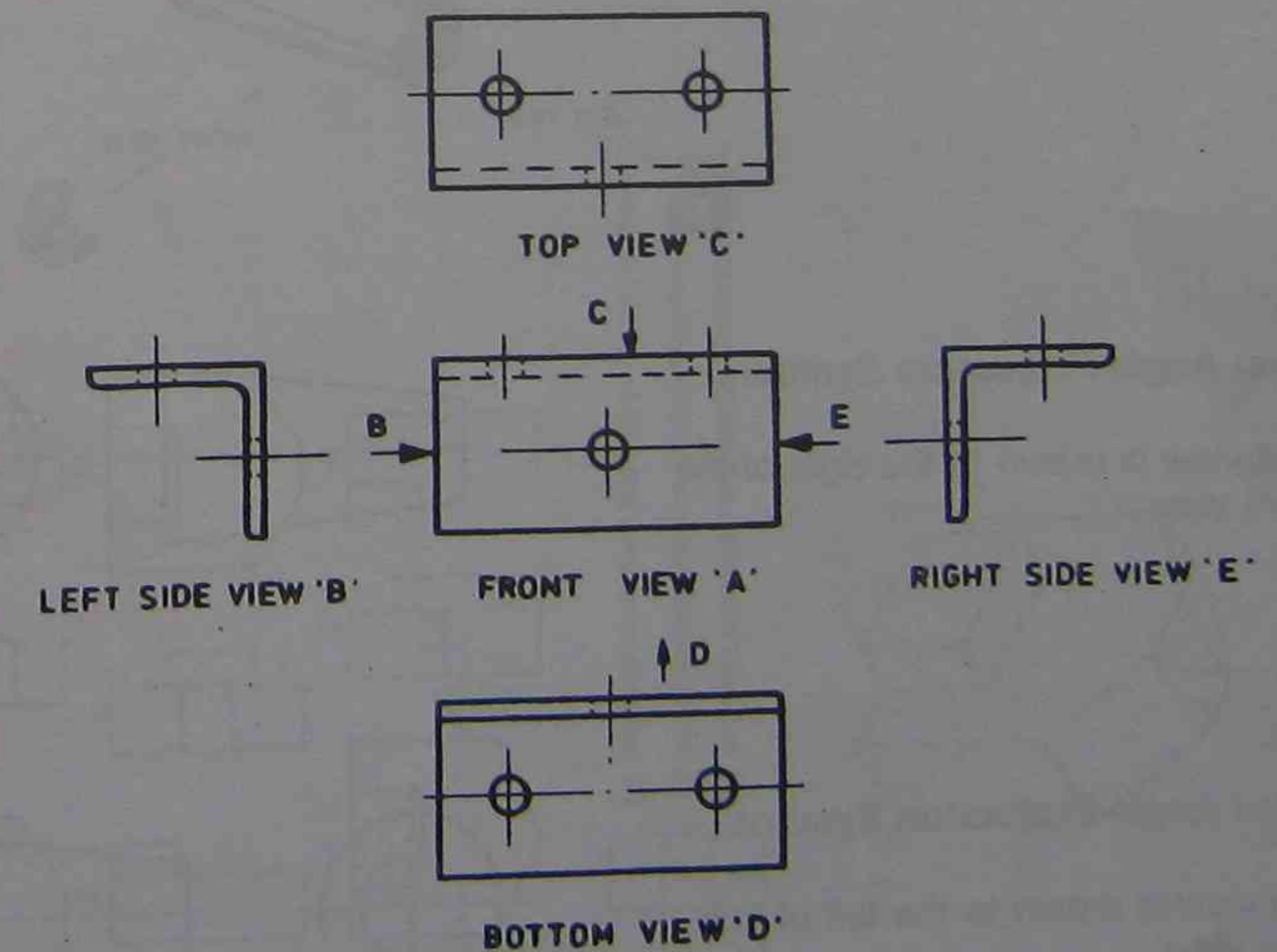
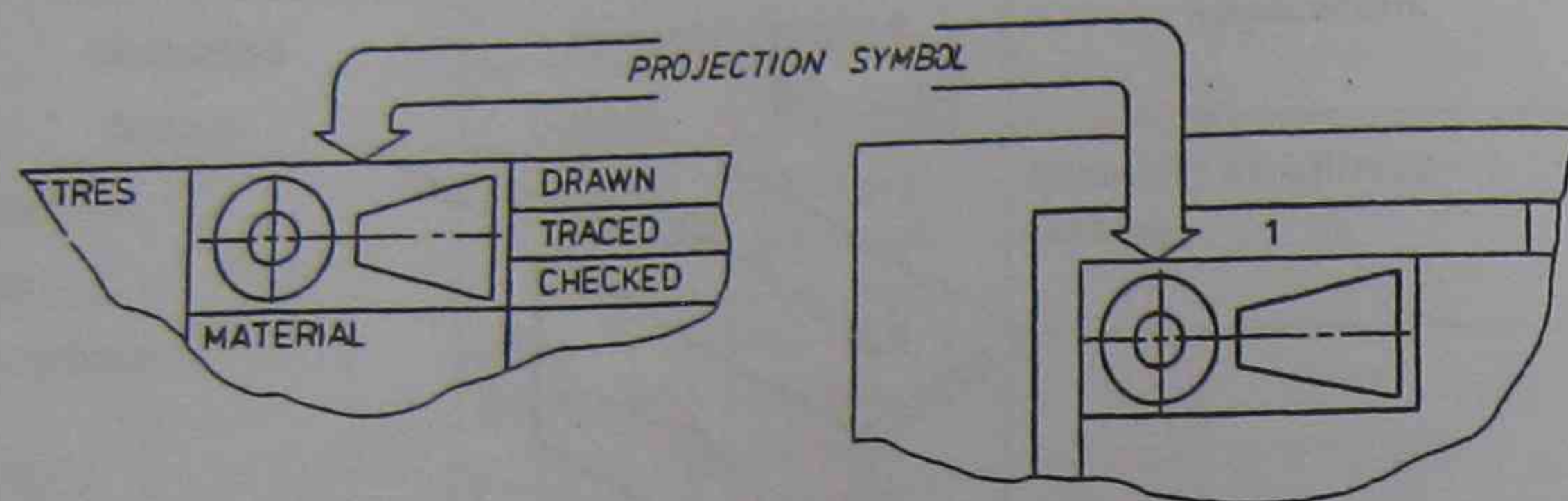


Figure 2

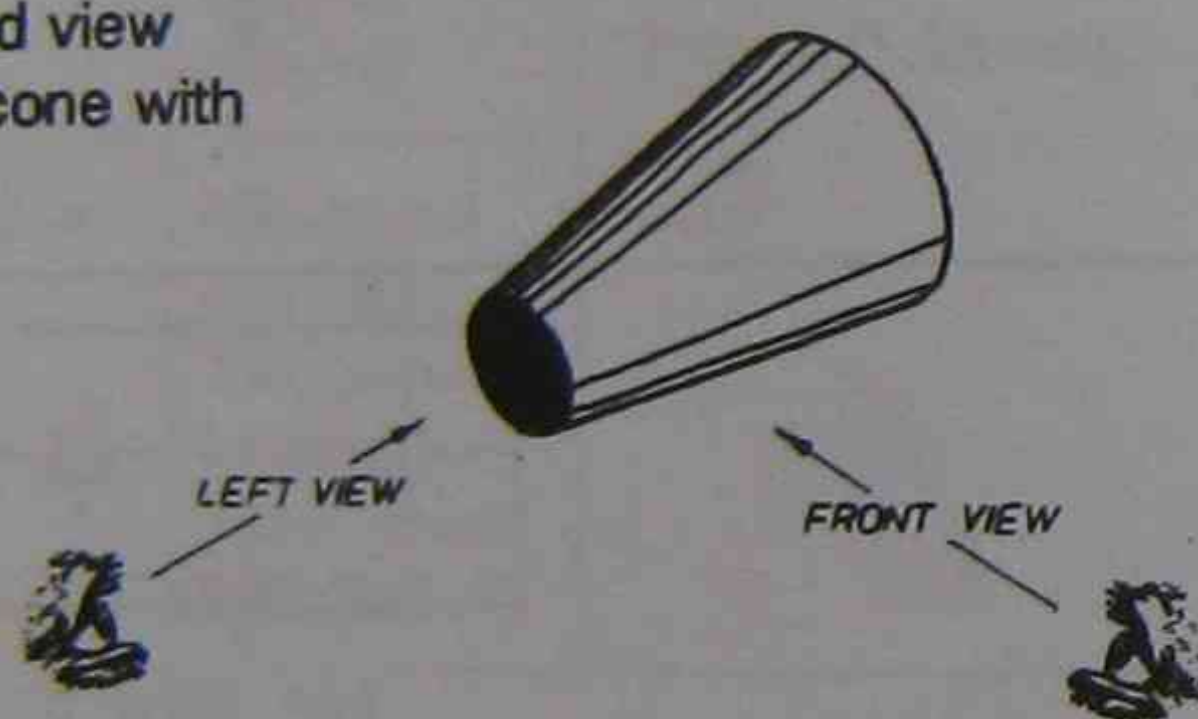
Projection symbol

All drawings that follow the AS 1100 standards must show which projection system they use. The symbol goes either in the title block at the top or bottom of the sheet with other details, or inside the grid lines, wherever it can be easily seen.



Type

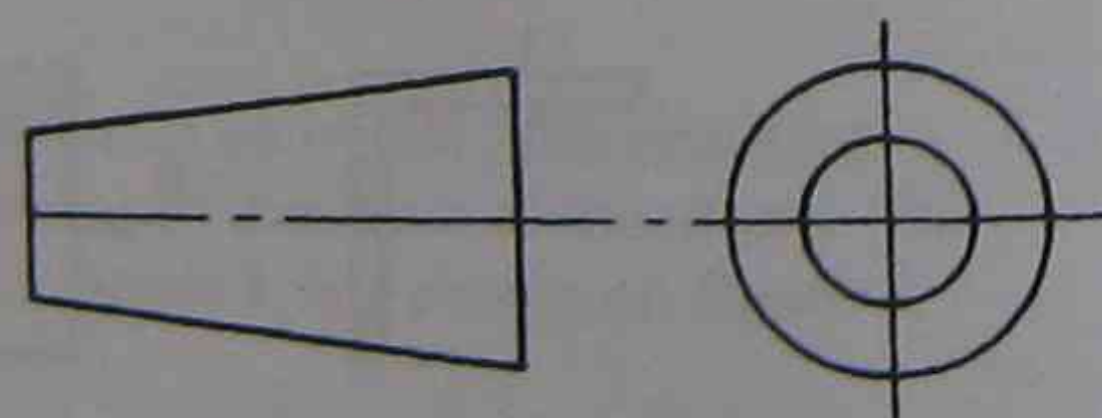
The projection symbol is a third view orthogonal drawing of a solid cone with the point cut off.



Type

First Angle Projection Symbol

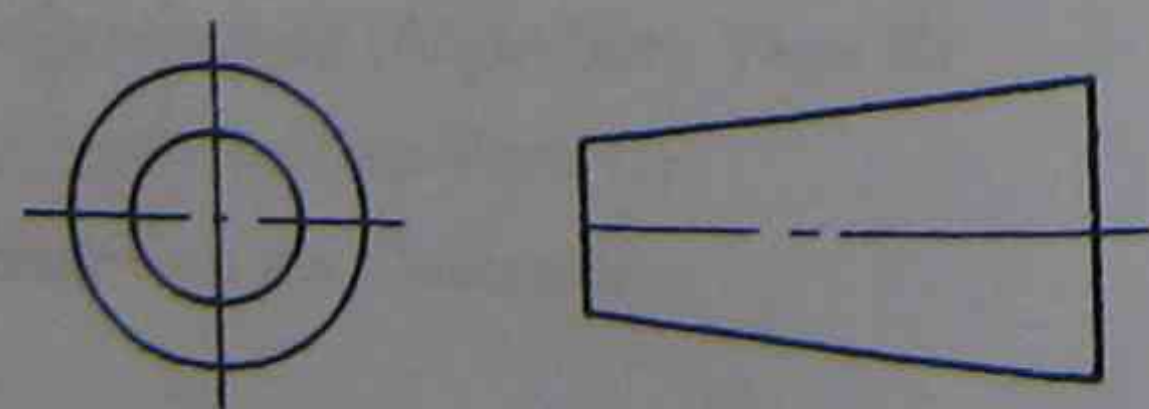
Left view is drawn to the right of the front view



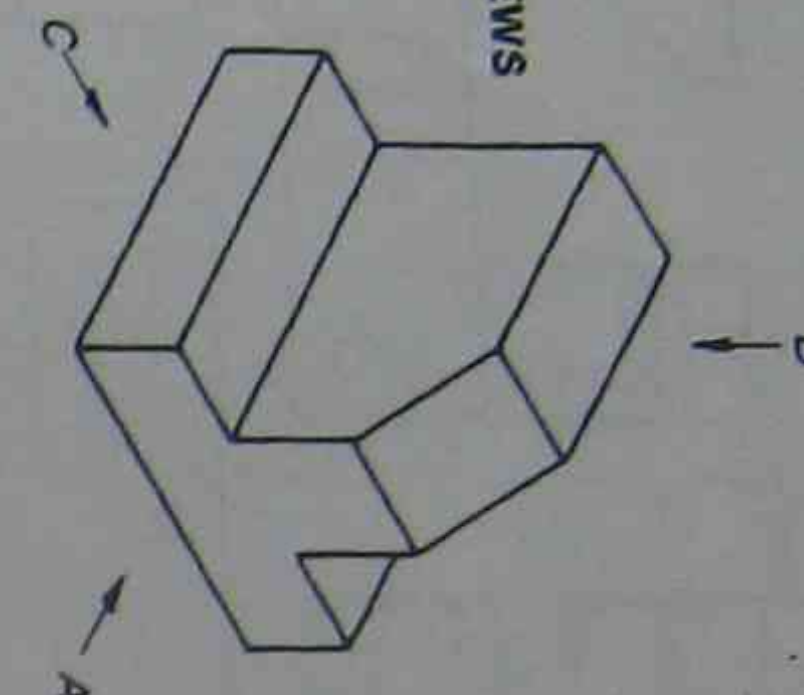
Type

Third Angle Projection Symbol

Left view is drawn to the left of the front view

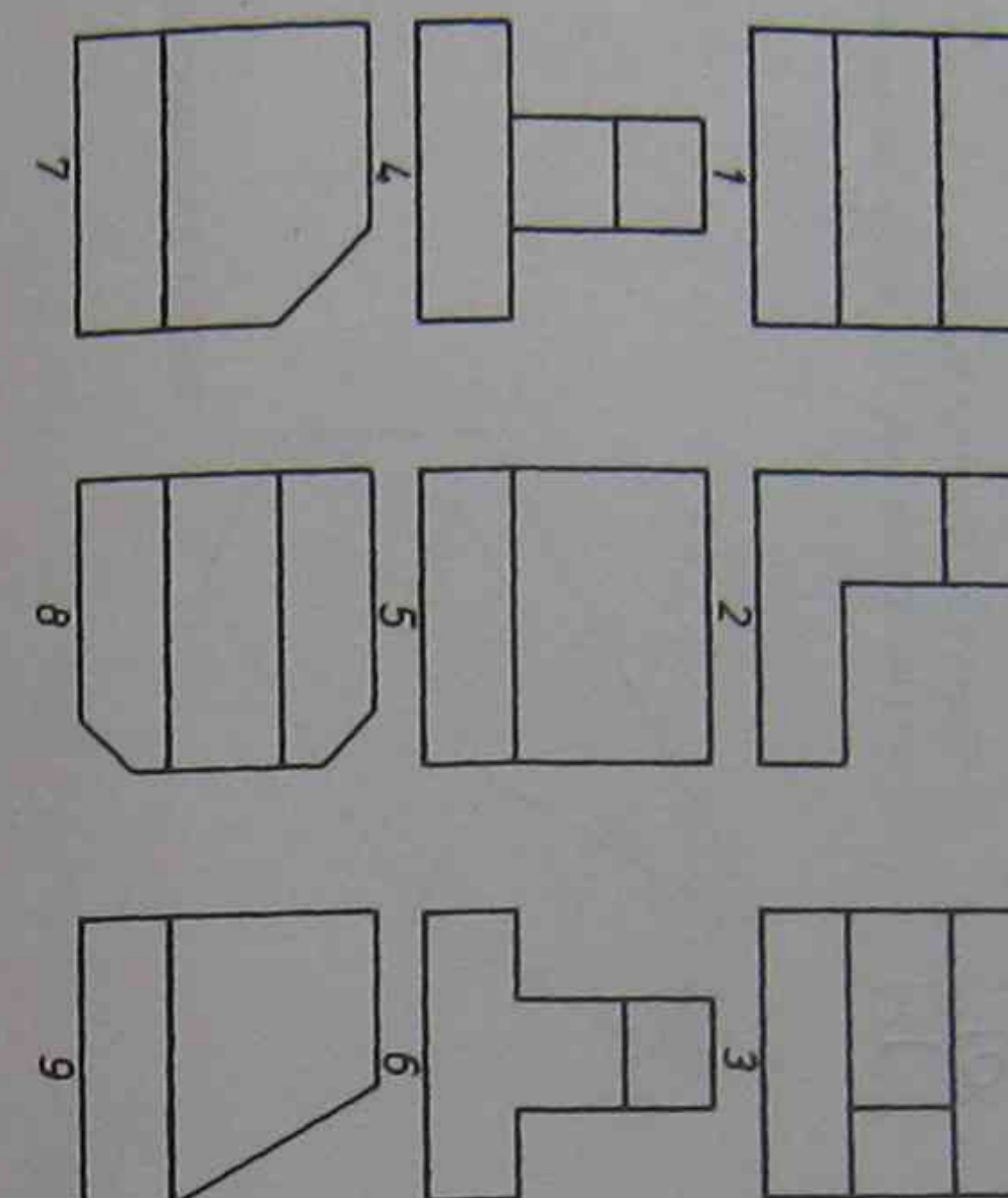


EXERCISE: 1 SELECT THE CORRECT VIEWS



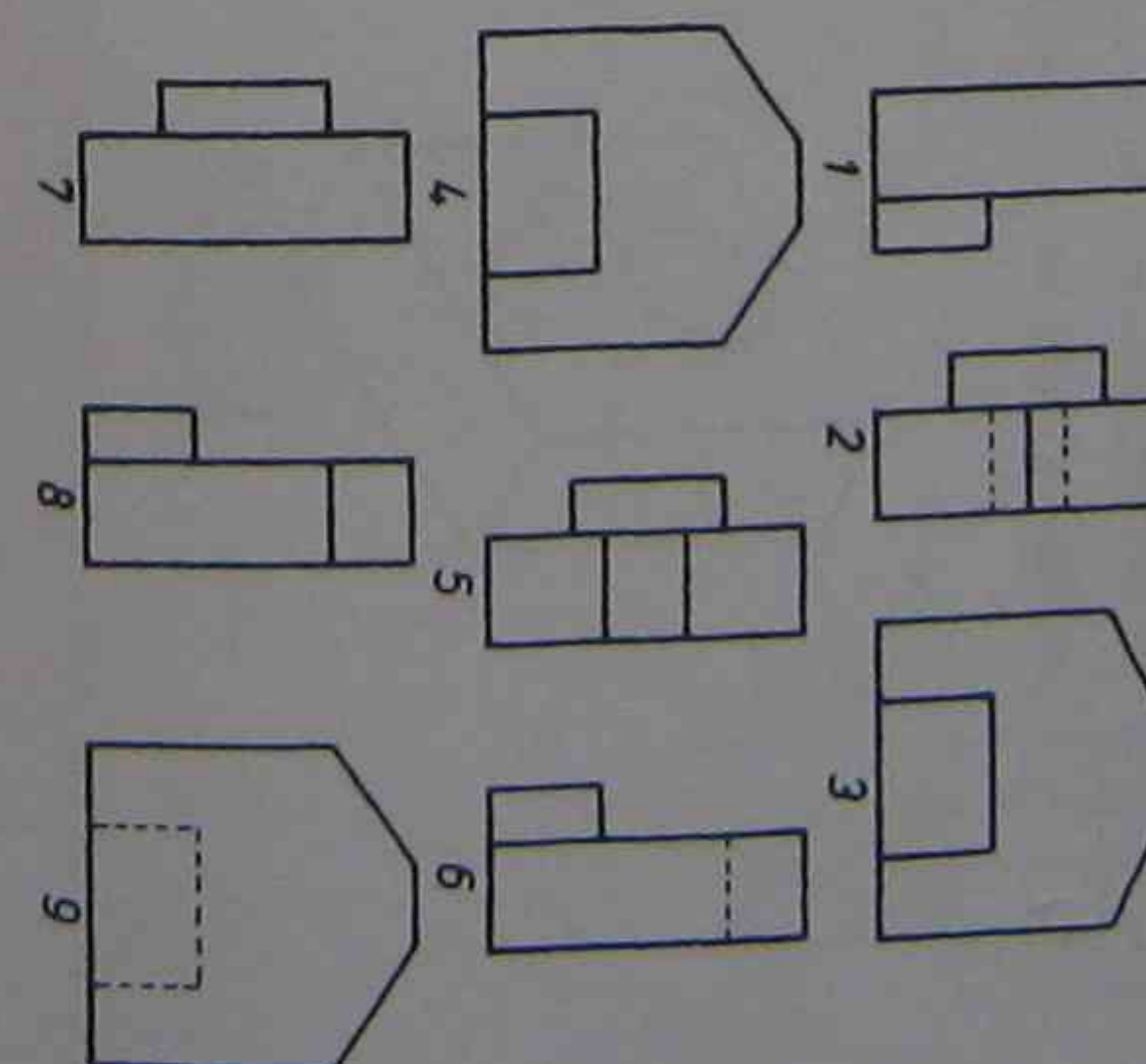
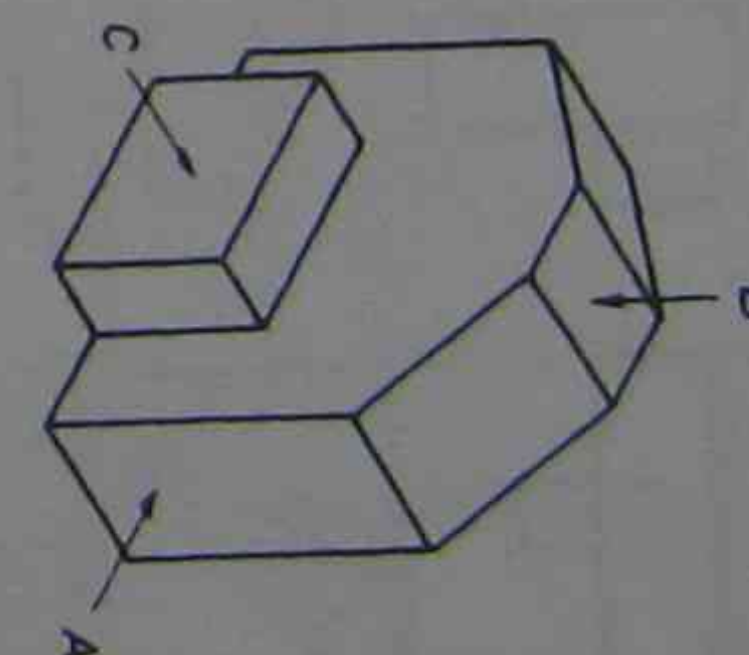
Which drawing shows the view from direction A?
Which drawing shows the view from direction B?
Which drawing shows the view from direction C?

A	
B	
C	



Which drawing shows the view from direction A?
Which drawing shows the view from direction B?
Which drawing shows the view from direction C?

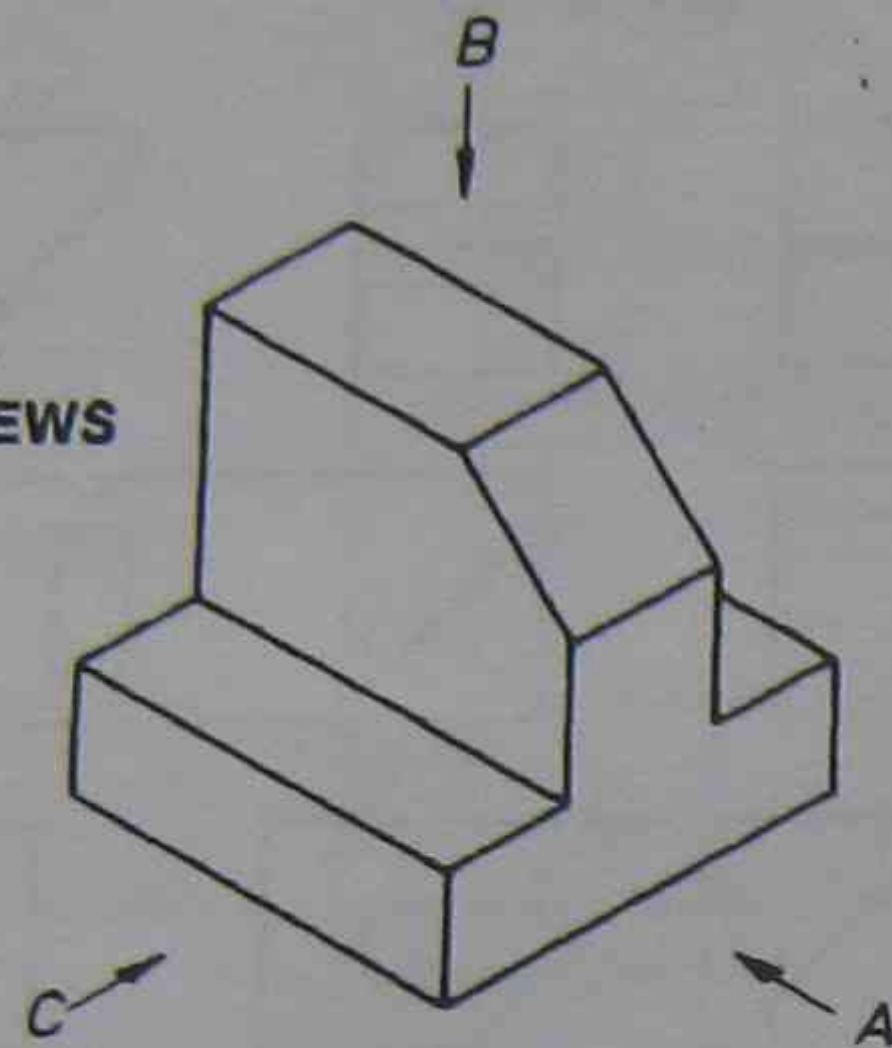
A	
B	
C	



Type

EXERCISE: 1

SELECT THE CORRECT VIEWS

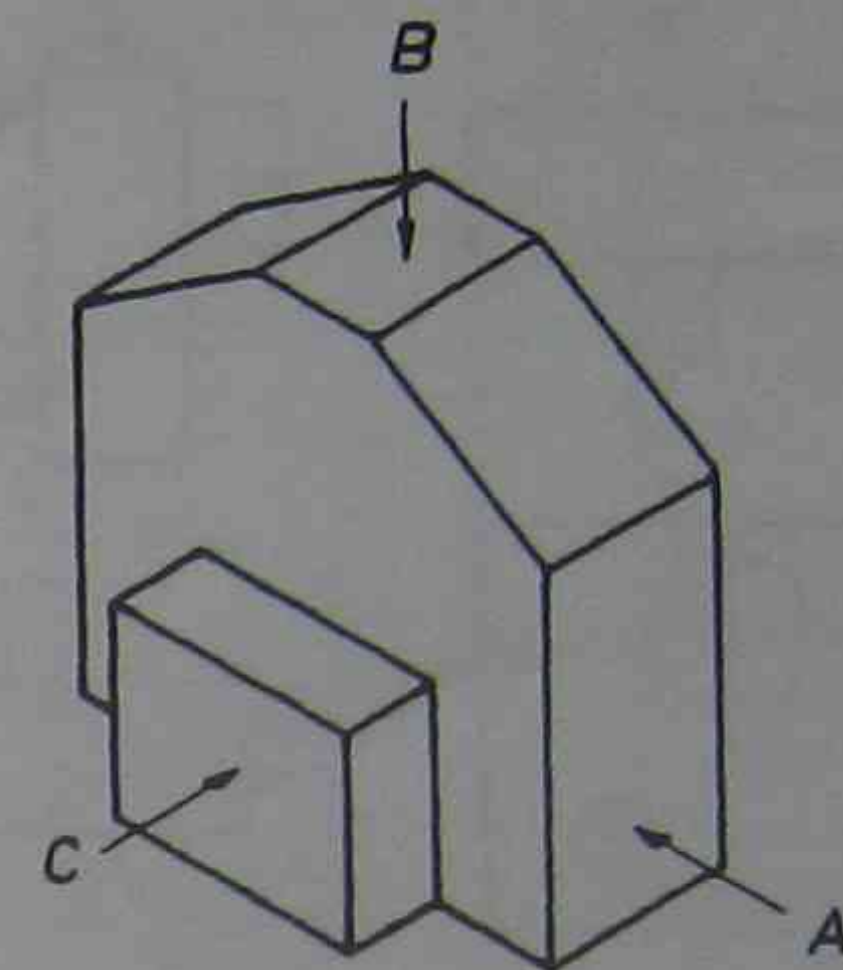
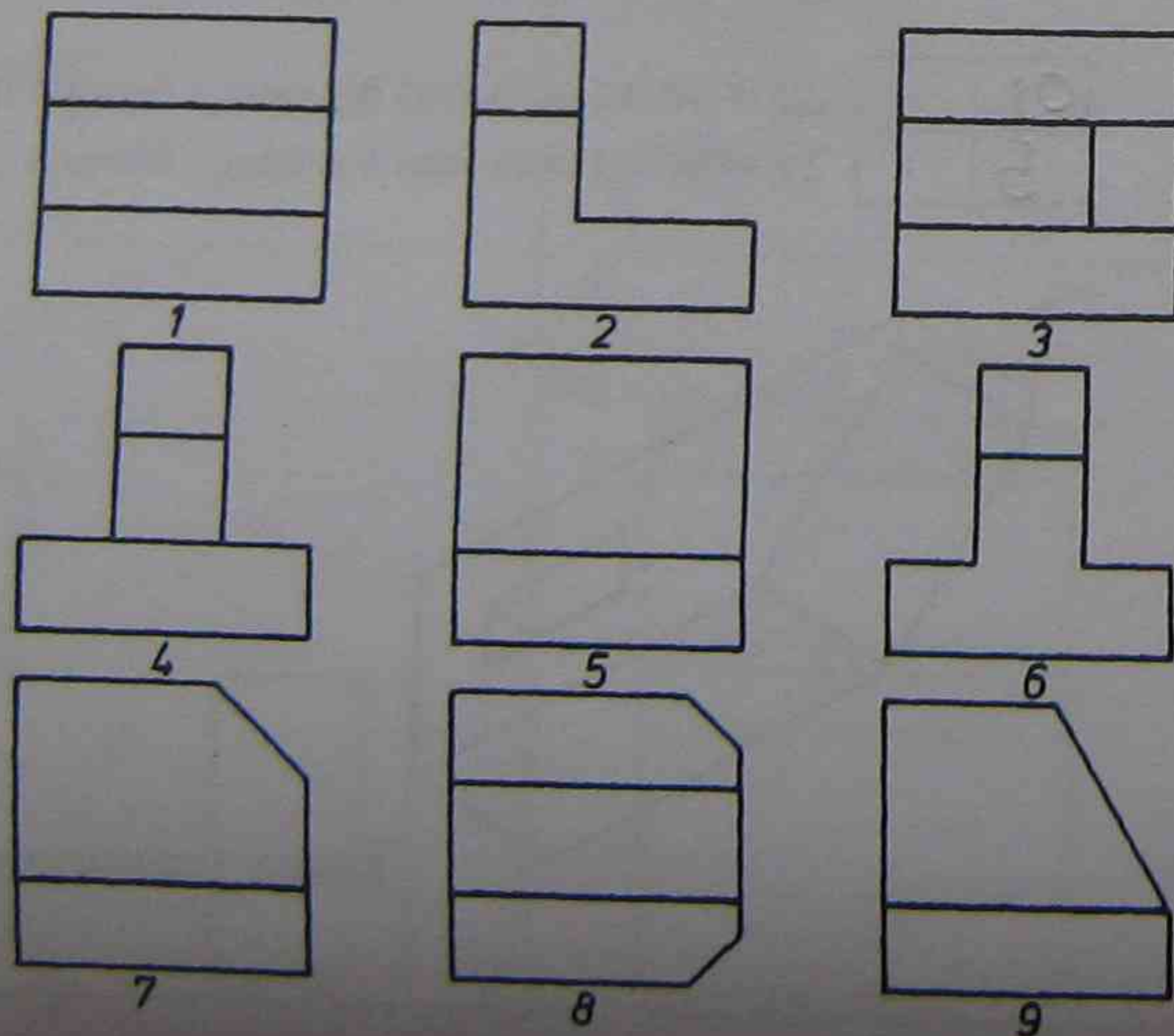


Which drawing shows the view from direction A?

Which drawing shows the view from direction B?

Which drawing shows the view from direction C?

A	
B	
C	



Which drawing shows the view from direction A?

Which drawing shows the view from direction B?

Which drawing shows the view from direction C?

A	
B	
C	

