

UNIT 4

DIMENSIONING

Total Periods: 7

Unit Outcome

At the end of this unit, students should be able to:

- ✓ Understand the purpose, convention and principle of dimensioning;
- ✓ Apply the standard dimensioning practice to describe the size of objects on technical drawing;
- ✓ apply the principles to dimension a given drawing.

Unit Overview

A working drawing is one form which a part can be produced. The drawing must be a complete set of instructions, so that it will not be necessary to give further information by word to the people fabricating the object. A working drawing, then, consists of the views necessary to explain the shape, the dimensions needed for manufacture, and required specifications may be found in the notes on the drawing, or they may be located in the title block.

There are rules and principles dimensioning a working drawing clearly and accurately. Therefore, mastering with the rules and principles is very important for drafters and engineers.

Lesson 4.1

Line, symbols, and reading direction of figures

Number of Period: 1

Learning Competencies

At the end of this lesson, students should be able to:

- ✓ Explain the use of dimensioning;
- ✓ Identify where to apply dimensioning;
- ✓ Identify the basic symbols, forms and elements of dimensioning;
- ✓ Identify the two systems in reading direction of figures.

Planning ahead

The lesson concentrate on basic symbols, forms and elements of dimensioning; purpose of dimensioning and where to apply dimension. Following instruction, the student will produce dimensioning arrows, lines, letters, and numerals, to the satisfaction of the teacher Therefore, plan the following instructional materials

1. Prepare visual aids to show “basic symbols, forms and elements of dimensioning”
2. Review essential questions, “what are the drawing principles to have a working drawing with complete description in a design process?”
3. Use the lesson with discussion and demonstration by showing visual aids.

Hints for Teaching

This lesson will be presented with the following suggested instructional strategies

1. Before giving idea on dimensioning directly, let the students say something (brainstorming) about dimensioning from the textbook.
2. Discuss and demonstrate the exact idea and concept of dimensioning with practical examples and visual aids. You can refer working drawings of machine parts and assembly drawings. Have students keep main points from discussion about sectional view in a notebook.
3. Show filmstrips/films/slides/video cassettes on dimensioning and careers in technical drawing.
4. Allow students to practice on activity individually and in group provided by the teacher and on check point 4.1.

Teaching Note

Dimension: the numerical value that defines the size, shape, location, surface texture, or geometric characteristic of a feature.

Dimension line: A thin, solid line ending with arrowheads that shows the extent and direction of a dimension.

Extension Line: A thin, solid line perpendicular to a dimension line, indicating the feature to which a dimension is associated.

A gap is left between the end of the extension line and the associated feature.

Center Line: A long, thin line shown with alternating short and long dashes that indicates an axis of symmetry or a path of motion. It may also be used in the same fashion as an extension line for dimensioning purposes.

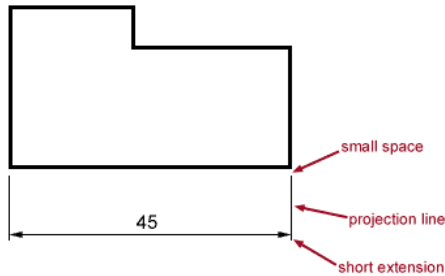
Leader Line: A thin, solid line used to indicate the feature with which a dimension, note, or symbol is associated. Leaders terminate with an arrow (for features in edge view) or a dot (for features appearing as a surface) on the drawing side and a horizontal shoulder at mid-letter height on the other.

Notes: Additional comments used to describe features of the body. Notes may be attached to a feature by use of leader or may be placed anywhere without a leader to provide a general comment regarding multiple or all features on the body.

Some common dimensioning symbols (often used in notes):

					
Counterbore or Spotface	Countersink	Depth or Deep	Slope	Conical Taper	
					
Diameter	Square (Shape)	Places, By, or Times,	Radius	Spherical Radius	Spherical Diameter

A dimensioned drawing should provide all the information necessary for a finished product or part to be manufactured. An example dimension is shown below.



Dimensions are always drawn using continuous thin lines. Two projection lines indicate where the dimension starts and finishes. Projection lines do not touch the object and are drawn perpendicular to the element you are dimensioning.

In general units can be omitted from dimensions if a statement of the units is included on your drawing. The general convention is to dimension in mm.

All dimensions less than 1 should have a leading zero. i.e. .35 should be written as 0.35

All notes and dimensions should be clear and easy to read. In general all notes should be written in capital letters to aid legibility. All lettering should be of the same size and preferably no smaller than 3mm. An example typeface is shown below.

Lesson 4.2 *Theory of dimensioning*

Number of Periods: 2

(1 period theory and 1 period for practice)

Learning Competencies

At the end of this lesson, students will be able to:

- ✓ Differentiate size and location dimensioning;
- ✓ Apply size and location dimension on different drawing;
- ✓ Select convenient dimensions properly to describe a feature of an object;
- ✓ Identify the relationship between scale of drawing and dimension figures;
- ✓ Write letters and numerals in an accepted standard form.

Planning ahead

Being able to teach dimensioning skill does require you to develop the first basic knowledge and skill, where you are expected to pass on to the students: learn the **technique of dimensioning**. Understand the different line types and techniques used to show dimensions.

Therefore, plan the following instructional materials

1. Prepare visual aids to show “Theory of dimensioning such as reading direction of figures”. If possible also prepare working drawings of machine parts and assembly drawings.
2. Teacher uses one period for theoretical concept and demonstration about theory of dimensioning like size and location dimensions. Two periods for student practice on activities and check points.

Hints for Teaching

Understanding geometric dimensioning is an instructor-lead course that simplifies dimensioning learning. You should be using mostly visual illustrations and less textual material. You have to explain basic dimensioning application, interpretation and verification. Students learn faster and retain more information when dimensioning concepts and rules are presented in visual format presentations.

Important dimensioning concepts should be reemphasized throughout the course. You should apply pop-quiz at the end of the lesson, it require immediate application and reinforce key learning points.

Standardization is a dynamic and continuous process. The ISO standards follow the development in engineering. Changing in standardization may make it compulsory to update some content of dimensioning course notes.

Suggested instructional strategies are:

1. You can start the class by inviting students in text question about theory of dimensioning from the textbook.
2. Discuss and demonstrate the theory of dimensioning and techniques used in drawing. Have students keep discussion main points about types of section view in a notebook.
3. Display visual aids like working drawings of machine parts and assembly drawings.
4. Allow students to practice on activity 4.1 and on check points 4.2 individually or in group.

Teaching Note

The object is said to be fully dimensioned when the two types of dimensions i.e. size dimension and location dimension are included. Size dimensioning describes size of an object such as height, width, depth, thickness, length, radius, diameter etc, with regard to its form and other features like holes and slots. Location dimensioning locates the various features like hole, slot etc, of an object relative to each other from center of one feature to centerline of another similar/ different feature or to a reference edge. It can be given in all width, height and depth direction.

When dimensioning an object the dimensions to be given should be selected in such a way that they are convenient for the workmen to use during manufacturing. The following points should be noted during selection of dimensions:

Dimensions of mating parts should be selected so as to ensure proper functioning.

Dimension should not be duplicated or minimum number of dimensions should be used (Fig.4.7 (c) and (d)).

Dimensions should be selected so that it will not be necessary to calculate, scale, or assume a dimension during manufacturing.

Selection of location dimension requires more attention than size dimensioning.

A hole dimension is given using diameter than radius on its circular view

Lesson 4.3 *Methods of dimensioning*

Number of Periods: 2
(1 period theory and 1 period for practice)

Learning Competencies:

At the end of the lesson, students should be able to:

- ✓ Identify the two methods of arrangement of dimensions;
- ✓ Select the appropriate methods of arrangement of dimensions;
- ✓ Use the two basic arrangement of dimensions alternately on drawing;
- ✓ Select dimensions to reduce the number of dimension lines;
- ✓ Perform different types of dimensioning techniques for any shapes of objects;
- ✓ Prepare dimensions of different views and objects.

Planning a Head

Learn the methods of dimensioning. Can you pick the most logical and practical place to put dimensions with respect to an object?

The lesson concentrates on methods of dimensioning such as chain and datum and also combined dimension.

Therefore, plan the following instructional materials

1. Prepare visual aids to show “methods of dimensioning like chain, datum and combined dimensioning”
2. Review essential questions, “what are the basic elements of dimensioning?”
3. Teacher uses one period for theoretical concept and demonstration about methods of dimensioning. One period for student practice on activities and check points.

Hints for Teaching

This lesson will be presented with the following suggested instructional strategies

1. let the students say something (brainstorming) about methods of dimensioning from the textbook.
2. Discuss and demonstrate the exact idea and concept of dimensioning with practical examples and visual aids. You can refer working drawings of machine parts and assembly drawings. Have students use Ames Lettering Guide for dimensioning. Have students keep main points from discussion about methods of dimensioning in a notebook.
3. Show filmstrips/films/slides/video cassettes on dimensioning and careers in technical drawing.
4. Allow students to practice on activity 4.2 individually or in group and on check point 4.3.

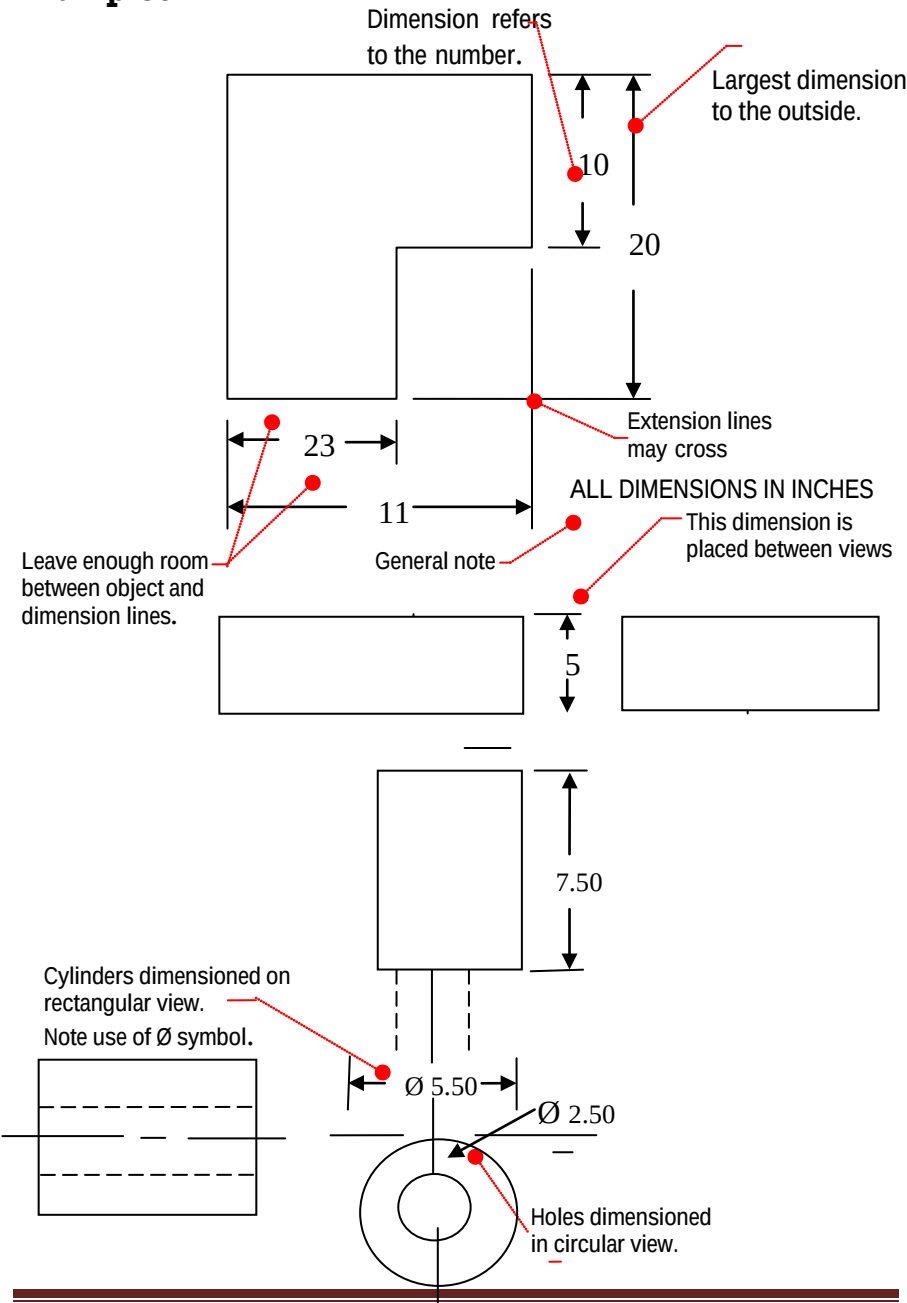
Teaching Note

Datum: A theoretically exact point, line, or plane often used as reference for tabular dimensioning.

Reference dimension: A redundant dimension provided for information only, not to be used for fabrication of the part. It is shown enclosed in parenthesis () or followed by the word REF.

Contour Principle: The concept of dimensioning a feature in the view where it is most clearly shown (preferably in true size/true shape if possible).

Examples



For dimensioning rules the overriding principle of dimensioning is CLARITY.

1. Each feature of an object is dimensioned once and only once.
2. Dimensions should be placed in the most descriptive view of the feature being dimensioned.
3. Dimensions should specify only the size of the feature. The manufacturing method should only be specified if it is a mandatory design requirement.
4. Angles shown on drawings as right angles are assumed to be 90 degrees unless specified otherwise and need not be dimensioned.
5. Dimensions should be moved outside the boundaries of the object whenever possible.
6. Dimension lines should be aligned and grouped where possible to promote clarity and uniform appearance.
7. Crossing dimension lines should be avoided whenever possible.
8. The space between the first dimension line and the object should be at least $\frac{3}{8}$ inch (.375). The space between all other dimension lines should be at least $\frac{1}{4}$ inch (.250).
9. There should be a visible gap between the object and the origin of the extension line.
10. Extension lines should extend $\frac{1}{8}$ inch (.125) beyond the last dimension line.
11. Extension lines should be broken if they cross or are close to arrowheads.
12. Leader lines should be oriented to be read from the bottom of the drawing.

13. Diameters are dimensioned with a numerical value preceded by the diameter symbol.
14. Radii are dimensioned with a numerical value preceded by the radius symbol.
15. Cylinders should be dimensioned in the Rectangular view where possible.
16. When a dimension is given to the center of an arc or radius a small cross is shown at the center.
17. The diameter and depth of holes that are counter-bored, spot faced, or countersunk, should be specified in a note.
18. The depth of a blind hole may be specified in a note, and is the depth of the full diameter from the surface of the object.

Lesson 4.4 *Placement of dimensions*

Number of Periods: 2

(1 period theory and 1 period for practice)

Learning Competencies

At the end of this lesson, students should be able to:

- ✓ Identify the placement of dimensions on views, on limited space and pictorial drawing;
- ✓ Apply dimension on views, on limited space rule and pictorial drawing;
- ✓ select dimensions to reduce the number of dimension lines;
- ✓ perform different types of dimensioning techniques for any shapes of objects;
- ✓ prepare dimensions of different views and objects.

Planning ahead

The lesson concentrates on placement of dimension on views, on limited space and pictorial drawing. So, prepare to teach this topic of dimensioning. Which dimensions should you show and which ones should you not show? Therefore, plan the following instructional materials

1. Prepare visual aids to show “methods of dimensioning like chain, datum and combined dimensioning”
2. Review essential questions, “what are the basic elements of dimensioning?”
3. Teacher uses one period for theoretical concept and demonstration about placement of dimension on view, limited space and pictorial drawing. One period for student practice on activities and check points.

Hints for Teaching

Suggested instructional strategies are:

1. Let the students say something (brainstorming) about placement of dimension from the textbook.
2. Discuss and demonstrate the placement of dimension with practical examples and visual aids. You can refer working drawings of machine parts and assembly drawings. Have students use Ames Lettering Guide for dimensioning. Have students keep main points from discussion about placement of dimensions in a notebook.
3. Show filmstrips/films/slides/video cassettes on dimensioning and careers in technical drawing.

4. Use continuing evaluation procedures which enhance student's dimensioning performance.
5. Arrange for a guest speaker whose work involves interpreting/applying drawing dimensions.
6. Allow students to practice on activity 4.3 individually or in group and teacher will give class work exercises.

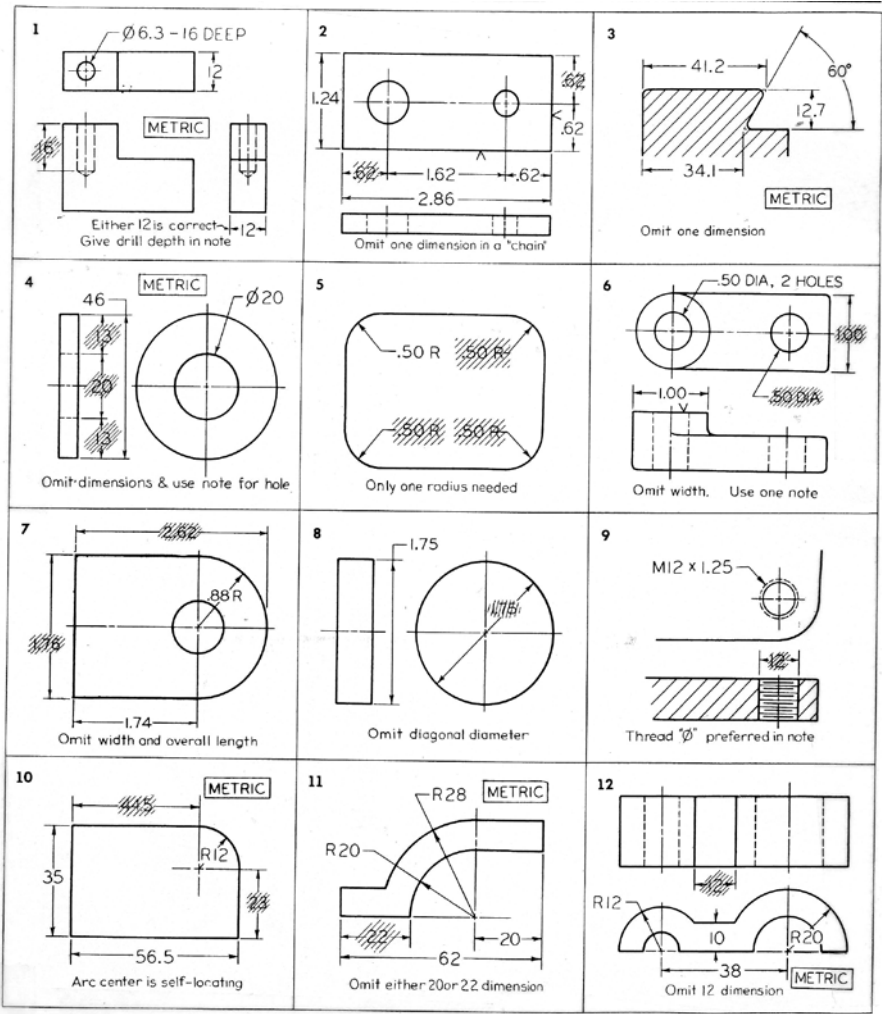
Teaching Note

Principles of placement of dimension on views, limited space and pictorial drawing is very essential. Just because you know how to place dimensions doesn't mean you always use every possible dimension you can. You typically only want to give the minimum number of dimensions that can completely define the object.

Some of the rules are:

1. Dimension should be placed between views whenever possible unless required elsewhere.
2. Use the same unit of measurement and dimension line terminator (arrowhead) on a single view.
3. Dimension the view that best shows the characteristic contour or shape of the object.
4. Avoid any dimension line which passes through a dimension figure.
5. Avoid crossing of two dimension lines and extension line.
6. Avoid using centerline and outline of a view of an object as dimension line, however centerline may be used as extension line.
7. In a parallel method of dimensioning the shortest and longest dimension lines should be placed closest and farthest from the outline of the view respectively.

Note of Caution: While the following examples show good choices for placing dimensions, some of the actual notes are given using an outdated ANSI standard.



Lesson Guide

Period	Lesson title	Starter activity	Main activities	Concluding activities
1	4.1 Introduction,	• Ask brain storming question like what the use of dimensioning in working drawing is? • Show visual aids on dimensioning and careers in technical drawing.	• . Discuss the difference between auxiliary planes and principal planes with students. • Demonstrate with visual aid principles and rules to draw sectional views of an object. • Let the students to practice on check points 4.1.	• Allow students to present their group work activity result in front of the class • Give as a home work to do exercises from the textbook
2	4.2 Theory of dimensioning	• Allow them to discuss previous lesson	• Provide demonstrations on theory of dimensioning. • Have students use Ames Lettering Guide for dimensioning. • Let the students to practice on activity 4.1 and check point 4.2.	• Allow students to present their group work activity result in front of the class • Give as a home work to do exercises from the textbook
2	4.3 <i>Methods of dimensioning</i>	Introduce the different cases on the placement of dimension	• Provide demonstrations on methods of dimensioning such as datum and chain. • Let the students to practice on activity 4.2 and check points 4.3.	• Arrange for a guest speaker whose work involves interpreting/applying drawing dimensions • Give home work to do exercises from the textbook
2	4.4 <i>Placement of dimension</i>	• Ask brain storming question like what are the rules to choices of dimension? • Show visual aids on dimensioning and careers in technical drawing.	• Provide demonstrations on rules for placement of dimension. • Let the students to practice on activity 4.3.	• Allow students to present their group work activity result in front of the class • Give as a home work to do exercises from the textbook

Evaluation

Instruct your students to:

- Students to explain the principles of dimensioning.
- Students to explain the importance of dimensioning.
- Students to dimension given drawings correctly using B.S 308 and B.S 1192.

Method

- Presentation (lecture) and Demonstration
- Group discussion (6-8 students per a group)
- Individual practice

Assessments

The teacher should follow and assess each student's work continuously over the whole activity of the each lesson and compare it with the following description to determine whether the student has achieved the minimum required level.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional activities at the end of the lesson or during breaks.

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

View Dimensions quiz

Name _____

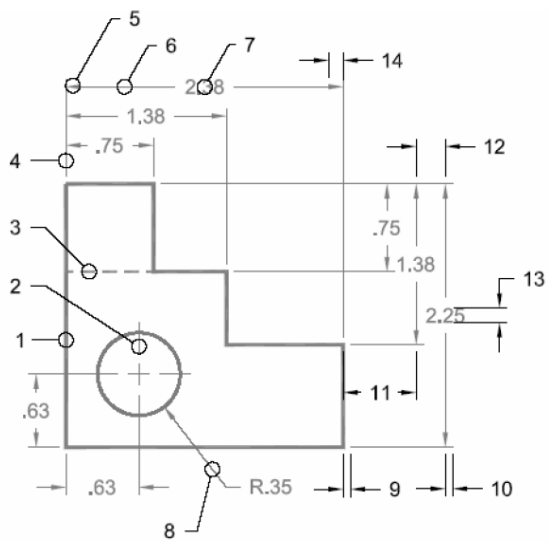
1. The height, width, and depth of a non-symmetrical object can be shown with a minimum of how many views? *Two views.*
2. Width is shown in which two views?
3. Depth is shown in which two views?
4. Height is shown in which two views?
5. What dimension does the top and front view have in common?
Width, height, or depth?
6. What dimension does the side view and front view have in common? Width, height, or depth?
7. What dimension does the top and right side view have in common? Width, height, or depth?

View Dimensions quiz key

1. The height, width, and depth of a non-symmetrical object can be shown with a minimum of how many views?
2. Width is shown in which two views? Front and top
3. Depth is shown in which two views? Top and side
4. Height is shown in which two views? Front and side
5. What dimension does the top and front view have in common?
Width, height, or depth?
6. What dimension does the side view and front view have in common? Width, height, or depth?
7. What dimension does the top and right side view have in common? Width, height, or depth?

Student Name _____ Period _____ date _____

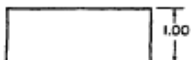
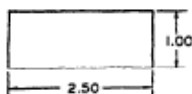
Use this figure to fill in the requested information:



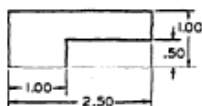
Label each of the following items.

- | | | | |
|----|-------|----|-------|
| 1. | _____ | 5. | _____ |
| 2. | _____ | 6. | _____ |
| 3. | _____ | 7. | _____ |
| 4. | _____ | 8. | _____ |

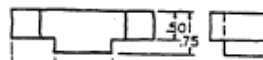
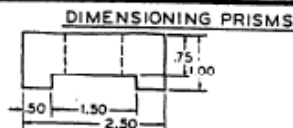
DIMENSIONING WORKSHEET 1



THE METHOD OF DIMENSIONING A SIMPLE BLOCK.

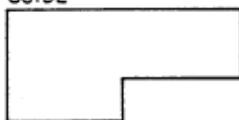


PLACEMENT OF DIMENSIONS ON A BLOCK WITH A NOTCH.



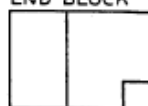
DIMENSIONS ARE PLACED ON THE MOST REPRESENTATIVE VIEWS.

1 GUIDE

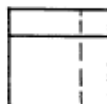


REQUIRED: DIMENSION THE FULL-SIZE PARTS. EITHER SKETCH OR USE INSTRUMENTS AS ASSIGNED.

END BLOCK



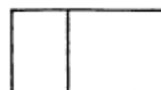
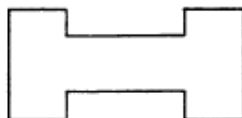
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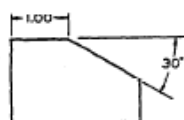
3 SEAT



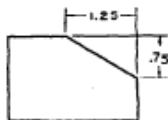
4 TONGUE



DIMENSIONING WORKSHEET 2



DIMENSIONING AN ANGLE USING DEGREES.

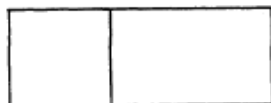
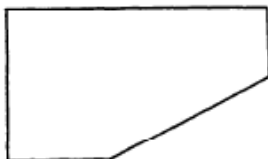


DIMENSIONING AN ANGLE USING COORDINATES.

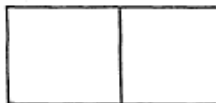
DIMENSIONING ANGLES

REQUIRED: DIMENSION THE FULL-SIZE PARTS BELOW. SKETCH OR USE INSTRUMENTS AS ASSIGNED.

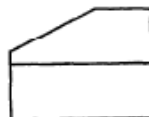
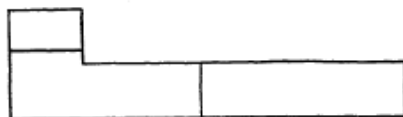
1 LIFTER



2 WEDGE



3 FIXTURE BASE



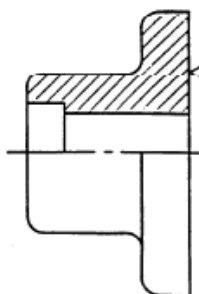
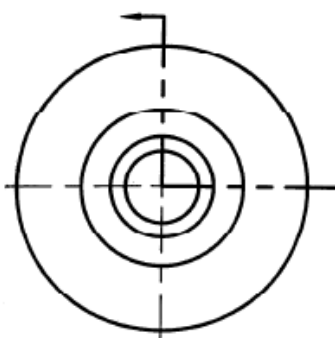
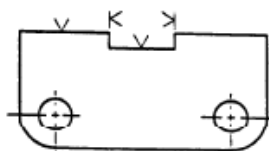
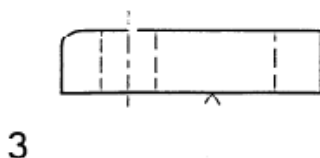
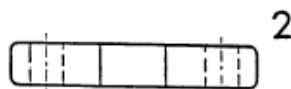
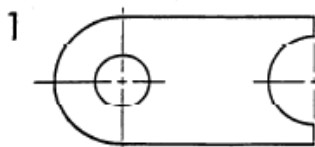
DIMENSIONING WORKSHEET 3



NOTES
ALL FILLETS &
ROUNDS R.25

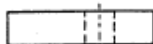
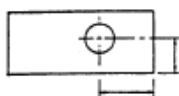
FILLETS & ROUNDS
R.25 UNLESS
OTHERWISE SPECIFIED

DIMENSIONING ARCS
TYPICAL METHODS OF DIMENSIONING ARCS
ARE SHOWN AT THE LEFT. NOTICE THAT A
RADIUS IS USED WHEN THE ARC IS LESS
THAN A FULL CIRCLE. NOTES CAN BE USED
TO SPECIFY FILLETS AND ROUNDS TO RE-
DUCE REPETITIVE DIMENSIONS.

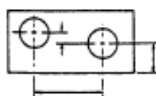


DIMENSIONING WORKSHEET 4

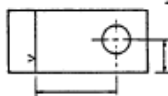
LOCATION DIMENSIONS



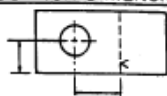
Holes should be located in the circular view with two dimensions.



Holes should be located from center to center when more than one hole is given.



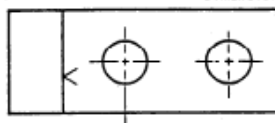
Holes should be located from finished surfaces for greater accuracy.



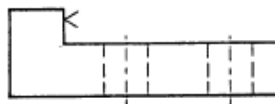
Holes should be located from finished surfaces even if the surface is hidden.

COMPLETELY DIMENSION THE FULL-SIZE
PART BY DRAWING LOCATION AND SIZE

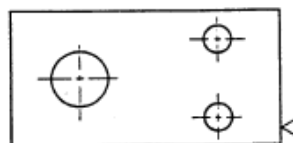
1 GUIDE



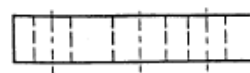
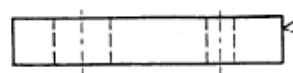
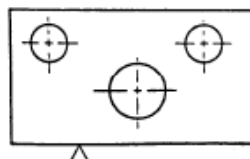
2 ADAPTER



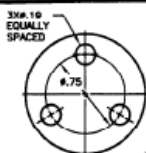
3 FLANGE



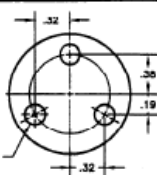
4 CASE



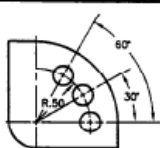
DIMENSIONING WORKSHEET 5



HOLES CAN BE LOCATED BY
DIMENSIONING THE CIRCLE OF
CENTERS AND WITH A NOTE.



HOLES CAN BE LOCATED WITH
COORDINATE DIMENSIONS
FROM THE CENTER LINES.



HOLES CAN BE LOCATED WITH
ANGULAR DIMENSIONS AND THE
RADIUS FROM A POLE POINT.

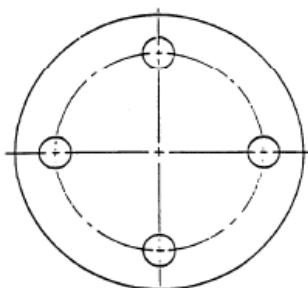
LOCATION DIMENSIONS



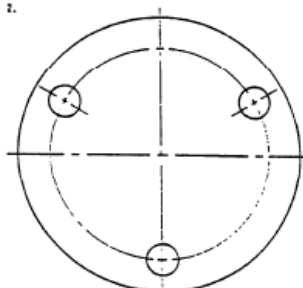
2

1

LOCATE THE HOLES USING
THE CIRCLE OF CENTERS
METHOD FOR PROBLEM 1
AND THE COORDINATE
METHOD FOR PROBLEM 2.
GIVE HOLE NOTES.

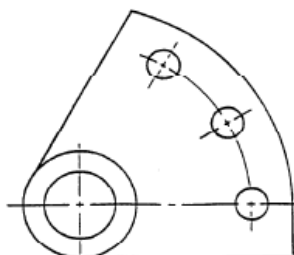


END CAP
HALF SIZE

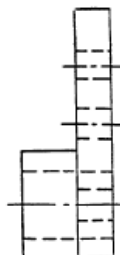


END CAP
HALF SIZE

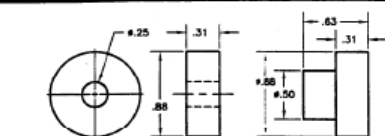
3 COMPLETELY DIMENSION
THE PART BELOW.



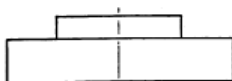
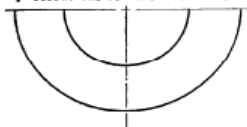
SHAFT BRACKET HALF SIZE



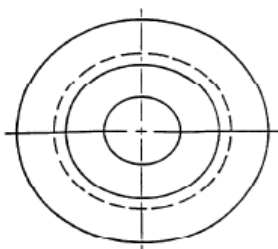
DIMENSIONING WORKSHEET 6



1 DIMENSION THE FULL-SIZE CYLINDRICAL PART BELOW. THE TOP VIEW IS A HALF VIEW.



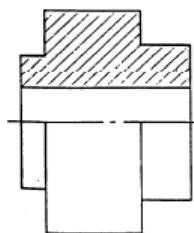
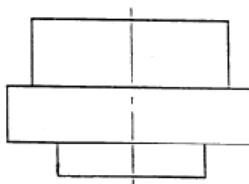
3 DIMENSION THE FULL-SIZE CYLINDRICAL PART SHOWN IN THE HALF SECTION.



DIMENSIONING CYLINDERS

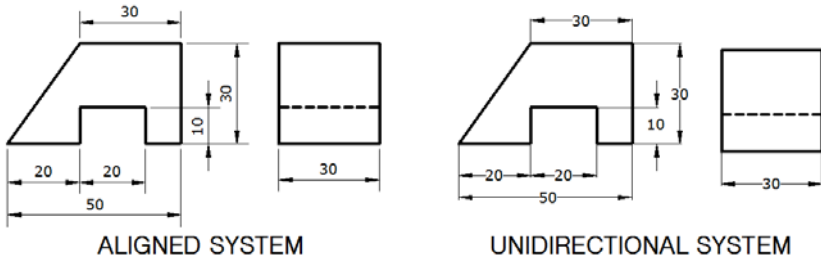
EXAMPLES OF DIMENSIONED CYLINDERS ARE SHOWN AT THE LEFT. DIMENSIONS ARE PLACED ON THE RECTANGULAR VIEW USING DIAMETERS INSTEAD OF RADII. SMALL HOLES ARE DIMENSIONED WITH A NOTE IN THE CIRCULAR VIEW. THE CIRCULAR VIEW CAN BE OMITTED WHEN DIMENSIONING CYLINDERS IF "DIA" IS PLACED AFTER EACH DIMENSIONED DIAMETER IN THE RECTANGULAR VIEW.

2 DIMENSION THE FULL-SIZE CYLINDRICAL PART. THE CIRCULAR VIEW HAS BEEN OMITTED.

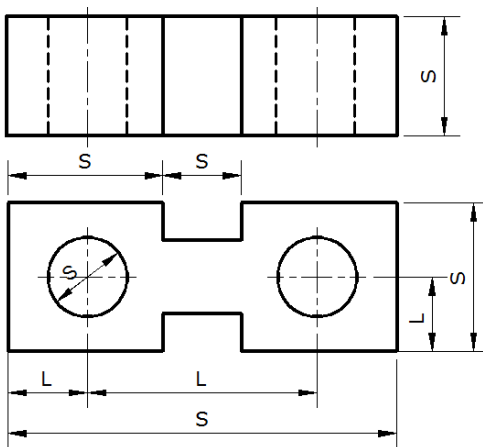


Answer key for the question in the textbook

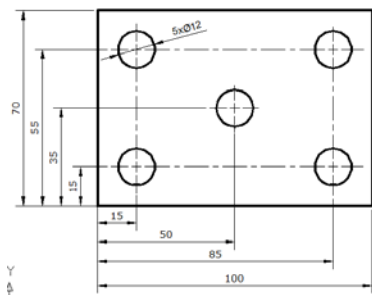
Solution for check point 4.1



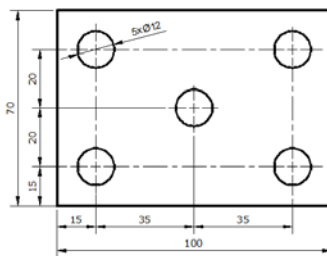
Solution for check point 4.2



Solution for check point 4.3

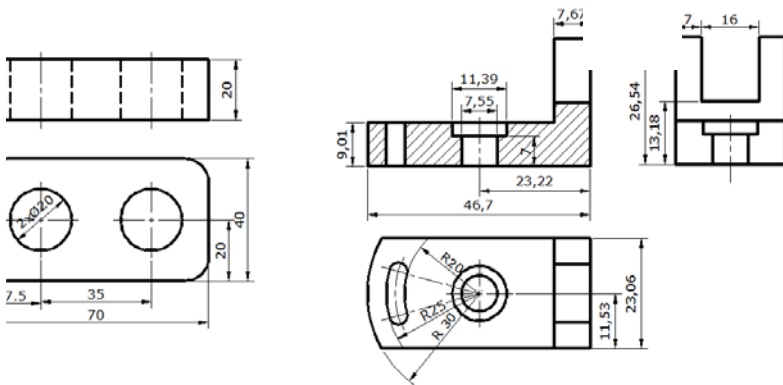


Parallel dimensioning



Chain dimensioning

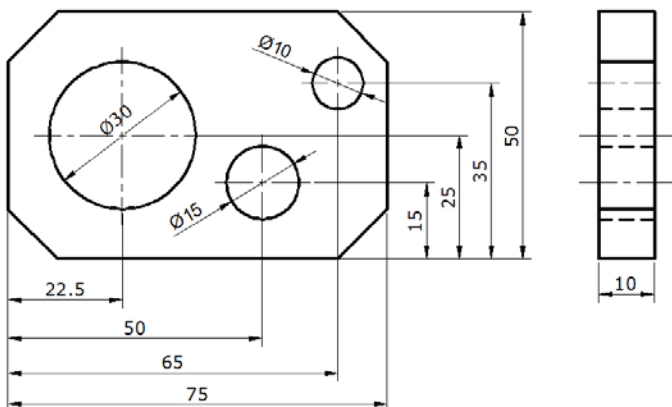
Solution for exercise 1



A

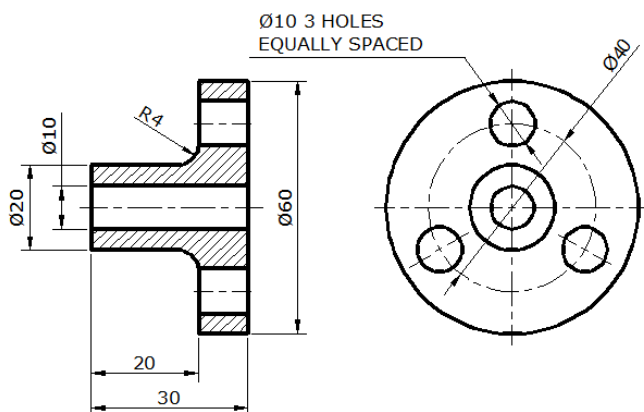
ALL ROUNDS R 10

B



ALL CHAMERS 10X45°

C



D

Isometric view of a mechanical part. Dimensions include: 46 (top length), 41 (bottom length), 11 (height of the base), R22 (top left radius), R11 (top right radius), 11 (width of the base), 15 (width of the base), and 11 (width of the base).

An isometric drawing of a mechanical part. The part has a base with a width of 45 and a depth of 25. The front face of the base is 30 high. A vertical plate of width 15 and height 20 is attached to the left side of the base. On top of the base, there is a sloped section that rises to a height of 25. The top surface of this section is 15 wide and 15 deep. A vertical plate of width 15 and height 10 is attached to the right side of the sloped section. The total height of the part is 30. The dimensions are: 30, 20, 15, 10, 15, 15, 25, 45, 25, 10, 15.

Isometric view of a mechanical part. Dimensions are given in mm. The part has a total width of 52.5 mm, a total depth of 57.5 mm, and a total height of 57.5 mm. The front face features a central rectangular cutout with a width of 22.5 mm and a height of 15 mm. The top surface has a width of 22.5 mm and a depth of 15 mm. The bottom surface has a width of 22.5 mm and a depth of 15 mm. The part is composed of several rectangular blocks joined together.

An isometric drawing of a mechanical part. The part has a rectangular base with a width of 60 and a depth of 37.5. The total height is 45. On the right side, there is a sloped surface with a height of 22.5. The top surface has a width of 80. There are two vertical slots, each with a width of 15.

83