

Demonstrate Basic Dimensioning Techniques

Unit: Graphic Agility

Problem Area: Principles of Dimensioning

Lesson: Demonstrate Basic Dimensioning Techniques

- **Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

- 1 Explain the necessity of accurate dimensions and notes on drawings.
- 2 Identify and explain the two general types of dimensioning.
- 3 Identify the types of lines and dimensions used when dimensioning.
- 4 Describe dimensioning systems and their applications.

- **List of Resources.** The following resources may be useful in teaching this lesson:

American Design Drafting Association. Accessed on March 10, 2008.
<<http://www.adda.org/>>.

American Institute of Architects. Accessed on March 10, 2008.
<<http://www.aia.org/>>.

Brown, Walter C. and Cloise E. Kicklighter. *Drafting for Industry.* The Goodheart-Wilcox Company, Inc., 1995.

American National Standards Institute. Accessed on April 10, 2008.
<<http://www.ansi.org/>>.



American Society of Mechanical Engineers. Accessed on April 10, 2008.
<<http://www.asme.org>>.

Engineering Fundamentals. Accessed on June 10, 2008.
<<http://www.efunda.com>>.

Walker, John R. and Bernard D. Mathis. *Exploring Drafting*. The Goodheart-Wilcox Company, Inc., 2007.

Wohler, Terry. *Applying AutoCad 2008*. The McGraw-Hill Companies, Inc., 2008.

■ **List of Equipment, Tools, Supplies, and Facilities**

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials
- ✓ Drawings showing examples of proper dimensioning practices

■ **Terms.** The following terms are presented in this lesson (shown in bold italics):

- ▶ aligned dimensions
- ▶ American National Standards Institute (ANSI)
- ▶ American Society of Mechanical Engineers (ASME)
- ▶ arrowheads
- ▶ decimal inch dimensioning
- ▶ dimension lines
- ▶ dimensioning
- ▶ dual dimensioning
- ▶ extension lines
- ▶ fractional dimensioning
- ▶ International Standards Organization (ISO)
- ▶ leader lines
- ▶ line weight
- ▶ location dimensions
- ▶ metric dimensioning
- ▶ SI Metric
- ▶ size dimensions
- ▶ unidirectional dimensions

■ **Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situation. A possible approach is included here.

Have the students write descriptions and draw sketches of various objects. Have the students share their written descriptions with a partner who would then sketch the object. Then, have the students compare their sketches. Conduct a class discussion about a manufacturer's ability to produce the object, based upon the written description. Next, discuss the ability to produce the object, based upon the sketch. Have the students add dimensions to their sketches and discuss the prospects of producing the object now. Use this exercise to illustrate to the students the importance of dimensioning in the manufacturing or production of any item. This exercise could lead to further discussion about the accuracy of dimensions and manufacturing standards in our highly technical society. You could also share drawings that illustrate properly and improperly dimensioned objects. Discuss the effect dimensioning has on the manufacturing or production of any item.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain the necessity of accurate dimensions and notes on drawings.

Anticipated Problem: How are dimensioning and dimensioning standards used in graphic communication?

- I. Dimensioning defined
 - A. **Dimensioning** is the process of defining the size, shape, and the location of geometric components located on a drawing. Geometric Dimensioning and Tolerancing (GDT) is a way to define the geometry of mechanical parts. Mechanical designers, fabricators, and inspectors use GDT to communicate complex geometrical descriptions.
 1. Size is the actual measurement (length, width, height, diameter, radius)
 2. Shape is the configuration (round, square, rectangle)
 3. Location defines the placement of geometric components.
 - B. Standard conventions for dimensioning are provided by three organizations.
 1. **American National Standards Institute (ANSI)** defines its oversight mission as “the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices

to construction equipment, from dairy and livestock production to energy distribution, and many more.”

2. **American Society of Mechanical Engineers (ASME)** has been providing standards to the industry since the 1950s, such as ASME Y14.5M Standard for Dimensioning and Tolerancing, which specifies engineering drawing requirements. ASME’s original goal was to delineate and define mechanical part hardware and to create a common technical drawing language for standardized drawing practices. Over the years ASME has expanded to incorporate technical innovations such as standards for electronic compatible systems.
3. **International Standards Organization (ISO)** is a worldwide federation of 145 national standards bodies, one from each country belonging to ISO. ISO is a term from the Greek (isos) meaning “equal.” No matter the country or the language, the organization’s name is always ISO.
 - a. According to ISO, it is a “non-governmental organization established in 1947 and based in Geneva, Switzerland ... whose mission is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.”
 - b. International ISO agreements are published as standards documents.
 - c. Many industries that meet ISO requirements publicize their association and ability to meet international standards — ISO 9000 certified industries share a common set of quality management standards worldwide.
 - d. ISO established the **SI Metric** (Système International d’Unités) system and made the metric system the standard measure.

Many techniques can be used to help students master this objective. Discuss the importance of having international standards for design, dimensioning, and manufacturing of products in our global economy. Use VM–A to review Objective 1.

Objective 2: Identify and explain the two general types of dimensioning.

Anticipated Problem: What are the two general types of dimensioning?

II. Two types of dimensioning

- A. **Size dimensions** define the size of geometric components of a part, product, or object.
- B. **Location dimensions** define the location of geometric components in relation to each other on a part, product, or object.

Many techniques can be used to help students master this objective. Use VM–A and LS–A to illustrate the two general types of dimensioning.

Objective 3: Identify the types of lines and dimensions used when dimensioning.

Anticipated Problem: What types of lines and dimensions are used when dimensioning?

III. Types of lines and dimensions

- A. **Aligned dimensions** are placed parallel to the dimension lines and are used mainly for architectural drawing.
- B. **Unidirectional dimensions** are used for mechanical and engineering drawings. All dimensions are placed and are designed to be read from the bottom of the drawing.
- C. **Dimension lines** are lines with termination points, such as dots, tick marks, or arrowheads, at each end to indicate the direction and limit of the dimension.
- D. **Arrowheads** are arrows drawn at the termination of dimension lines or leaders.
- E. **Extension lines** are used to indicate the termination of a dimension and are usually drawn perpendicular to a dimension line.
- F. **Leader lines** are thin lines that lead from a dimension or note to a feature on the drawing.
- G. **Line weight** is the thickness of the line. Dimension, extension, and leader lines are drawn lighter and thinner than the object lines of the drawing, usually with a 4H pencil.

Many techniques can be used to help students master this objective. Use VM–A and LS–A to illustrate types of lines and dimensions.

Objective 4: Describe dimensioning systems and their applications.

Anticipated Problem: What are the types of dimensioning systems and how is each used?

IV. Dimensioning systems

- A. **Decimal inch dimensioning** is preferred in most manufacturing industries because it is easier to add, subtract, multiply, and divide. High levels of accuracy are possible with this system. Examples are 1.20, 0.0075, or 0.391.
- B. **Fractional dimensioning** is commonly used in architectural or structural drawings. Close tolerances and high levels of accuracy are not as necessary in these fields. Examples are $\frac{1}{2}$ ", $14\frac{1}{4}$ ", or $12' 4\frac{1}{2}$ ".
- C. **Metric dimensioning** is a base-ten number system that makes it is easier to add, subtract, multiply, and divide. It is referred to internationally as the *Système International d'Unités* or *SI Metric* system. High levels of accuracy are possible with this system. Examples are 25 mm, 75 m, or 30 km.

- D. **Dual dimensioning** uses inch and metric dimensions on the same drawing. The inch measurement is usually represented in decimal inches and the metric measurement in millimeters. These drawings are used between the U.S. and other countries in the global market.
- E. Rules for dimensioning
1. Place location and size dimensions on the views that show the feature as a visible object.
 2. Plan the locations of the dimensions so that they do not look crowded. Follow ASME or ISO standards.
 3. Avoid placing dimensions on the object or part unless absolutely necessary.
 4. Completely dimension the part so that no dimensions must be estimated or assumed, and so it is not necessary to take measurements from the drawing.
 5. State each dimension clearly. Ensure that the measurement may be interpreted in only one way.
 6. Avoid duplication of dimensions when dimensioning multiple views.
 7. Dimensions should be placed between the primary views.
 8. Dimension and extension lines should be placed between the primary views and should contrast with object lines.
 9. Plan carefully so that extension lines do not cross dimension lines. This requires shorter dimensions be placed closer to the object.
 10. When chaining dimensions, always leave out the last dimension in the chain.
 11. When arranging dimensions on a drawing, overall dimensions should be placed farthest from the view.

Many techniques can be used to help students master this objective. Use VM–A and LS–A to apply the information presented in the lesson.

- **Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle.
- **Application.** Use the included visual masters and lab sheet to apply the information presented in the lesson. Assign students various drawings and products to check their abilities to properly dimension drawings.
- **Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. Assign students various drawings and products to check their abilities to properly dimension drawings. A sample written test is provided.

■ **Answers to Sample Test:**

Part One: Multiple Choice

1. a
2. d
3. c
4. d
5. b
6. a

Part Two: Completion

1. Aligned
2. Unidirectional
3. millimeters
4. millimeter

Part Three: True/False

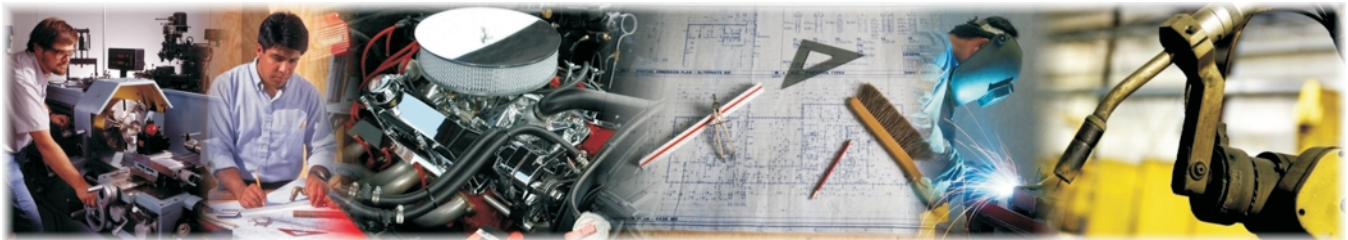
1. T
2. T
3. F
4. F
5. F

Demonstrate Basic Dimensioning Techniques

► Part One: Multiple Choice

Instructions: Write the letter of the correct answer.

- ____ 1. ANSI, ASME, and ISO are _____.
 - a. standards organizations and agencies
 - b. dimension lines
 - c. dimension features
 - d. None of the above
- ____ 2. Arrowheads on dimensions are _____.
 - a. used to show the extent of the dimension
 - b. drawn perpendicular to the line that is being dimensioned
 - c. usually placed on both ends of the dimension line
 - d. Both a and c
- ____ 3. Dimensions that line up with the bottom of the page, regardless of the orientation of the dimension line, are called _____.
 - a. linear dimensions
 - b. aligned dimensions
 - c. unidirectional dimensions
 - d. None of the above
- ____ 4. When arranging dimensions on a drawing, ____ dimensions should be placed farthest from the view.
 - a. location
 - b. size
 - c. small
 - d. overall



- ____ 5. The lines that extend from the object to the dimension line in a dimension are ____.
- center marks
 - extension lines
 - dimension lines
 - datums
- ____ 6. Leaders are used to ____.
- point out a particular feature in a drawing
 - identify general drawing notes
 - identify the title block in a drawing
 - All of the above

► Part Two: Completion

Instructions: Provide the word or words to complete the following statements.

- ____ dimensions are placed parallel to the dimension lines.
- ____ dimensions are placed horizontally to read from the bottom of the drawing.
- Drawings made in SI Metric units are most commonly dimensioned in ____.
- The ____ is the standard metric unit for dimensioning engineering drawings.

► Part Three: True/False

Instructions: Write *T* for true or *F* for false.

- ____ 1. Dual dimensioning uses inch and metric dimensions on the same drawing.
- ____ 2. Dimensions can be created in either U.S. customary (inches) or metric (millimeters) units.
- ____ 3. When dimensioning a drawing, it is acceptable to scale or assume distances.
- ____ 4. Dimension lines are drawn to the same lineweight as object lines.
- ____ 5. Drawings made in mechanical drafting are most commonly dimensioned in fractional inches.

DEMONSTRATE BASIC DIMENSIONING TECHNIQUES

Standards for dimensioning are provided by three organizations.

◆ American National Standards Institute (ANSI)

- The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more.

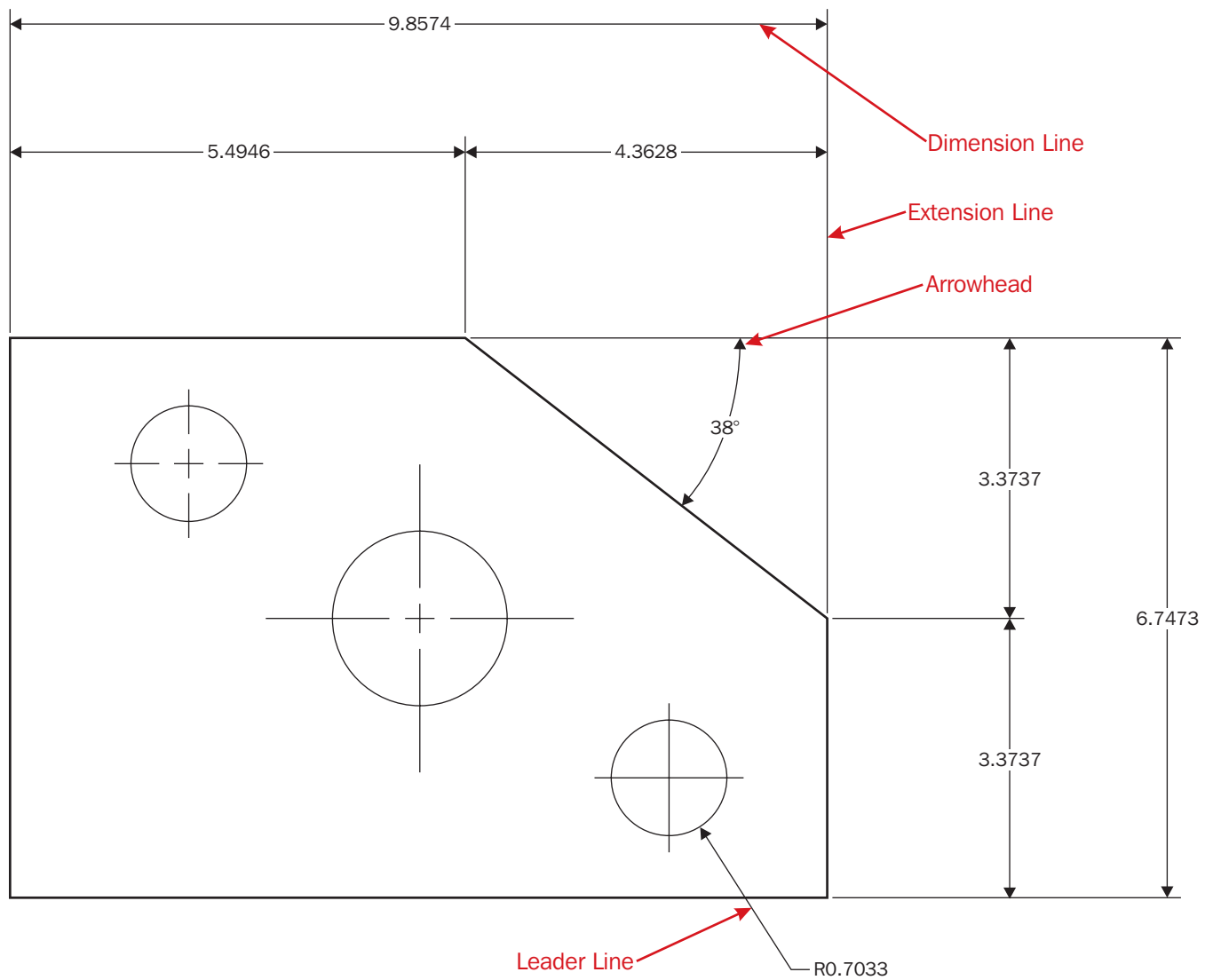
◆ Society of Mechanical Engineers (ASME)

- ASME Y14.5M Standard for Dimensioning and Tolerancing, which specifies engineering drawing requirements, originated in the 1950s. Over the years it has incorporated technical innovations such as the new electronic compatible systems. Its original goal was to delineate and define mechanical part hardware and to create a common technical drawing language for standardized drawing practices, acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more.

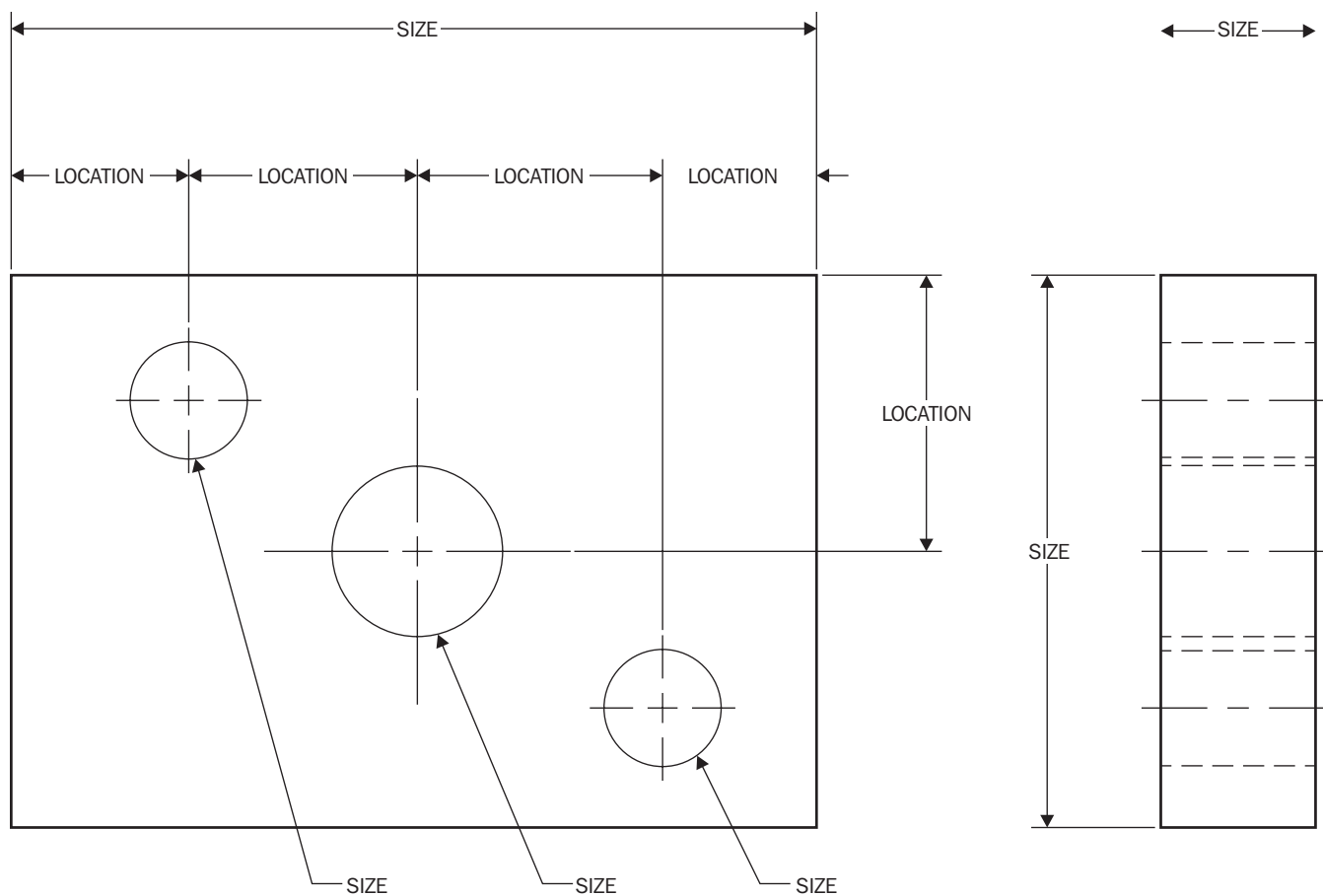
◆ International Standards Organization (ISO)

- ISO is a worldwide federation of national standards bodies from more than 145 countries, one from each country. ISO is a non-governmental organization established in 1947 and based in Geneva, Switzerland. Its mission is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. ISO's work results in international agreements, which are published as International Standards and other types of ISO documents.

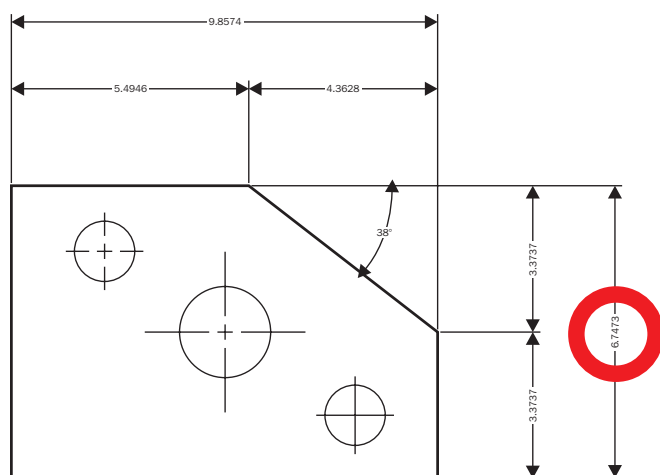
Dimension Line Samples



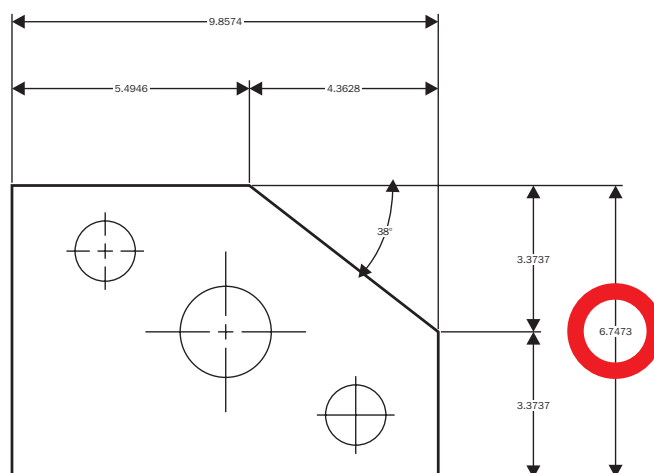
Two General Types of Dimensioning— Size and Location



Aligned and Unidirectional Dimensioning Systems



Aligned Dimensions



Unidirectional Dimensions

Dimensioning Systems

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- ◆ Metric dimensioning is a base-ten number system that makes it is easier to add, subtract, multiply, and divide. It is referred to internationally as the *Système International d'Unités* or *SI Metric* system. High levels of accuracy are possible with this system. Examples are 25 mm, 75 m, or 30 km.
- ◆ Dual dimensioning uses inch and metric dimensions on the same drawing. The inch measurement is usually given in decimal inches and the metric measurement is given in millimeters. These drawings are used between the U.S. and other countries in the global market.

Dimensioning Rules

- ◆ Place location and size dimensions on the views that show the feature as a visible object.
- ◆ Plan the locations of the dimensions so that they do not look crowded, and follow ASME or ISO standards.
- ◆ Avoid placing dimensions on the object or part unless absolutely necessary.
- ◆ Completely dimension the part so that no dimensions must be estimated or assumed. It should be unnecessary to take measurements from the drawing.
- ◆ State each dimension clearly so that it can be interpreted in only one way.
- ◆ Avoid duplication of dimensions when dimensioning multiple views.
- ◆ Dimensions should be placed between the primary views.
- ◆ Dimension and extension lines should be placed between the primary views and should contrast with object lines.
- ◆ Plan carefully so that extension lines do not cross dimension lines. This requires that shorter dimensions are placed closer to the object.
- ◆ When chaining dimensions, always leave out the last dimension in the chain.
- ◆ When arranging dimensions on a drawing, overall dimensions should be placed farthest from the view.

Basic Dimensioning

Purpose

The purpose of this activity is to review basic dimensioning, types of lines, and systems of dimensioning.

Objectives

1. Answer the questions 1 through 4 during a discussion of various dimensioning lines, types, and systems of dimensioning.
2. Make notations of each element's importance to the dimensioning process.

Materials

- ◆ lab sheet
- ◆ writing utensil

Procedure

Use the back of this worksheet to communicate further the various dimensioning lines, types, and systems of dimensioning.

1. Why are dimensions and notes needed on drawings?
2. Identify the two general types of dimensioning.
3. Identify the types of dimensions and lines used while dimensioning.
4. Explain the proper use of dimensioning systems and their applications.

