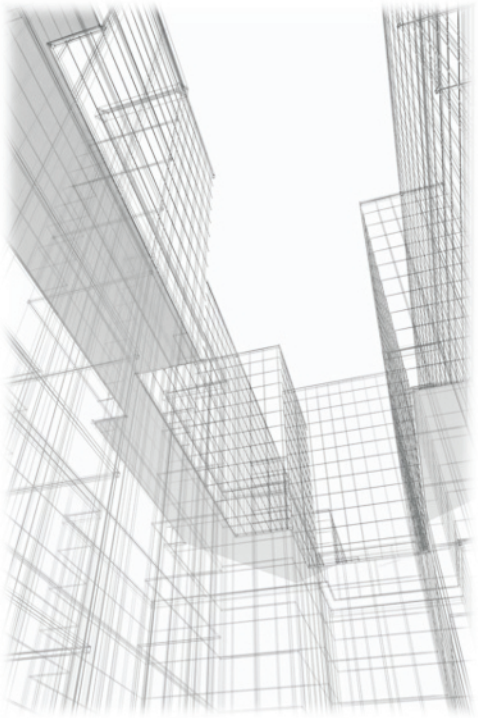
Demonstrate Basic Dimensioning Techniques

DIMENSIONS make it possible to build designed items. Because dimensions are one of the most important elements on technical drawings, standards have been created to aid with consistency and communication. Variations on techniques and styles exist among different professions, but all follow a series of important rules and guidelines to ensure that things are built accurately, safely, and efficiently.



Objectives:

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

Key Terms:

aligned dimensions
American National Standards Institute (ANSI)
American Society of Mechanical Engineers (AMSE)
arrowheads
decimal lines
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

The Necessity of Accurate Dimensions and Notes on Drawings

Dimensioning is the process of defining the size, shape, and location of different features on an object. The size is the actual measurement of the object (e.g., the length, width, height, diameter, or radius). The shape is the object's configuration. Basic forms are round, square, and rectangular. Most objects have a series of different features within their form, usually defined by dimensioning their exact location referenced to the outer edges.

Geometric Dimensioning and Tolerance (GDT) is a way to define the geometry of mechanical parts. Mechanical designers, fabricators, and inspectors use GDT to communicate complex geometrical descriptions. In addition, dimensions and notes describe and explain the actual size and technical information of a designed object. Several organizations have established standards for consistency: the American National Standards Institute, the American Society of Mechanical Engineers, and the International Standards Organization.

AMERICAN NATIONAL STANDARDS INSTITUTE

The **American National Standards Institute (ANSI)** is an organization that provides a series of guidelines and standards used across all fields. ANSI standards were created to ensure that the world could work together and exchange information. The mission statement describes how ANSI creates thousands of standards and guidelines that impact the world every day in industries such as construction, livestock production, energy use, and distribution.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The **American Society of Mechanical Engineers (ASME)** is an organization that has been providing standards to the industry for more than 50 years. Its ASME Y14.5M specifies engineering drawing requirements for dimensioning and tolerances. The goal was to create a common technical drawing language for standardized drawing practices and to define specifics in mechanical hardware parts. Now AMSE has expanded to include standards for technical innovations in electronic compatible systems.

INTERNATIONAL STANDARDS ORGANIZATION

The **International Standards Organization (ISO)** is a worldwide federation. It has 145 national standard bodies—one from each member country. Established in 1945, ISO is a non-government organization based in Geneva, Switzerland. Its mission is to facilitate the international exchange of goods and services. The organization also wants to ensure clear communication of intellectual, scientific, technological, and economic activity. Goods and services are becoming more international, so the importance of ISO is increasing. Agreements made among members are published as standard documents.

SI Metric System

The International Standards Organization also sets up a series of quality-control management standards to be followed worldwide. Industries that meet these standards (e.g., the ISO 9000 certified industries) can publicize their association. The **SI Metric** system (Systeme International d' Unites) was established by the ISO. It made the metric system the standard international form of measurement.

FIGURE 1. Although SI metric units are not typically used in the United States, most of the world uses them, as seen in this technical drawing. Depending on the field in which you work, you may need to learn metric units in the future.

Types of Dimensioning, Lines, and Dimensions

DIMENSIONING

In general, two main functions for dimensions are to locate objects or features and to give their sizes.

Size Dimensions

Size dimensions are dimensions that define the size of geometric features of an object or its parts.

Location Dimensions

Location dimensions are dimensions that give the exact location of geometric features in relation to other features or reference points. This information is required so the objects can be fabricated, produced, or constructed according to the exact design requirements. It is essential to provide the overall size of an object, all the features, and the locations to ensure accuracy.

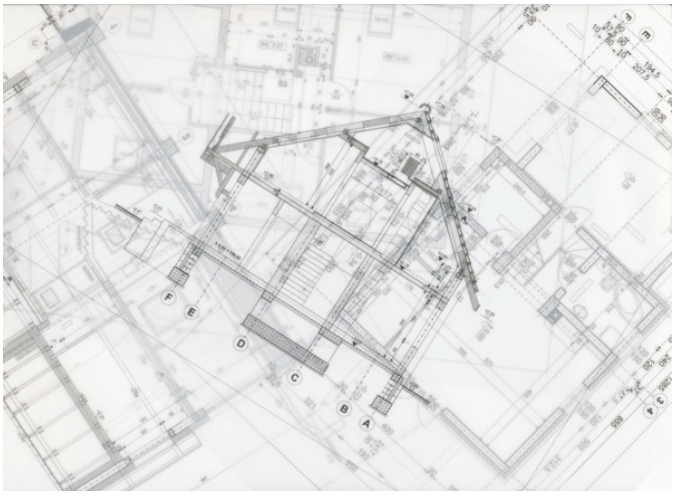


FIGURE 2. It is important for design reasons and for safety purposes that drawings used for construction or production have every element properly located and sized, as seen in this example.

LINES

Several types of elements or features make up a drawing dimension. They can be changed or altered, depending on what is required for the dimension or how and where it is being used. All drawn dimensions have a **line weight**, which is the thickness of the line. To keep a drawing clear, a line weight is usually drawn lighter or thinner than the rest of the lines in the drawing. If drafted by hand, it may be drawn with 4H pencils. In CAD, you would typically use the lightest established line weight.

DIMENSIONS

Dimensions are composed of three basic elements: dimension lines, arrowheads, and extension lines.

Dimension Lines

Dimension lines are the lines that designate the actual length. They run parallel to the feature or the object's side they reference. Usually along this line (in its center location), the numeric distance is given. These lines are terminated at their ends with arrowheads.

Arrowheads

Arrowheads are designations that mark the exact beginning and end of the dimension. They can be in the form of a closed or filled arrowhead, dot, or a tick mark. At these end points, extension lines are drawn.

Extension Lines

Extension lines are lines perpendicular to the dimension lines and run up to the edge of the dimensioned feature or object. They point to the exact location on the object where the dimension starts and stops. Typically, they are held just off of the object for clarity.

Leader Lines

Leader lines are lines used to give dimensions and other information about an object's features. On one end, they will have a note with text or a numeric distance, and the other end will have an arrowhead that points to the exact feature being described.

Types of Dimensions

Two types of dimensions are aligned and unidirectional. Their difference is how the numeric distance is located along the dimension line.

Aligned Dimensions

For **aligned dimensions**, all the numeric distances are placed parallel to the dimension line. They are mainly used in architectural drawings.

Unidirectional Dimensions

With **unidirectional dimensions**, the numeric distance always line up so they can be read from the bottom of the drawing. They are mainly used for mechanical and engineering drawings.

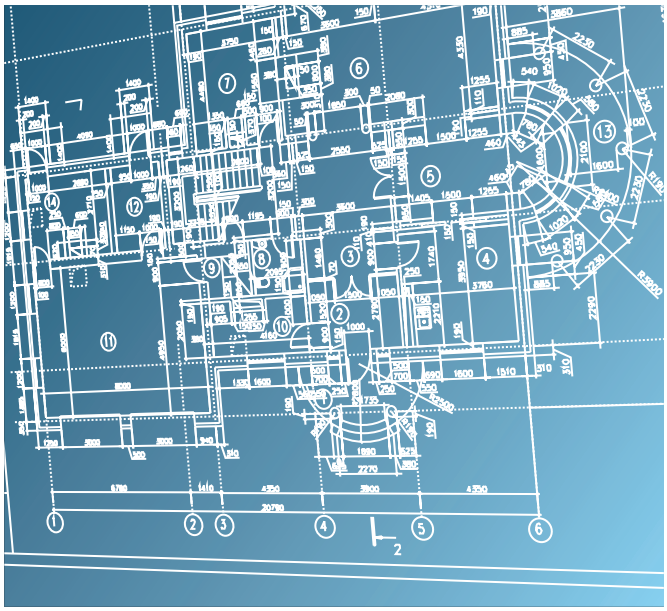


FIGURE 3. Different industries and individuals will use variations on dimensioning standards. Here is an example of aligned dimensions.

Dimensioning Systems and Their Applications

Several types of dimensioning systems exist. They have been developed over the years throughout different professions and disciplines. Four popular types are decimal inch dimensioning, fractional dimensioning, metric dimensioning, and dual dimensioning.

DIMENSIONING SYSTEMS

Decimal Inch Dimensioning

Decimal inch dimensioning is a system typically used in manufacturing industries. It allows for high levels of accuracy with numbers that you can add, subtract, multiply, or divide easily. Some examples are 1.4, 1.0725, and 0.0083.

Fractional Dimensioning

Fractional dimensioning is a system frequently used in architectural and structural drawings. Given the scale of these projects, very close tolerances and a high level of accuracy are not necessary. Some examples are ¼", 8½", and 5' to 7 ¾".

Metric Dimensioning

Metric dimensioning is a system that uses a numbering system based on 10. This makes it simpler to add, subtract, multiply, and divide. Internationally, it is referred to as the SI metric system. Some examples are 20 mm, 85 m, and 47 km.

FURTHER EXPLORATION...

ONLINE CONNECTION: Line Vocabulary

Learning all the types of lines and their meaning can take time, and some terms can be confusing. Dimensioning alone has a whole list of terms. The following Web link has a "class vocabulary" list. Reading through this list can help you become familiar with many of the commonly used terms, thereby improving your comprehension of the material and your interaction with professionals in the field.

http://www.toolingu.com/definition-800130-35887-dimension-line.html

Dual Dimensioning

Dual dimensioning is a system that uses inches and feet or the English system and the metric or SI metric system on the same drawing. This is typically used between the United States and other countries in the global market for manufactured products. The inch measurement is usually represented in decimal inches, and the metric measurement is represented in millimeters.

APPLICATIONS: RULES FOR DIMENSIONING

The following is a standard list of rules and guidelines that should be followed when dimensioning.

1. All dimensions should be located on the view or drawing that shows the feature being dimensioned. Do not dimension part of the object that cannot be seen.
2. You should lay out your dimensions so they appear organized and easy to read, not crowded. You can follow the ASME or ISO standards.
3. You should try to locate dimensions on the outside of the objects, if possible. This will keep the objects clear.
4. It is necessary to completely dimension the objects—all of the features and the overall size. This way no one will try to scale the drawing for dimensions.
5. Try to be as clear as possible about what is being dimensioned and how. You do not want the dimension to be misinterpreted.
6. To keep your drawing clean, do not duplicate dimensions—even in multiple views.
7. Dimension lines should be located between primary views and have different line weights than the object's lines.
8. You do not want any of your extension lines to cross. This may require some adjustment and planning.
9. Overall dimension lines should be placed farthest from the object, and you should arrange smaller or detailed dimensions closer to the object's features.

Summary:

Dimensioning is the process of defining the size, shape, and location of different features located on an object. Geometric Dimensioning and Tolerance is a way to define the geometry of mechanical parts. Several organizations have established standards. In general, there are two main functions for dimensions: to locate objects or features and to give their sizes.

Several types of elements make up a drawing dimension. They can change or alter depending on what is required. Dimensions are composed of three basic elements: dimension lines, arrowheads, and extension lines. Dimensions can be organized on a drawing, depending on how they will be read.

The types of dimensioning systems are based on inches and feet or the metric system. In some cases, both measurement types are required. You must follow basic rules and guidelines when dimensioning to ensure clarity and accuracy.

Checking Your Knowledge:

1. Name one organization that has set up dimensioning standards.
2. What are two main functions of dimensions?
3. What do you call dimensions that are always placed parallel to the dimension line?
4. Name two dimensioning systems and their purposes.
5. List five of the dimensioning rules.

Expanding Your Knowledge:

Creating clear and organized dimensions is not always easy. A great way to learn is to see how it is done. Plan a trip to a local engineering, manufacturing, or architectural firm. Each place of employment will have a specific technique that is followed. Before your visit, create a list of questions and bring a drawing of your own to discuss.

Web Links:

Rules for Dimensioning Tooling Components
http://www.ferris.edu/faculty/hillm/CDTD130/Dimensioning%20Rules.htm

Dimensioning Rules & Common Practices
http://www6.district125.k12.il.us/teched/Courses/ITD/ITDDimRules.html

Dimension Line Conventions
http://www.tpub.com/content/draftsman/14276/css/14276_142.htm