



**People's Democratic Republic of Algeria**  
**Ministry of Higher Education and Scientific Research**  
**Abdelhafid BOUSSOUF University of Mila**



**Institute of Science and Technology**  
**Department of Civil and Hydraulic**  
**Engineering**

# **Technical Drawing**

**Practical Work / 2nd Year Bachelor / Civil and Hydraulic Engineering**

**Presented by:**  
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**Chapter V:**  
**DIMENSIONING**

# General Principles

## Purpose of Dimensioning

The dimensioning of a part aims to indicate the dimensional information necessary for its manufacturing. It must be done according to established rules.

## Quantities to be Dimensioned:

Lengths, expressed in millimeters

Angles, expressed in degrees

Slopes, expressed in %

## Elements of Dimensioning:

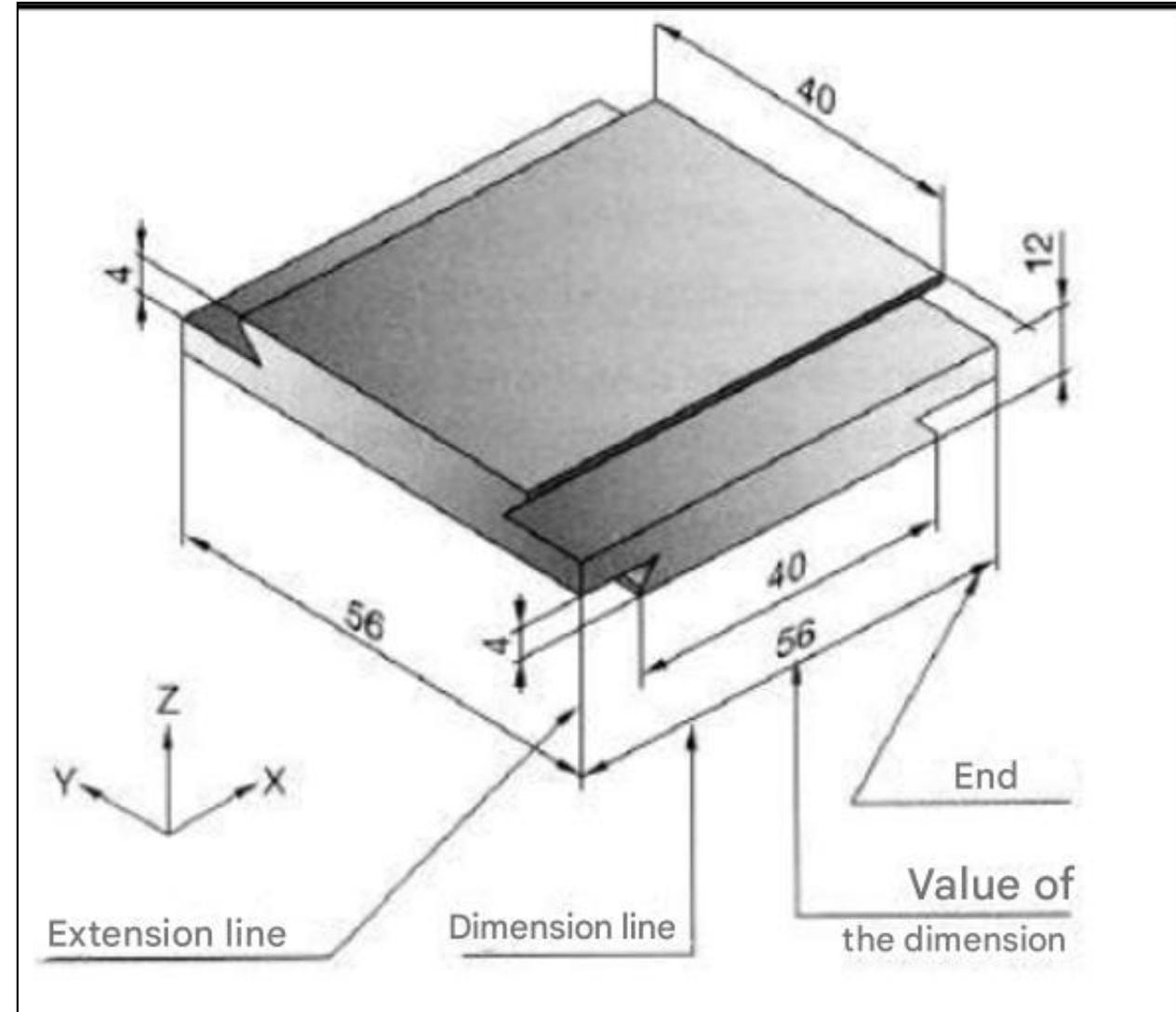
A dimensioning includes the following elements:

Dimension lines

Extension lines

Arrows or endpoints

The dimension value



**Fig 1.** Elements of Dimensioning

**Dimension Line:** Dimension lines are parallel to the segment being dimensioned and at least 5 mm away from it. They are drawn with thin continuous lines.

A dimension line must never be intersected by another line.

If an element is shown in a broken view, the dimension lines related to it are not interrupted.

**Extension Lines:** Extension lines are perpendicular to the segment being dimensioned and slightly extend beyond the dimension line. They are drawn with thin continuous lines.

Extension lines can intersect each other.

They must be perpendicular to the element being dimensioned.

If necessary, they can be drawn obliquely but must remain parallel to each other.

**Arrows:** Arrows are located at the ends of the dimension line and are formed by two branches with a  $30^\circ$  opening. They are drawn with thick continuous lines.

All arrows in the same drawing must be identical.

**Dimension Value:** The dimension value is placed at the center and slightly above the dimension line. Values are expressed in mm or  $^\circ$ , but the units are not written.

The value must never be intersected by a drawing line.

The dimensions indicated are those of the actual object, regardless of the drawing scale.

**Writing Values:** Dimension values must be written in characters of sufficient size for good visibility. Standard sizes: height of numerals = 3.5 mm. Line width for writing  $\approx 0.35$  mm.

## General Dimensioning Method

Values are written to be read from the bottom or from the right side of the drawing.

**Dimensioning Angles:** Angular values must be placed outside. Avoid placing them inside.

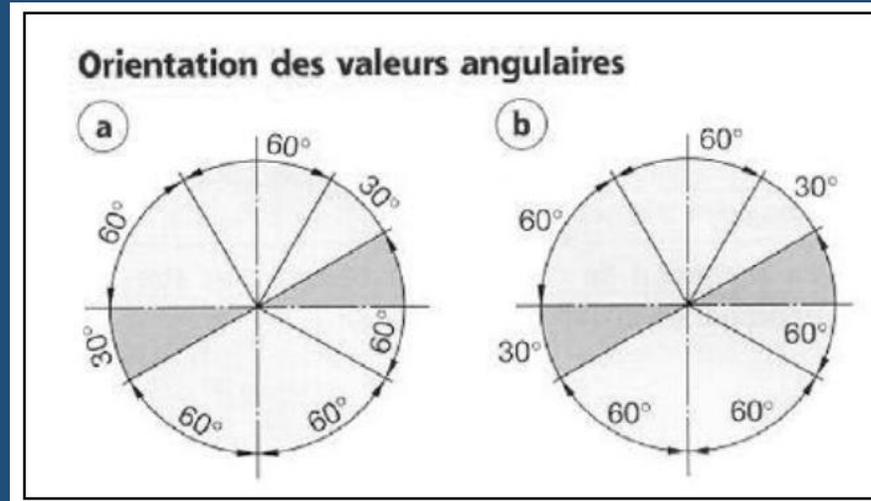


Fig 2. Dimensioning of Angles

**Dimensioning a Chord, Arc, or Angle:** For an arc, the value of the arc length is preceded by a semicircle

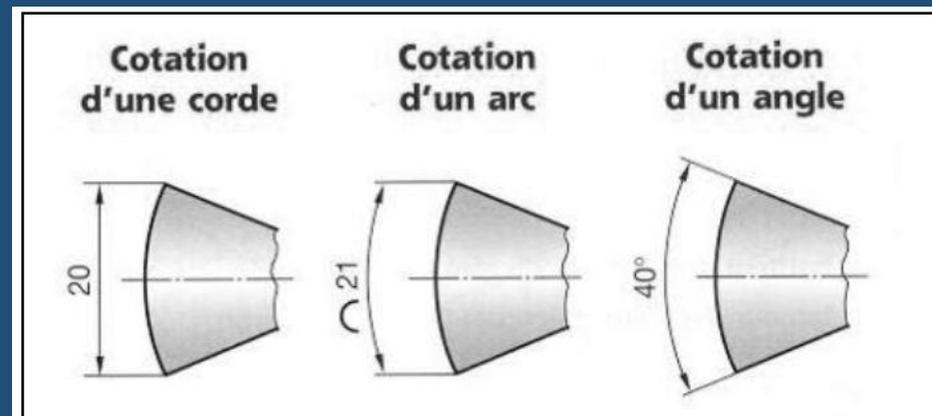
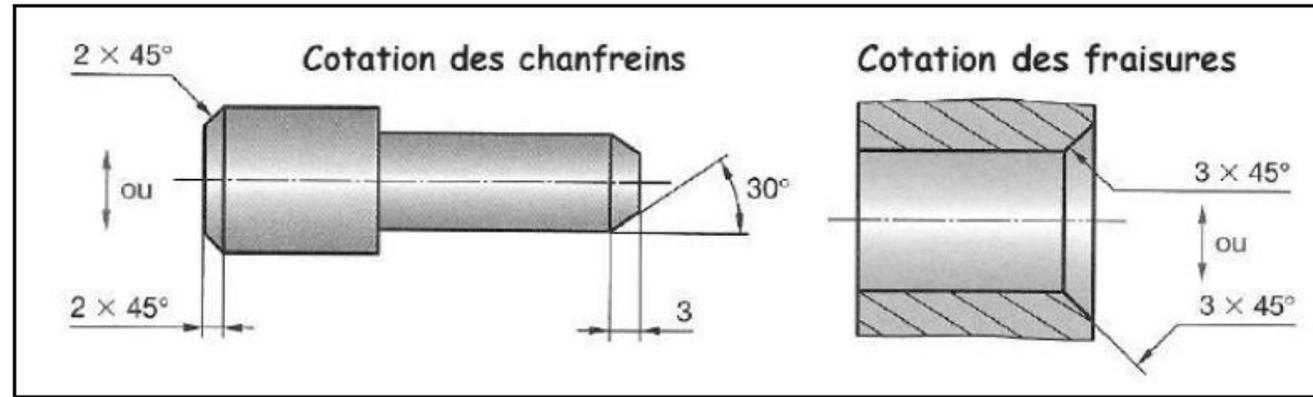


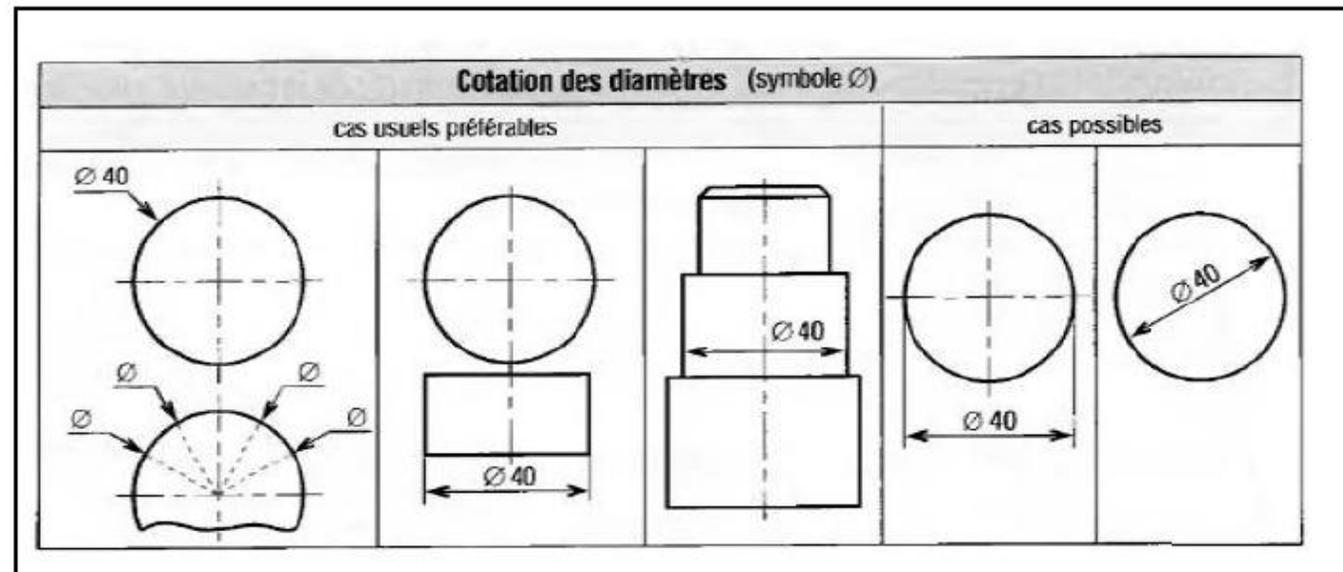
Fig 3. Standard Dimensioning of a Chord, Arc, and Angle

- **Dimensioning of Chamfers and Countersinks**



**Fig 4.** Dimensioning of Chamfers and Countersinks

- **Dimensioning of Diameters**



**Fig 5.** Example of Standard Dimensioning of Diameters

## Particular Arrangement

- Standardized Symbols

Élément à coter	Symbole
Diamètre	$\varnothing$
Rayon	R
Surplat d'un carré	□
Rayon de sphère	SR
Diamètre de sphère	S $\varnothing$
Longueur de l'arc	$\frown$
Épaisseur	t

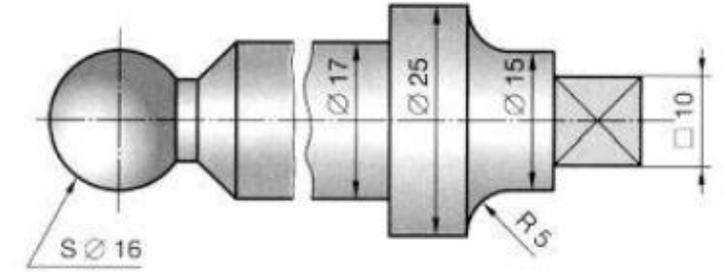


Fig 6. Standardized symbol

•If a continuous dimensioning layout becomes too crowded, the intermediate arrows may be replaced with dots, and the dimension value is placed above the extension of the dimension line, preferably on the right-hand side.

•When this approach is not feasible, the dimension must be indicated using a leader line.

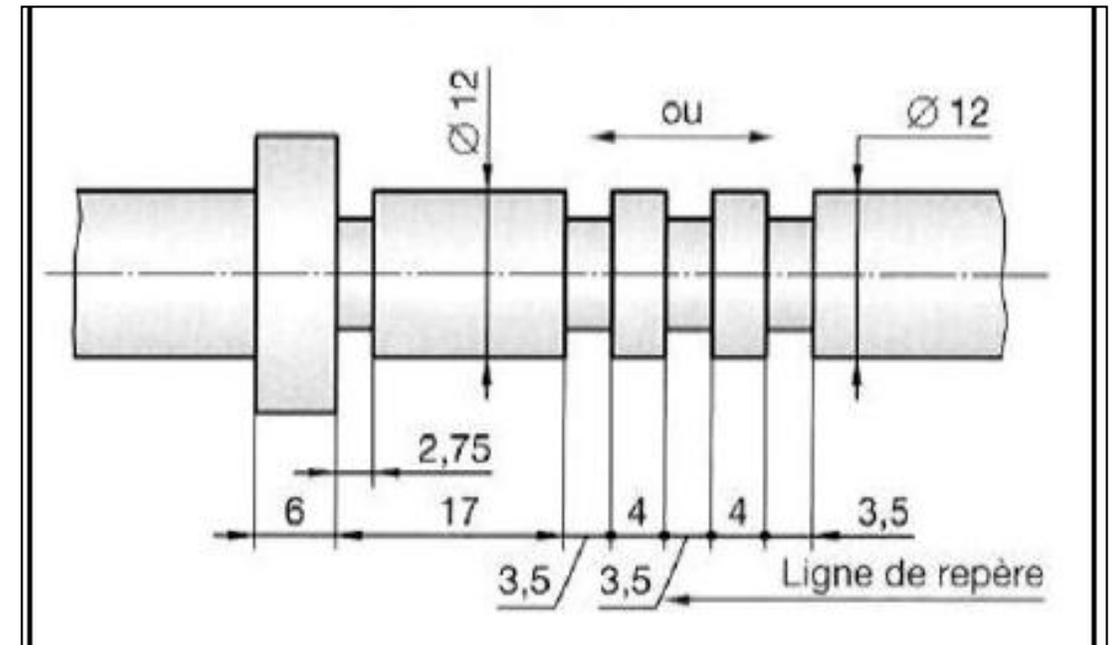
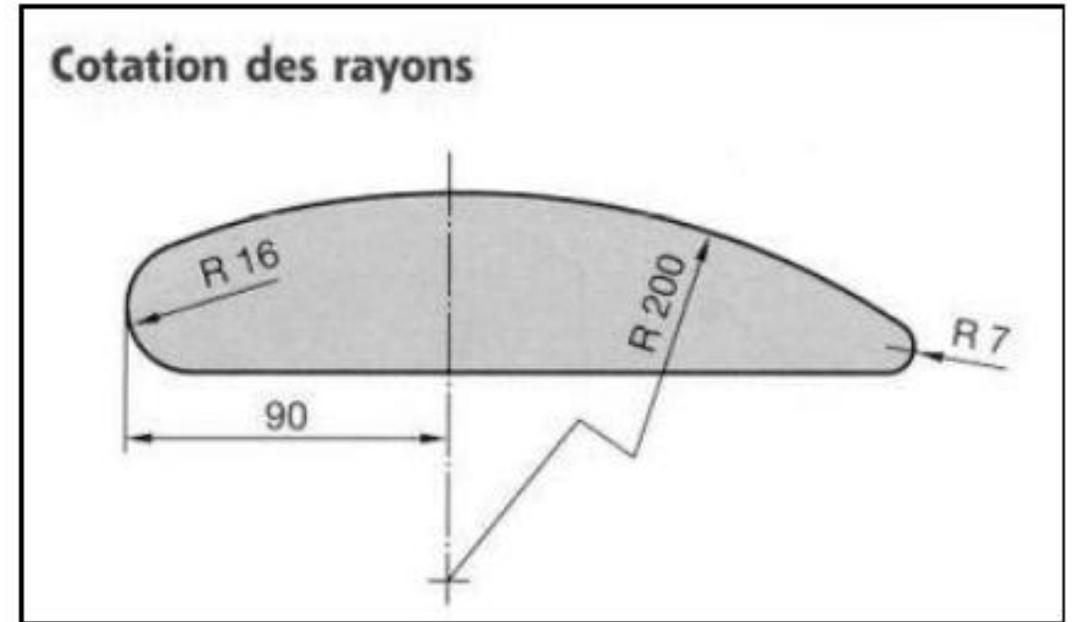


Fig 7. Cases where space is limited

## •Dimensioning of Radius

To dimension a radius:

- Use a **dimension line** directed along the radius of the arc.
- The **arrow** points toward the **concave side** of the arc, except for small radii, where the arrow is drawn on the **convex side**.



**Fig 8.** Dimensioning of Radius

## Dimensioning of Equidistant Elements

### 1. Linear Intervals

In the case of multiple holes and to avoid unnecessary repetition, for example, for dimensioning five equidistant holes on a ruler, the following method can be used:

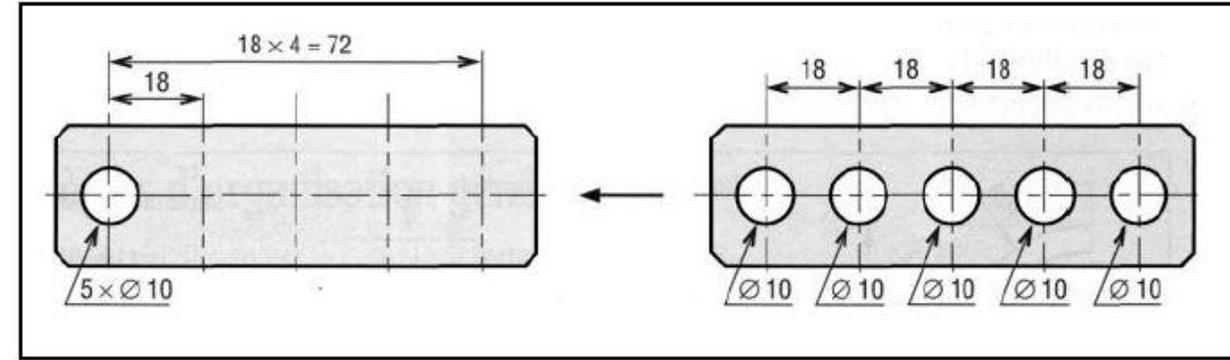
First, indicate the **number of intervals**. Then, give the **linear or angular dimension** separated by the symbol ( $\times$ ).

### 2. Angular Intervals

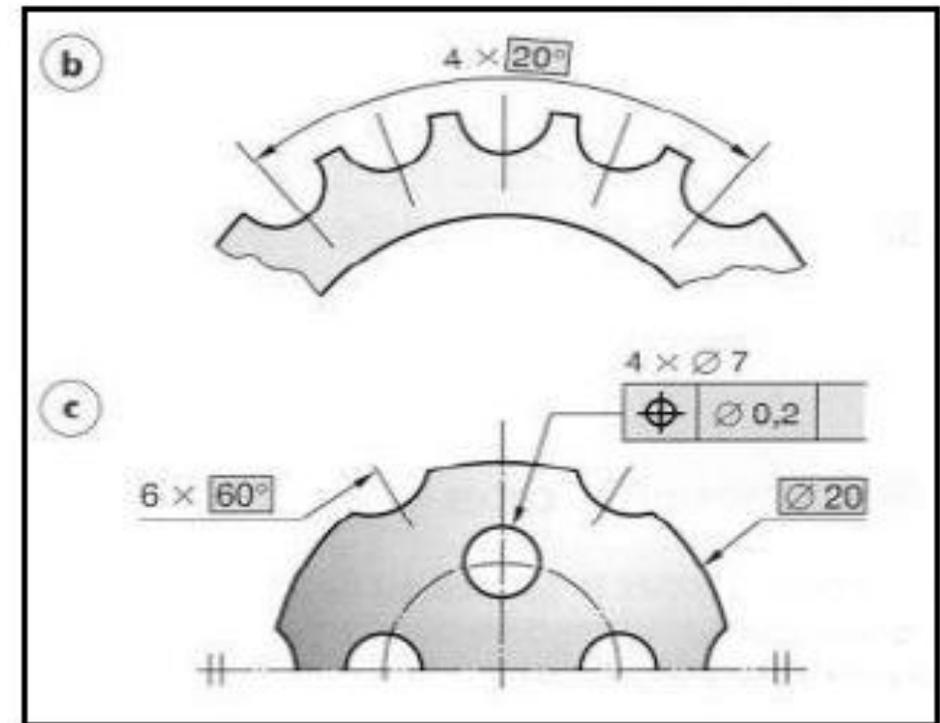
For elements arranged at equidistant angular intervals, dimensioning can be done:

**Directly**, as indicated.

**Indirectly**, by specifying the **number of repetitive elements**.



**Fig 9.** Equidistant Elements at Linear Intervals



**Fig 10.** Equidistant Elements at Angular Intervals

## Dimensioning Method

After a careful selection of the elements to be dimensioned, the arrangement of dimensions on a drawing generally results from the use of various dimensioning methods.

### •Chain Dimensioning

This dimensioning method consists of placing several dimensions along the same line. The dimensions follow one another without overlapping.

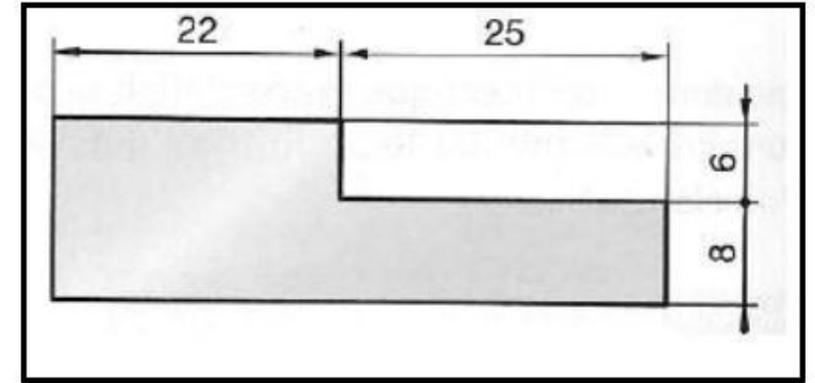


Fig 11. Chain Dimensioning

### •Parallel Dimensioning

The dimensions are arranged on parallel lines and originate from a common extension line.

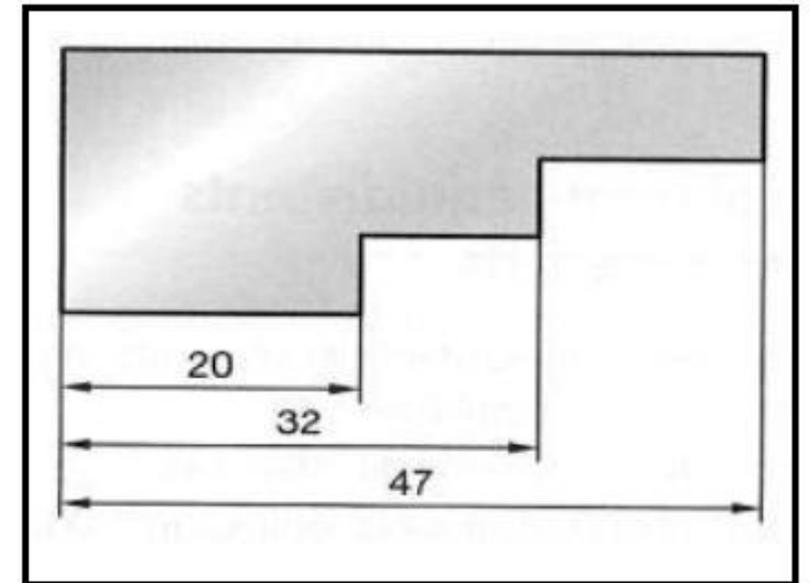
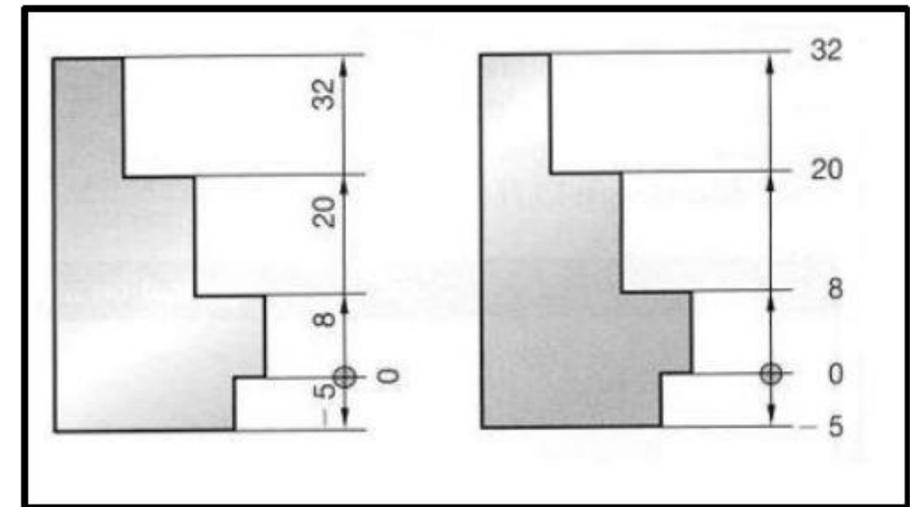


Fig 12. Parallel Dimensioning

- **Stacked Dimensioning**

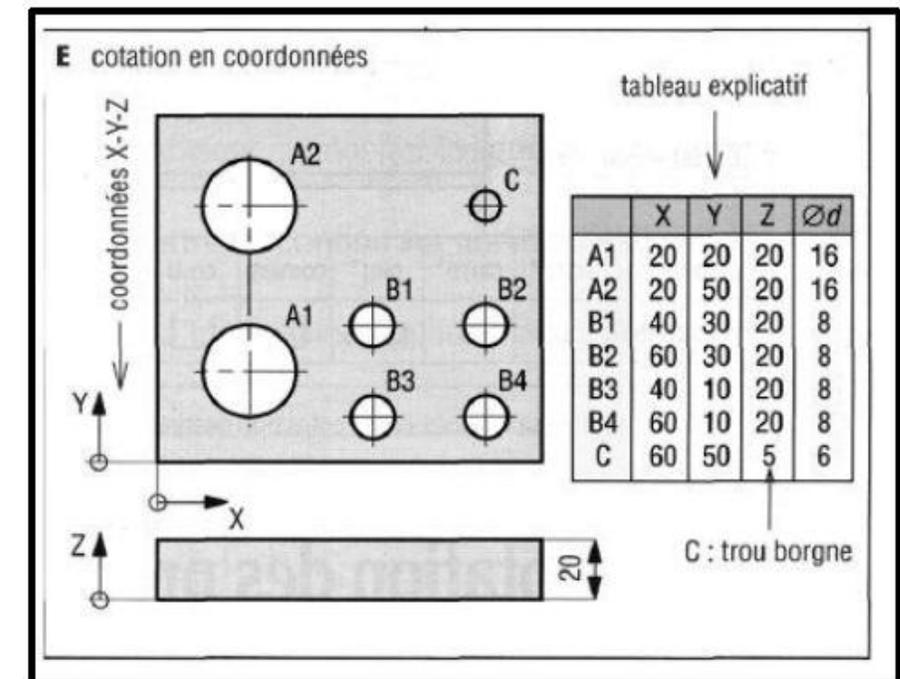
This method is used to save space when the number of parallel dimensions is large. All dimensions are placed on the same line and originate from the same reference point.



**Fig 13.** Stacked Dimensioning

- **Cartesian Coordinate Dimensioning**

This method is mainly used for manufacturing drawings. The zero reference point can be located at the intersection of two dimensions of the part or on any other element, for example, the axis of a bore. The dimensions are grouped in a table outside the drawing, making the drawing less cluttered and more readable.



**Fig 14.** Cartesian Coordinate Dimensioning

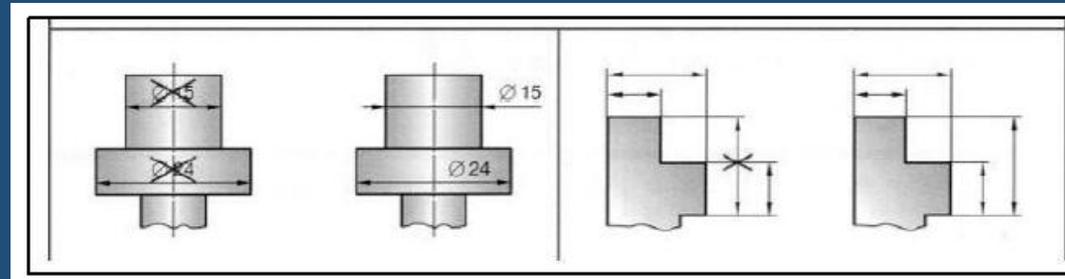
## Common Rules and Suggestions for Effective Dimensioning

A good overall organization and adherence to standardized rules facilitate reading, understanding, and prevent misinterpretation by different stakeholders.

All dimensions, measurements, and tolerances must be written using the same unit. In mechanical engineering, the standardized units are **millimeters (mm)** and **degrees (°)**.

The same dimension should appear only **once** in the entire drawing; avoid repeating the same dimension in different views.

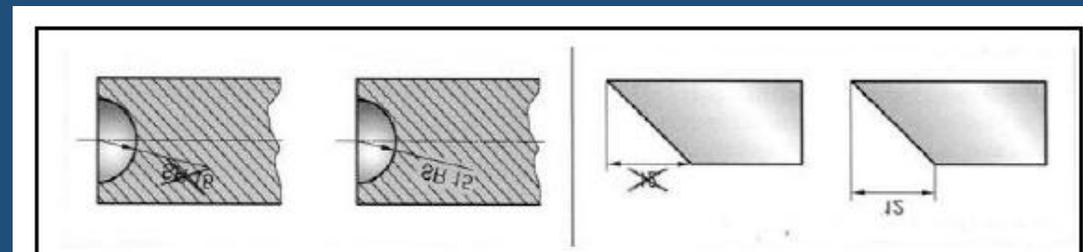
A **dimension line** must not be intersected by another line (extension lines may intersect each other).



**Fig 15.** Dimensioning Errors  
(Dimension Line 1)

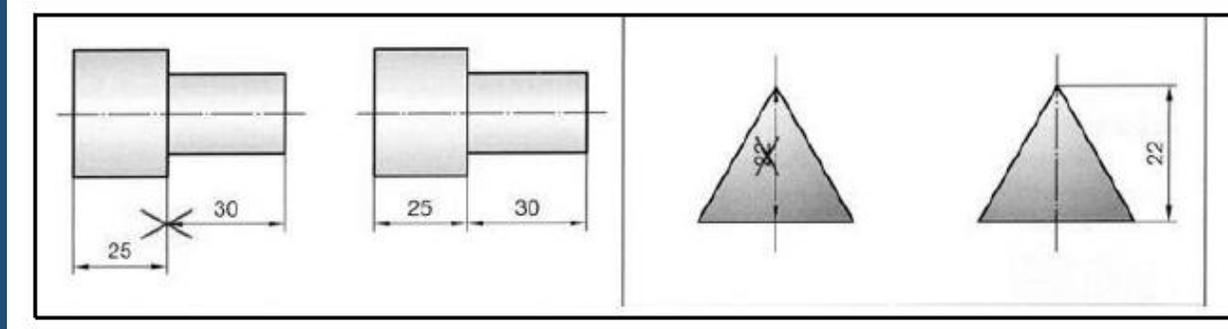
Interrupt hatching to maintain the readability of the dimension value.

A dimension line must never be aligned with another dimension line or a drawing line.



**Fig 16.** Dimensioning Errors  
(Hatching)

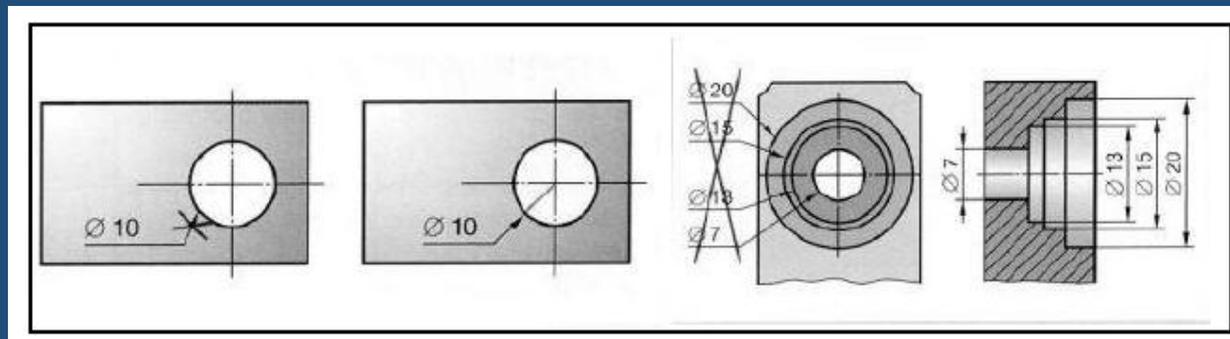
**Whenever possible, align dimension lines.  
An axis must never be used as a dimension line.**



**Fig 17. Dimensioning Errors (Dimension Line 2)**

The extension of the dimension line for diameter 10 must pass through the center of the circle.

Preferably dimension cylinders in the view where their projection is rectangular.



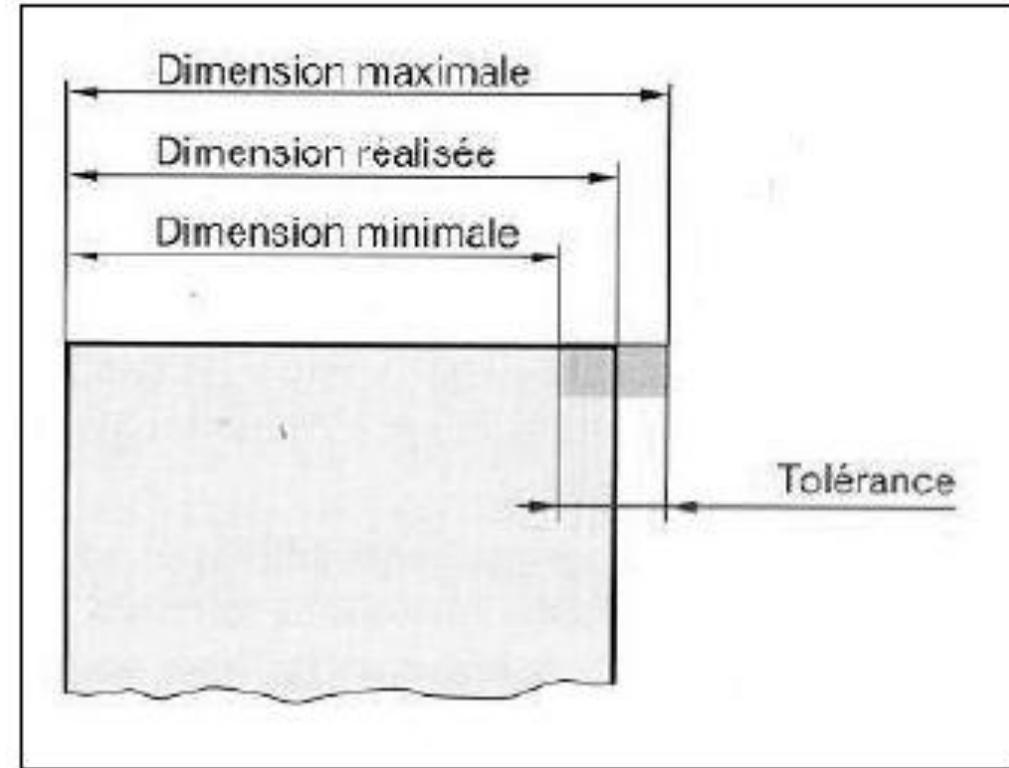
**Fig 18. Dimensioning Errors (Cylinder Dimensioning)**

# Dimensioning, Tolerance, and Fit

## Definition of a Tolerance

Considering the chosen manufacturing process and the machines used, the actual measurement of a dimension of an object cannot be exactly the same as the one indicated on the design drawing. It is impossible to produce a series of identical objects that always have the same dimensions. For this reason, it is necessary to allow the actual dimension to fall **between two limit values: a maximum dimension and a minimum dimension**. The difference between these two values is called the **tolerance, or tolerance range**.

The higher the required precision, the smaller the tolerance range must be.



**Fig 19.** Tolerance

## Dimensioning and Tolerance

**Nominal Dimension (Cote Nominale):** The reference dimension used for identification and indicated on the drawings.

**Tolerance (Tolerance Range):** The allowed (permissible) variation of the actual dimension of the part.

**Upper Deviation (ES):** The difference between the maximum dimension and the nominal dimension.

$$ES = C_{\text{max}} - C_{\text{nom}} \quad ES = C_{\text{max}} - C_{\text{nom}}$$

**Lower Deviation (EI):** The difference between the minimum dimension and the nominal dimension.

$$EI = C_{\text{min}} - C_{\text{nom}} \quad EI = C_{\text{min}} - C_{\text{nom}}$$

**Bore (Alésage):** Conventionally used to refer to any internal feature of a part, even if it is not cylindrical.

**Shaft (Arbre):** Conventionally used to refer to any external feature of a part, even if it is not cylindrical.

### Standardized ISO/AFNOR Fits

Fits are categories of standardized dimensional tolerances used for the assembly of two cylindrical or prismatic parts. They include:

**Clearance Fits:** Example:  $\text{Ø}50 \text{ H}8/\text{f}7$

**Transition Fits (Clearance or Interference):** Example:  $\text{Ø}65 \text{ H}7/\text{k}6$

**Interference Fits:** Example:  $\text{Ø}80 \text{ H}7/\text{p}6$

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