Lecture-02

Lines in Engineering Drawing

(EE-215)

Types of Lines in Engineering Drawing

Type of line	Used for drawing	Pencil Grade	Sample Drawing
Continuous thick	Visible outlines	H	
Continuous thin	Dimension line,leader line,extension, construction lines and hatching lines	2H	
Continuous thin (drawn free hand)	Irregular boundary line,short break line	2H	
Continuous thin with zigzag	Long break line	2H	
Short dashes (Hidden line)	Invisible edges	H	
Long chain (thin)	Center lines	2H	
Long chain (thick at ends and thin else where)	Cutting plane	H&2H	

Meaning of Lines

Visible lines represent features that can be seen in the current view

Hidden lines represent features that can not be seen in the current view

Center line represents symmetry, path of motion, centers of circles, axis of axisymmetrical parts

Dimension and Extension lines indicate the sizes and location of features on a drawing

DIMENSIONING

Why do we need to dimension drawings?

Dimensions and notes define the size, location, finish and other requirements to fully define what you want manufactured.

ENGINEERING DESIGN

PROCESS	RESULT	TRANSFERRED INFORMATION
Design a part	Sketches of ideas	
Create drawings	Multiview Drawing	Shape
	Dimensioning	1. Size, Location 2. Non-graphic information
Manufacture		

Why is dimensioning important?

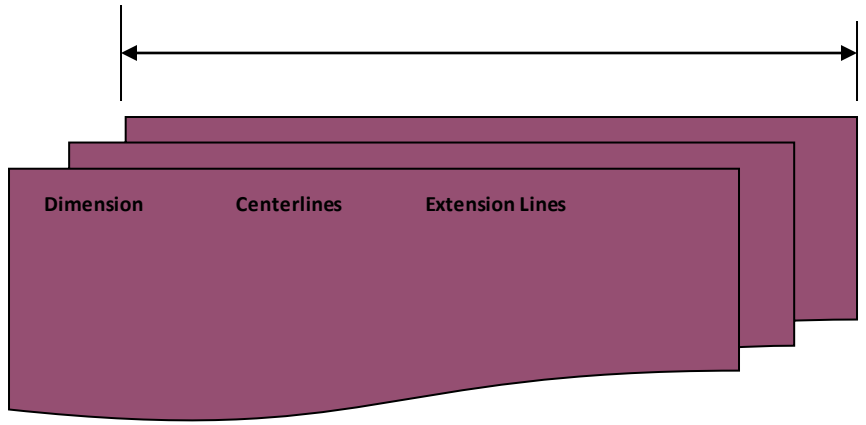
- Even if you make a drawing to scale, it would be difficult to determine the exact precision that is needed.
- It would be time consuming to measure each of the lines to determine measurement.
- The basis for modern part dimensioning is the need for interchangeable parts (being able to buy something off the shelf that fits what you already have)

Location Dimensions

- When locating an item within the drawing (locating a hole or other object) always give the horizontal and vertical position as it relates to the object.
- Then give the size of the object
- Eg. Where is the object located and how big is it?

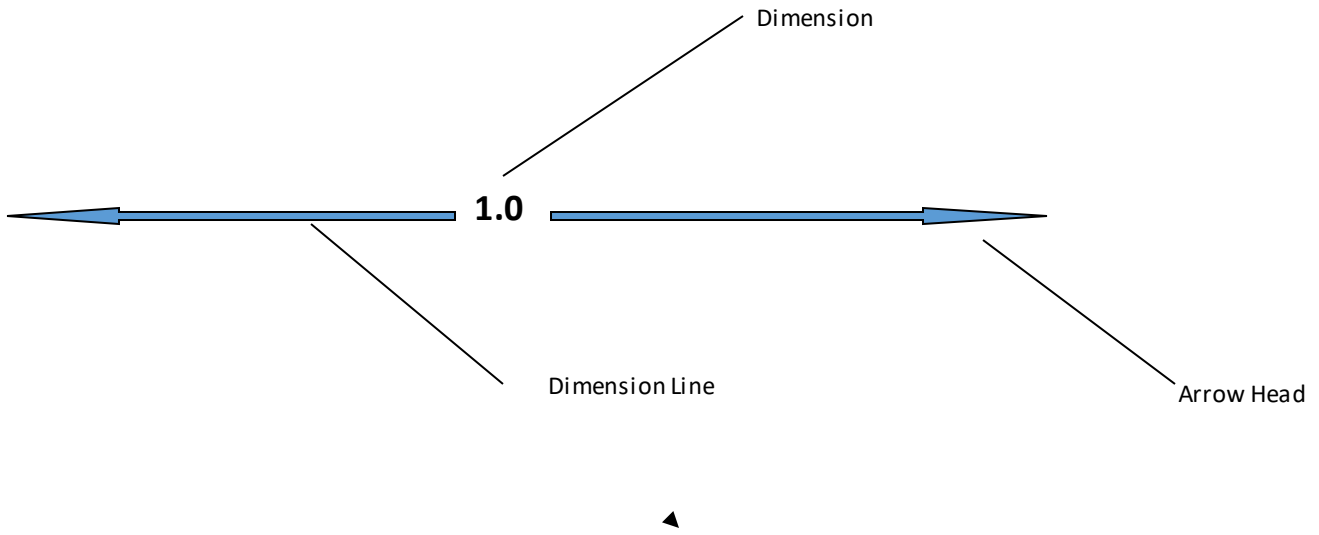
Most dimensions consist of three types of lines

- Dimension lines
- Extension lines
- Centerlines



Dimension Lines

- A Dimension Line is a thin, dark, solid line that is terminated by an arrowhead.



Extension Lines

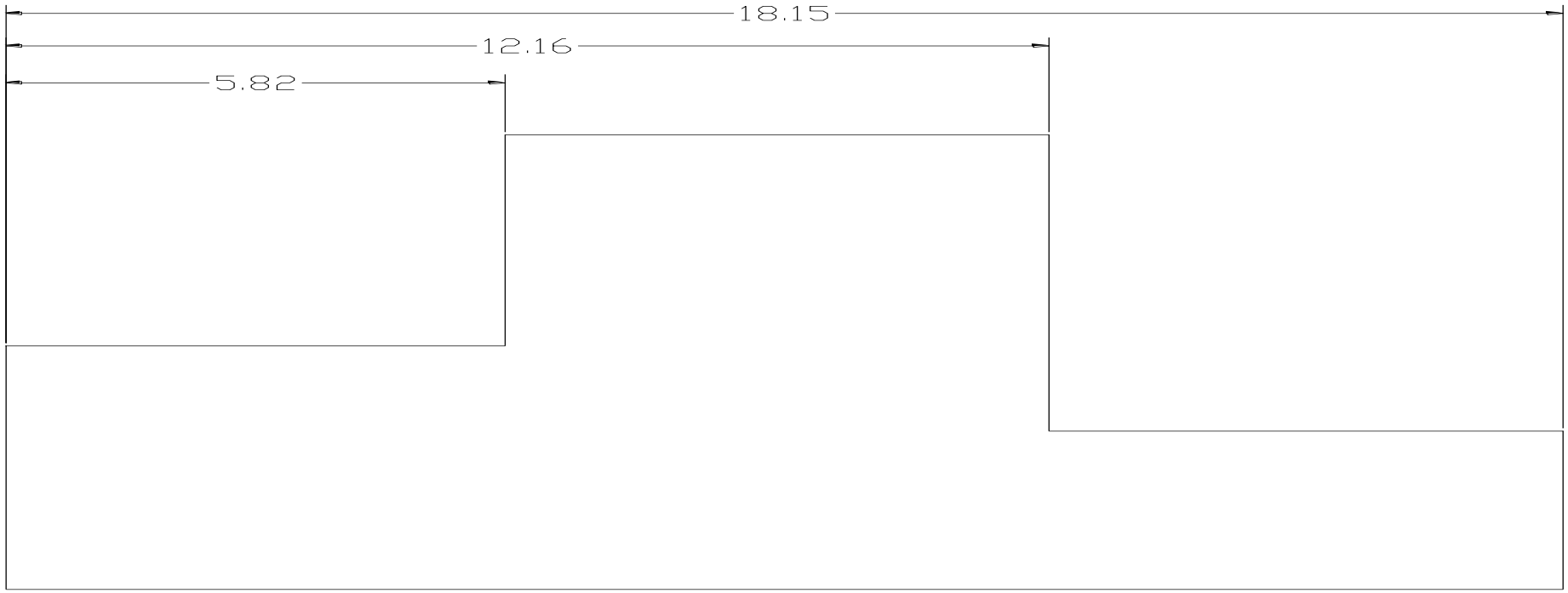
- An Extension Line is a thin, dark, solid line that extends from a point on the drawing to which a dimension refers.

Centerlines

- A Centerline is a thin, dark line alternating long and short dashes that is commonly used as an extension line in location holes or other symmetrical objects.

Dimension Stacking

- When stacking dimensions, the shortest dimension goes closest to the object, while the longest (or overall) appears furthest.
- Dimension Lines typically should not cross extension lines or other dimension line

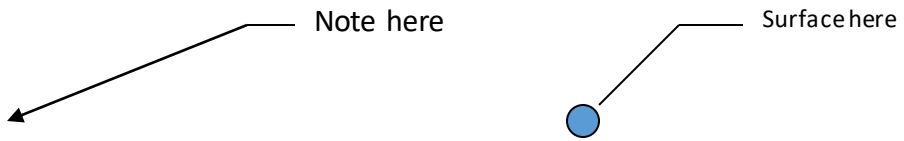


Arrow Heads

- When drawing Arrowheads they should be long and lean at a ratio of 3:1 (length:height)
- In Architecture this is different!

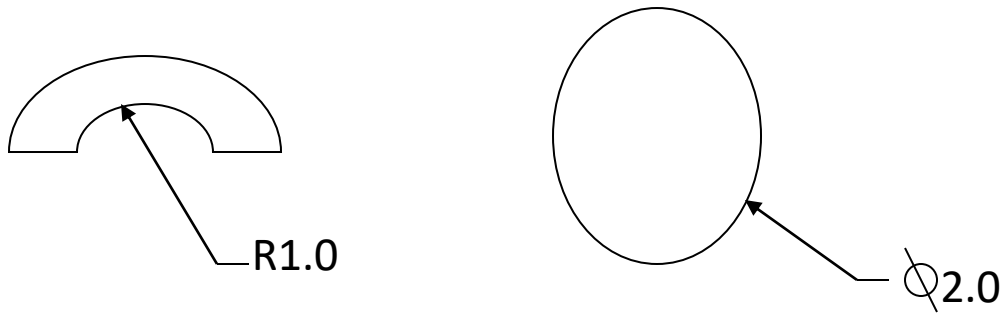
Leaders

- A Leader is a thin solid line that directs the viewer's attention to a note or dimension.
- A Leader with an **arrow** identifies a **location**.
- A Leader with an **dot** identifies a **surface**.
- Try not to draw leaders so that they are horizontal or vertical (and/or to long)
- A Leader to a circle should be drawn so that it would pass through the center of the circle if extended.



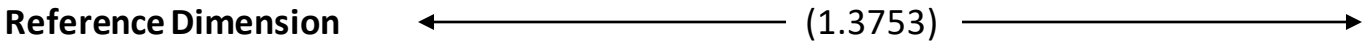
Dimensioning Arcs Vs. Circles

- When dimensioning an arc use the radius symbol (R)
- When dimensioning a circle use the diameter symbol (⌀)



Over Dimensioning

- When dimensioning, it is good technique to avoid listing the dimension more than once through out the drawing.
- If you need to list a dimension more than once, for accuracy or ease of viewing, you must encase the dimension within a set of brackets.



Rules and Practices

- Accurate dimensioning is one of the most demanding undertakings when designing parts.

- *Use the checklist to insure you have followed the basic dimensioning rules.*

- *Keep in mind there may be a case where the need to break a standard could occur to give clarity to the part and manufacturer.*

Standards

- In order for the drawings to be dimensioned so that all people can understand them, we need to follow standards that every company in the world must follow. Standards are created by these organizations:
  - -ANSI
  - -ISO
  - -DIN
  - -JIS
  - -MIL
  - -DOD
  - -CEN

Standards Institutions

- ANSI - American National Standards Institute - This institute creates the engineering standards for North America.

- ISO - International Organization for Standardization - This is a world wide organization that creates engineering standards with approximately 100 participating countries.

Standards Institutions

- DIN - Deutsches Institut für Normung - The German Standards Institute created many standards used world wide such as the standards for camera film.

- JIS - Japanese Industrial Standard - Created after WWII for Japanese standards.

- CEN - European Standards Organization

Standards Institutions

- The United States military has two organizations that develop standards.
  - DOD - Department Of Defense
  - MIL - Military Standard

Dimensioning Methods

- Dimensions are represented on a drawing using one of two systems, unidirectional or aligned.
- The *unidirectional* method means all dimensions are read in the same direction.
- The *aligned* method means the dimensions are read in alignment with the dimension lines or side of the part, some read horizontally and others read vertically.

Types of Dimensions

- There are two classifications of dimensions: size and location.

- *Size* dimensions are placed in direct relationship to a feature to identify the specific size.
- *Location* dimensions are used to identify the relationship of a feature to another feature within an object.

Dimensioning Checklist

- Each dimension should be written clearly with only one way to be interpreted.
- A feature should be dimensioned only once.
- Dimension and extension lines should not cross.
- Each feature should be dimensioned.
- Dimension features or surfaces should be done to a logical reference point.

Dimension Checklist

- Dimension circles should have diameters and arcs with a radius.
- A center line should be extended and used as an extension line.
- Dimension features on a view should clearly show its true shape.
- Enough space should be provided to avoid crowding and misinterpretation.

Dimension Checklist

- Extension lines and object lines should not overlap.
- Dimensions should be placed outside the part.
- Center lines or marks should be used on all circles and holes.

Dimensioning Components

DIMENSIONING COMPONENTS

- Extension lines
- Dimension lines

  (with arrowheads)
- Leader lines

→ Drawn with **2H** pencil

- Dimension figures
- dimension lines

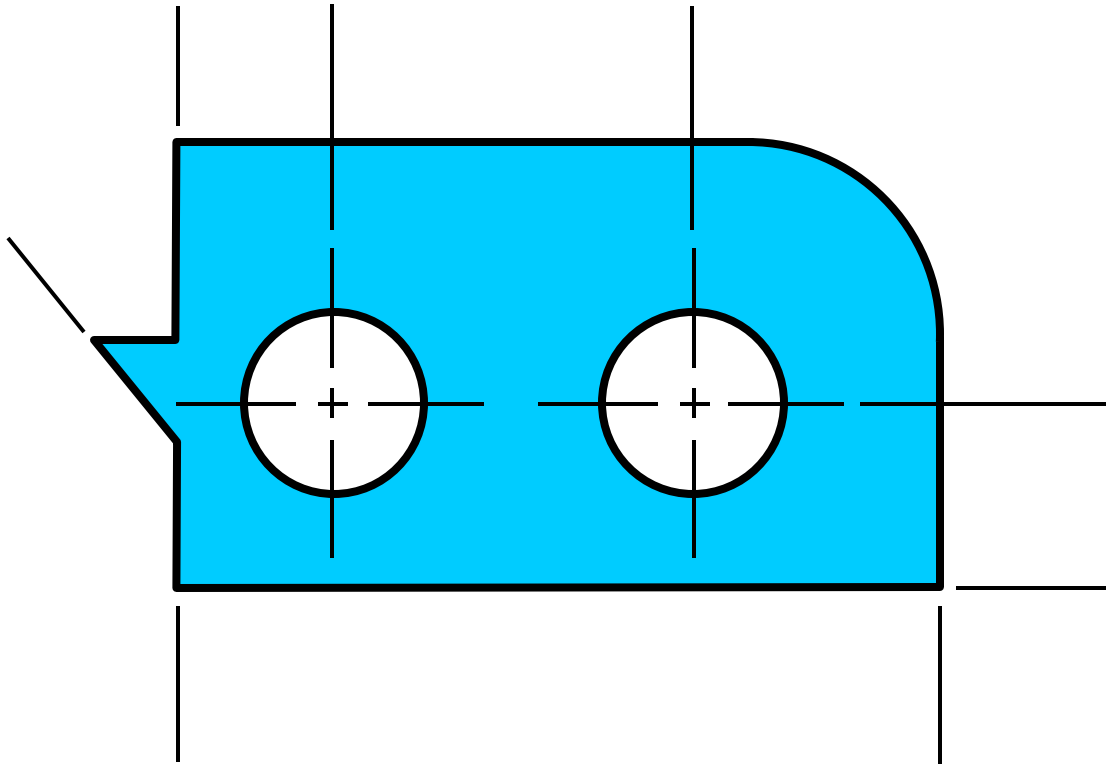
Notes :

- *local note*
- *general note*

→ Lettered with **H** pencil.

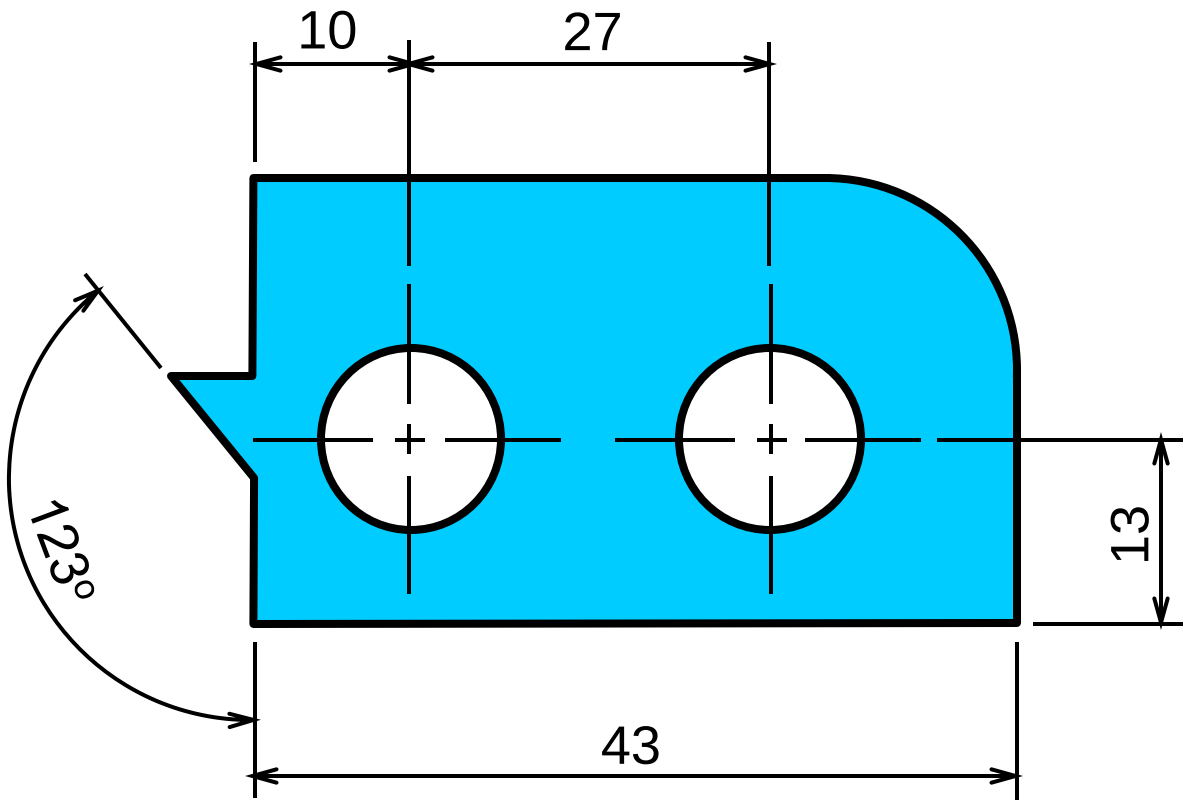
EXTENSION LINES

indicate the location on the object's features that are dimensioned.



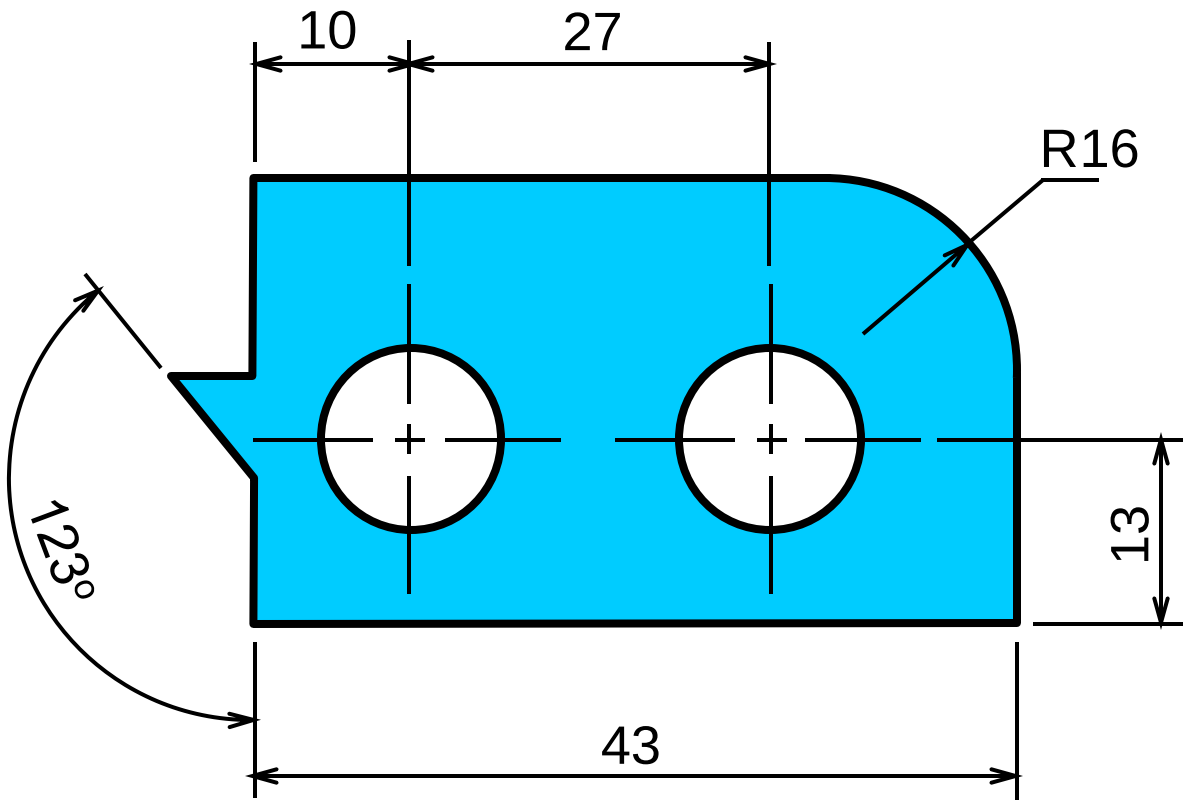
DIMENSION LINES

indicate the direction and extent of a dimension, and inscribe ***dimension figures***.



LEADER LINES

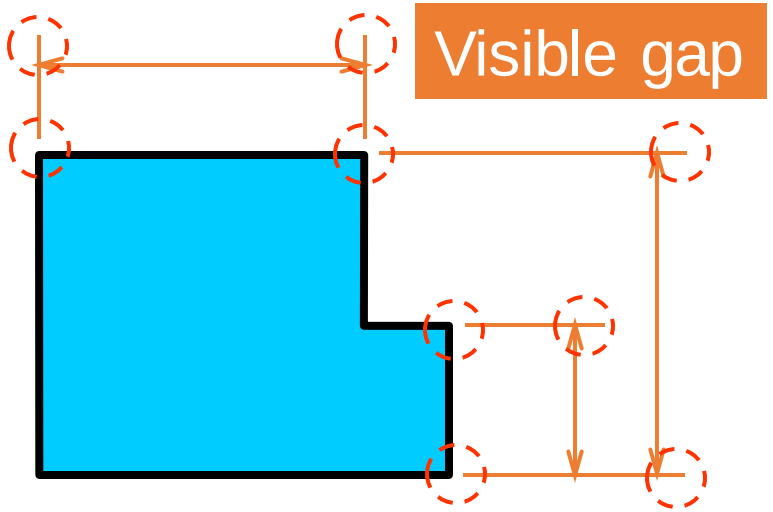
indicate details of the feature with a ***local*** note.

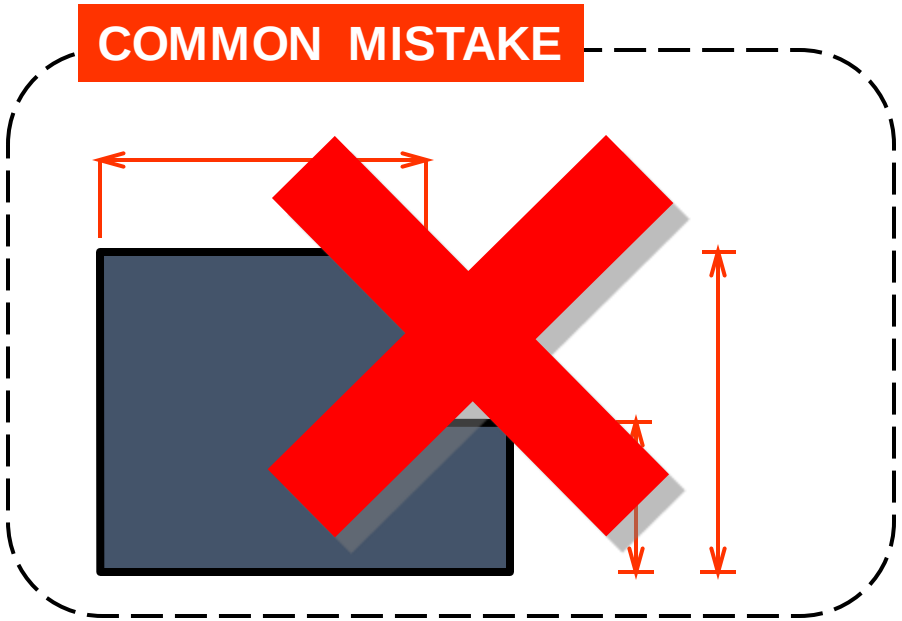


Recommended Practices

EXTENSION LINES

- Leave a **visible gap** (≈ 1 mm) from a view and start drawing an extension line.
- Extend the lines beyond the (last) dimension line 1-2 mm.

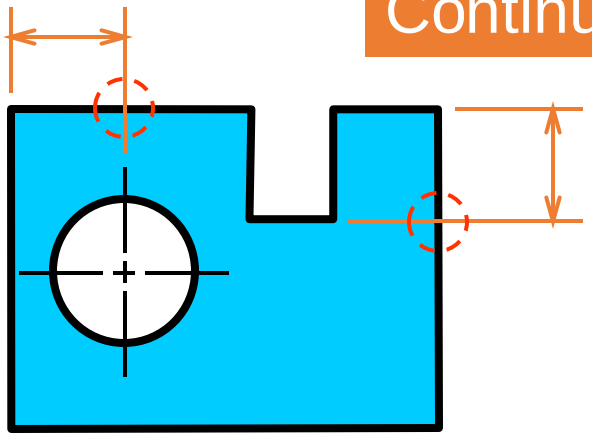




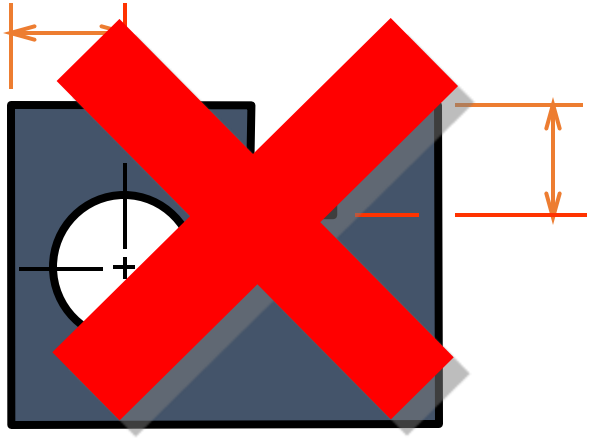
EXTENSION LINES

- **Do not** break the lines as they cross object lines.

Continuous

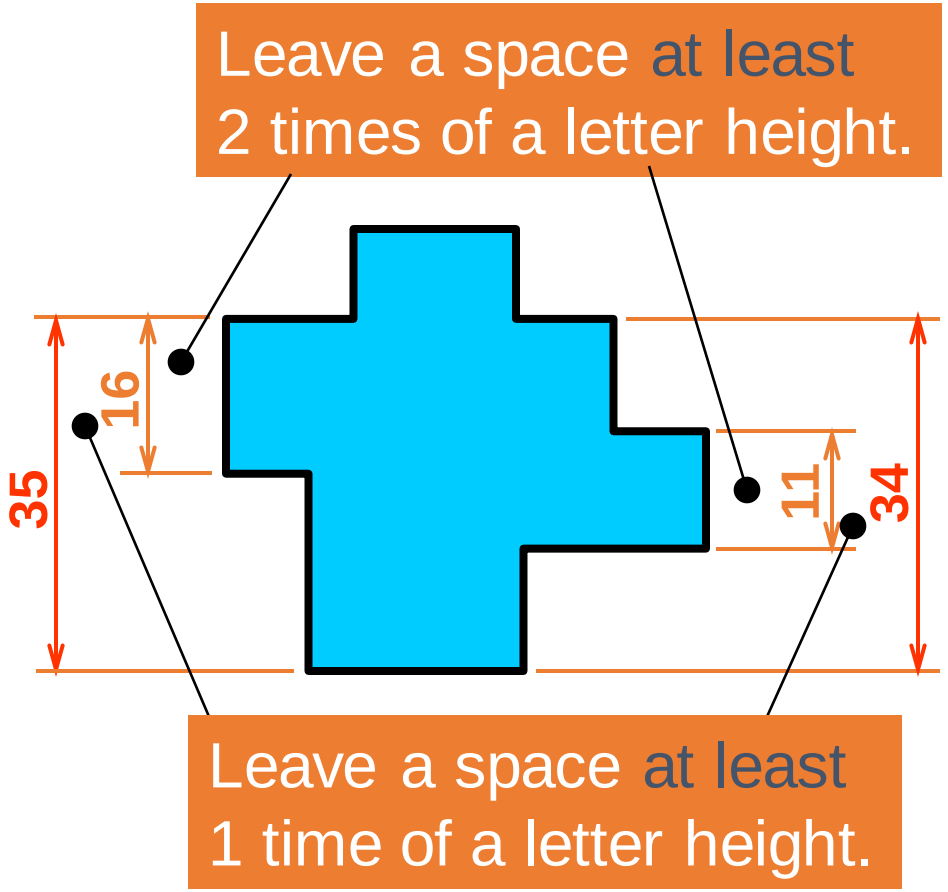


COMMON MISTAKE



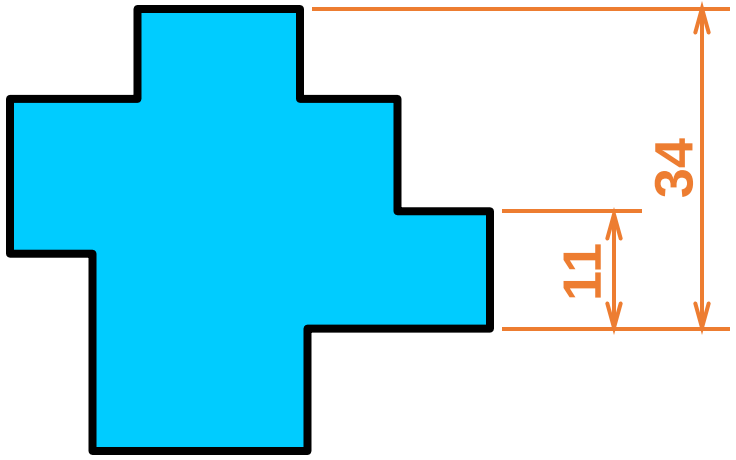
DIMENSION LINES

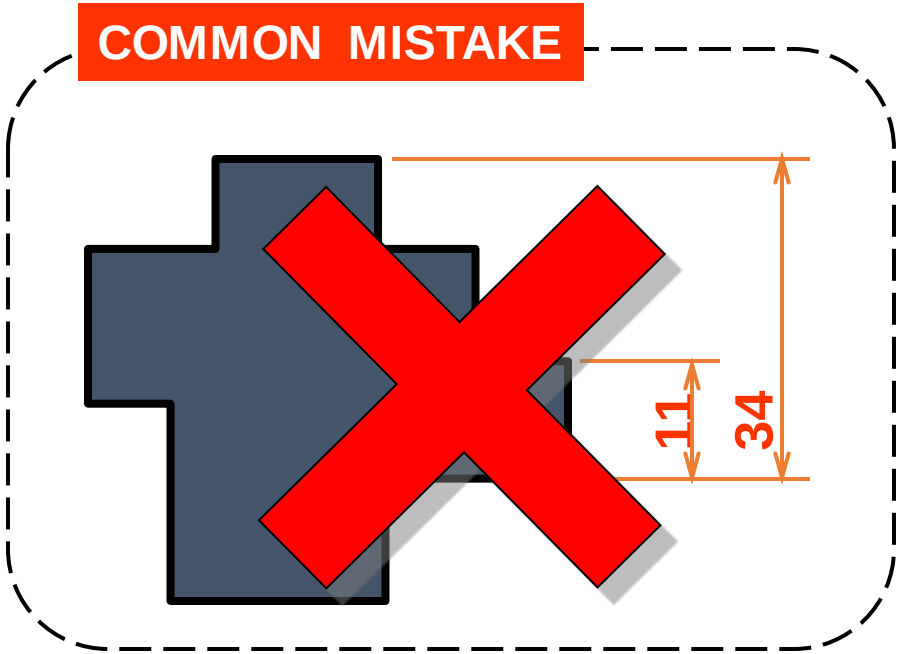
- Dimension lines should **not** be spaced too close to each other and to the view.



DIMENSION FIGURES

- The height of figures is suggested to be 2.5~3 mm.
- Place the numbers at about 1 mm *above dimension line* and *between extension lines*.

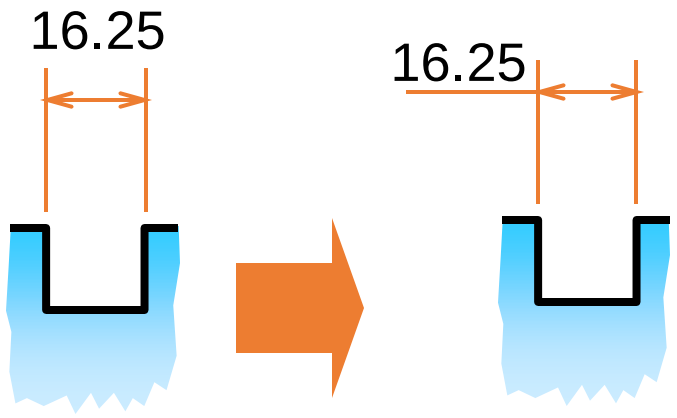




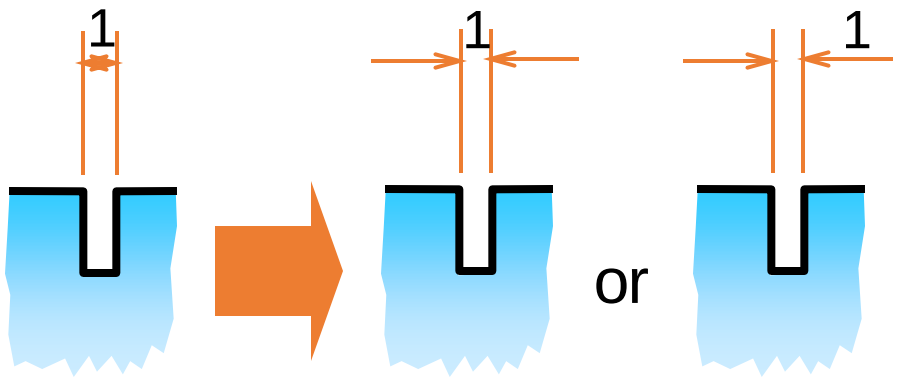
DIMENSION FIGURES

When there is **not** enough space for figure or arrows, put it **outside** either of the extension lines.

Not enough space for ***figures***



Not enough space for ***arrows***



DIMENSION FIGURES : UNITS

The JIS and ISO standards adopt the unit of

- **Length** dimension in **millimeters without** specifying a unit symbol “mm”.

- **Angular** dimension in **degree** with a symbol “o” place behind the figures (and if necessary **minutes** and **seconds** may be used together).

DIMENSION FIGURES : ORIENTATION

1. Aligned method

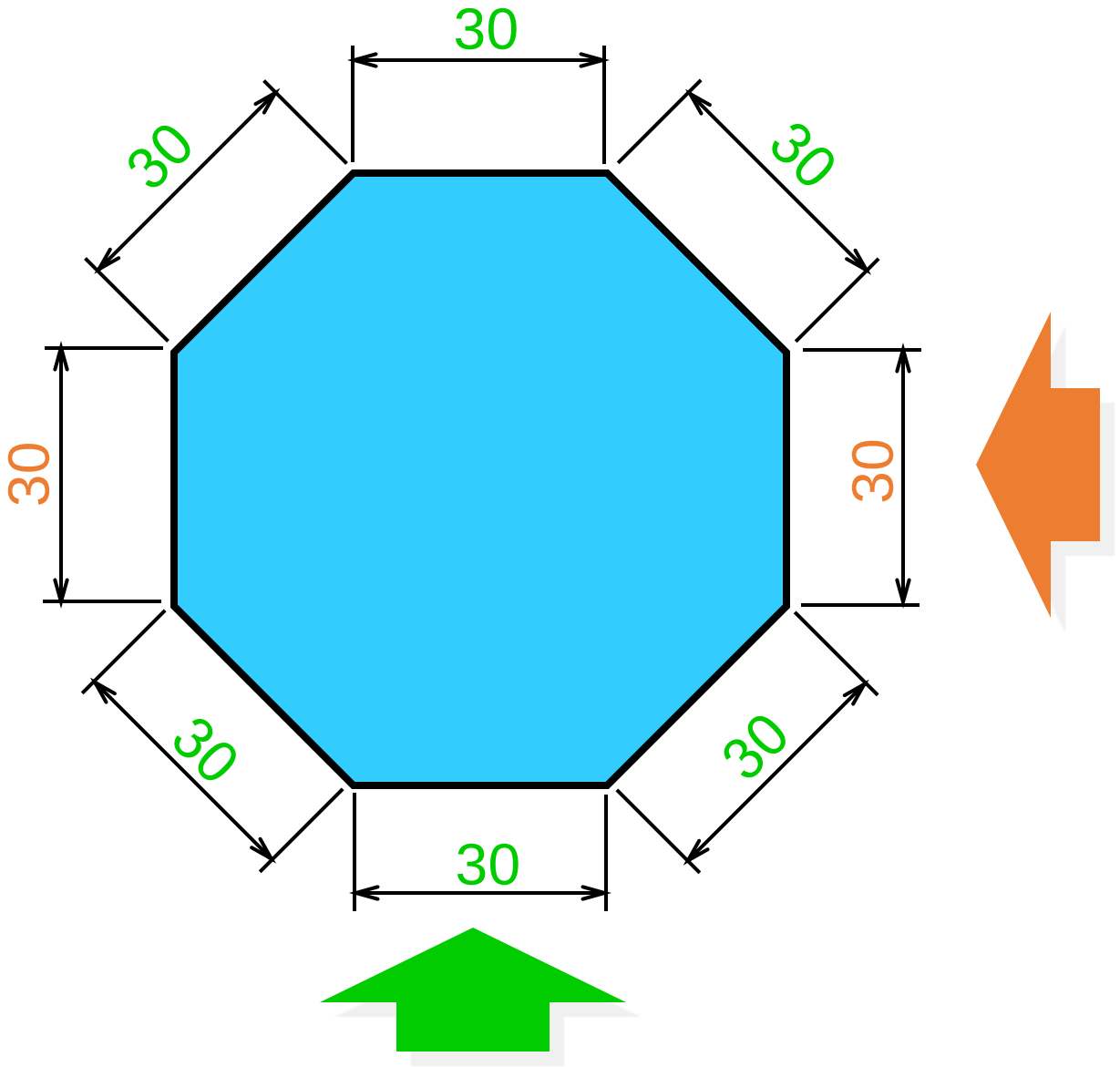
The dimension figures are placed so that they are readable from the **bottom** and **right side** of the drawing.

2. Unidirectional method

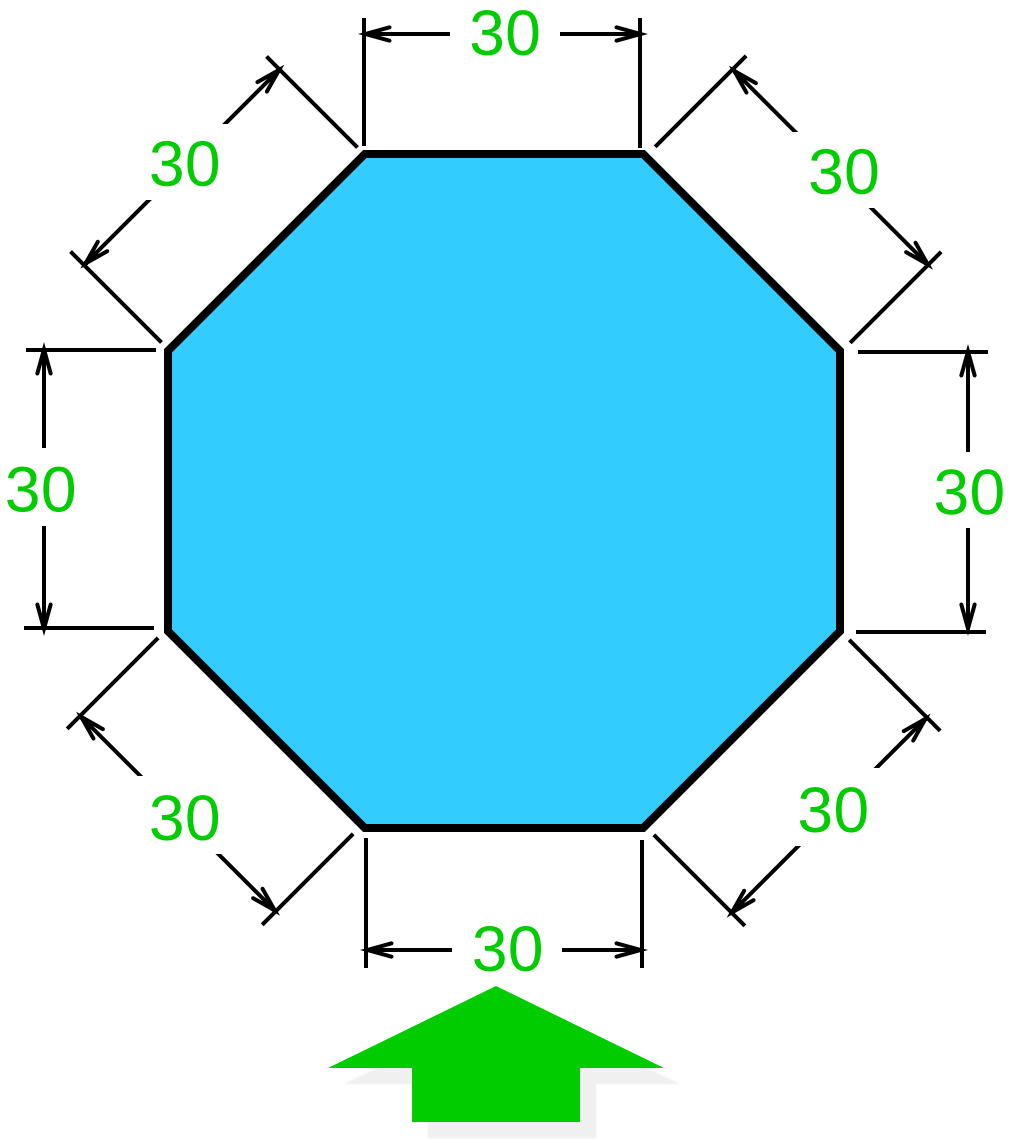
The dimension figures are placed so that they can be read from the **bottom** of the drawing.

Do not use both system on the same drawing or on the same series of drawing (JIS Z8317)

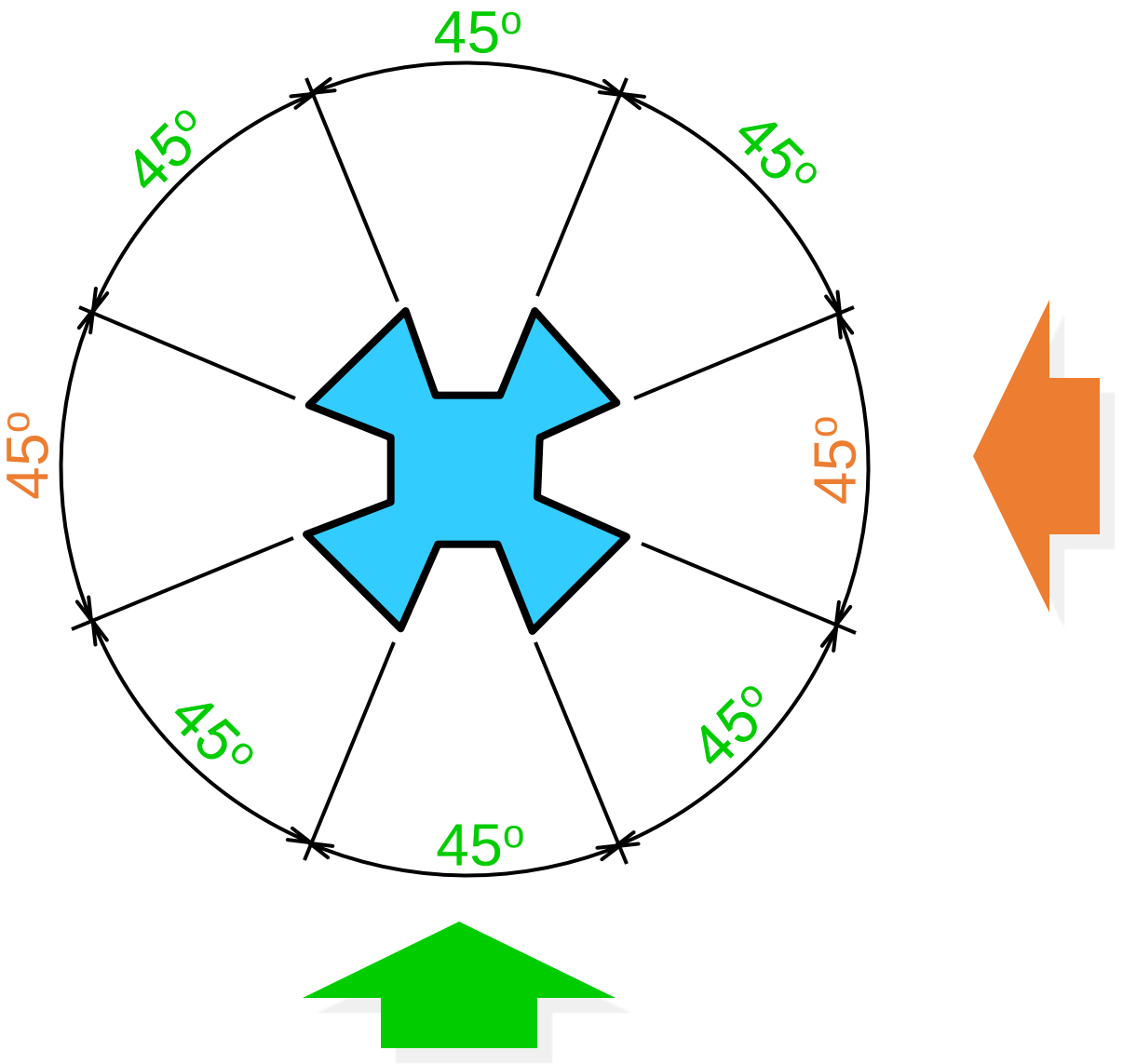
EXAMPLE : Dimension of ***length*** using ***aligned*** method.



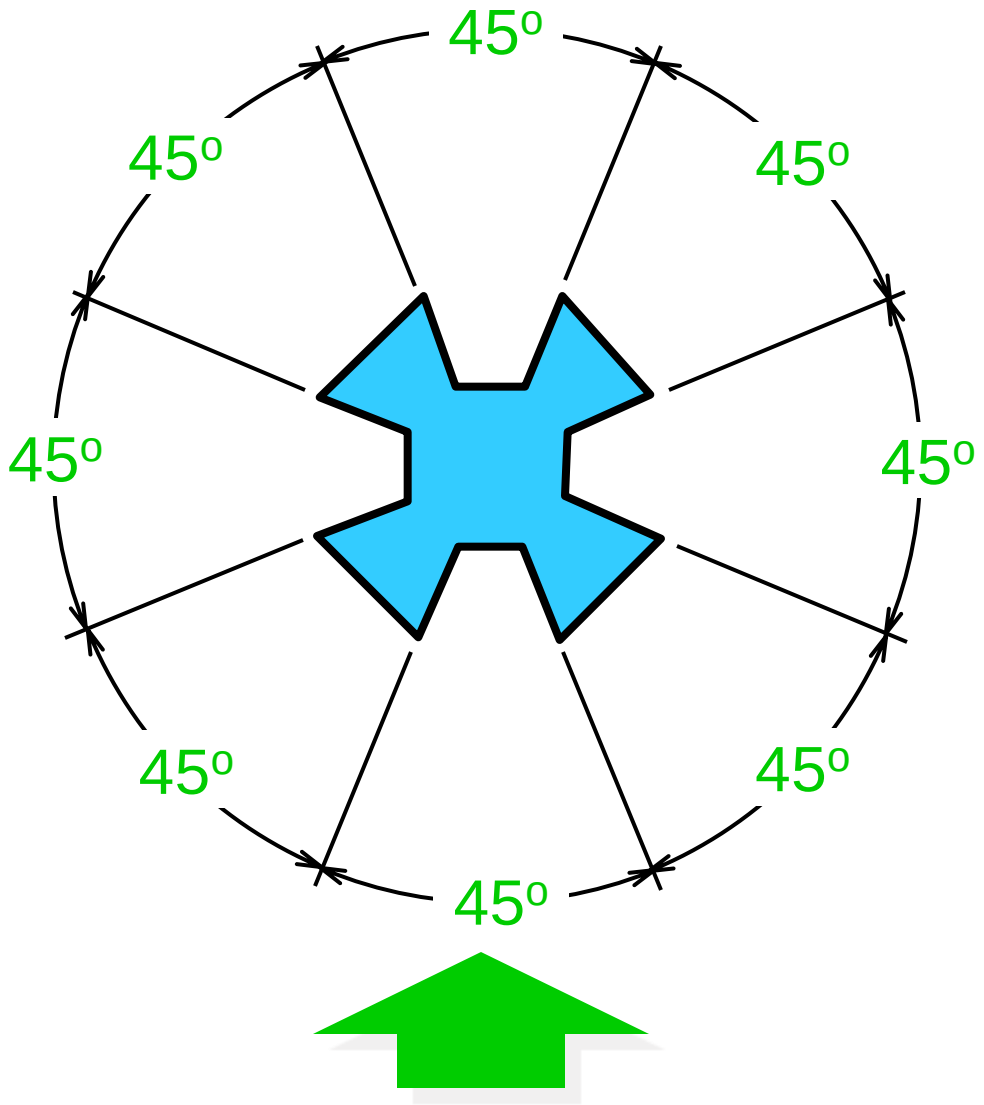
EXAMPLE : Dimension of ***length*** using ***unidirectional*** method.



EXAMPLE : Dimension of ***angle*** using ***aligned*** method.

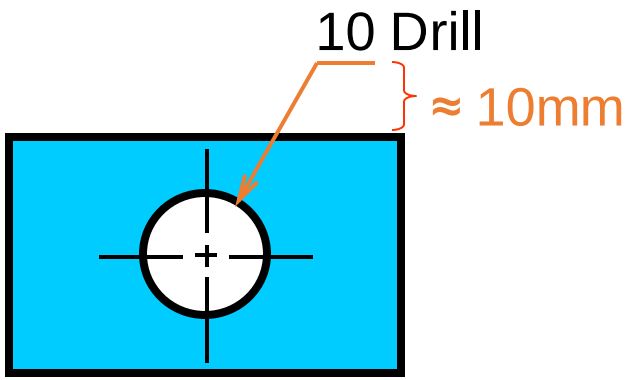


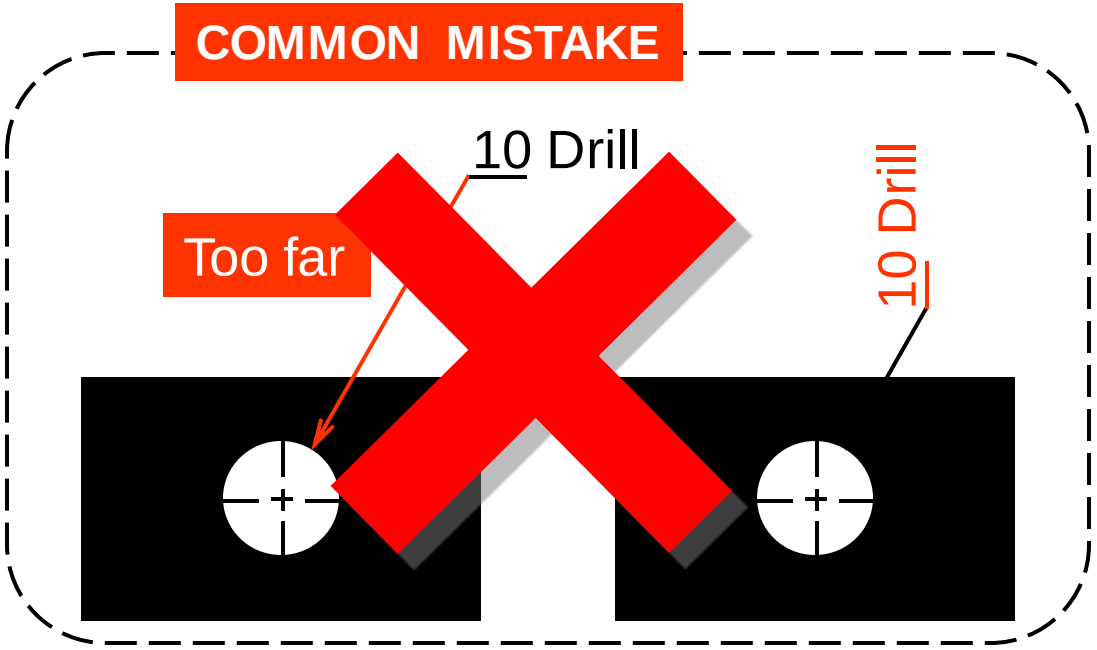
EXAMPLE : Dimension of ***angle*** using ***unidirectional*** method.



LOCAL NOTES

- Place the notes **near** to the feature which they apply, and should be placed outside the view.
- Always read **horizontally**.





Dimensioning Practices

THE BASIC CONCEPT

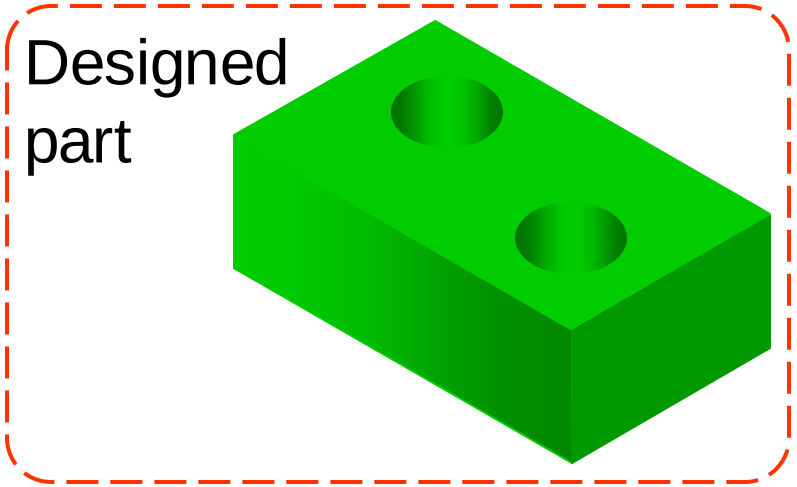
Dimensioning is accomplished by adding ***size*** and ***location*** information ***necessary to manufacture*** the object.

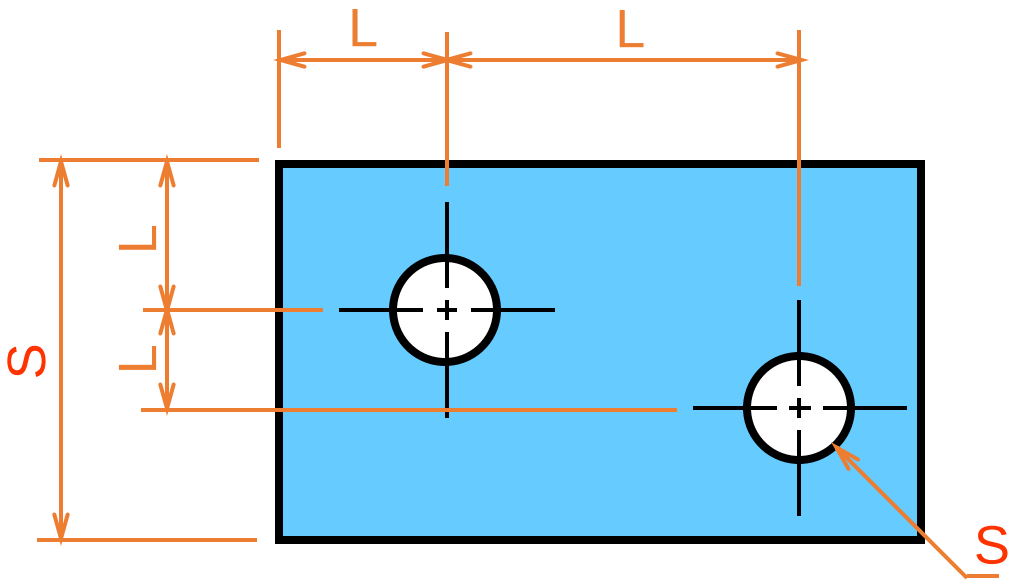
This information have to be

- Clear
- Complete
- Facilitate the
  - manufacturing method
  - measurement method

EXAMPLE

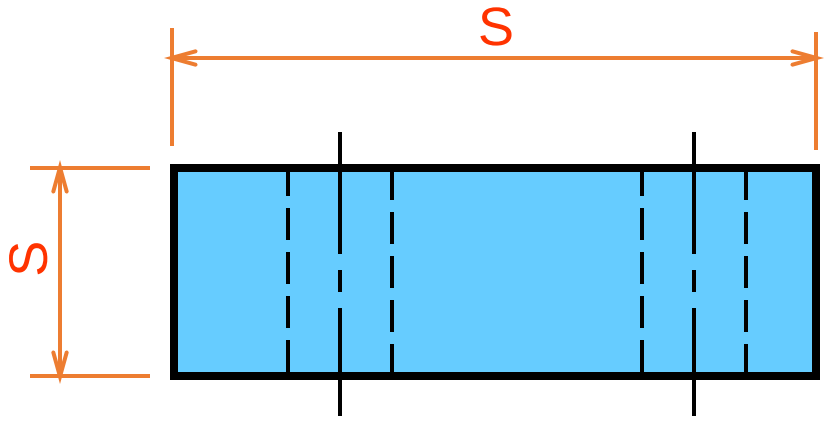
Designed part





To manufacture this part we need to know…

1. **Width**, **depth** and **thickness** of the part.
2. **Diameter** and **depth** of the hole.
3. **Location** of the holes.

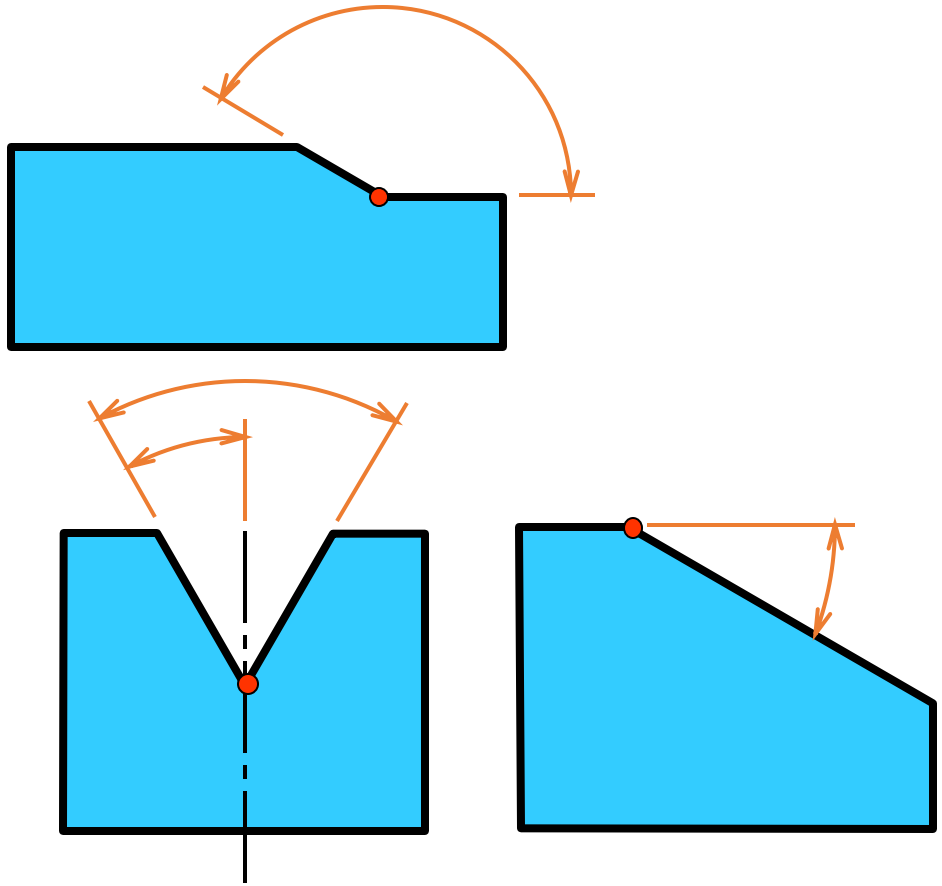


"S" denotes size dimension.

"L" denotes location dimension.

ANGLE

To dimension an angle use **circular dimension line** having the center at the vertex of the angle.



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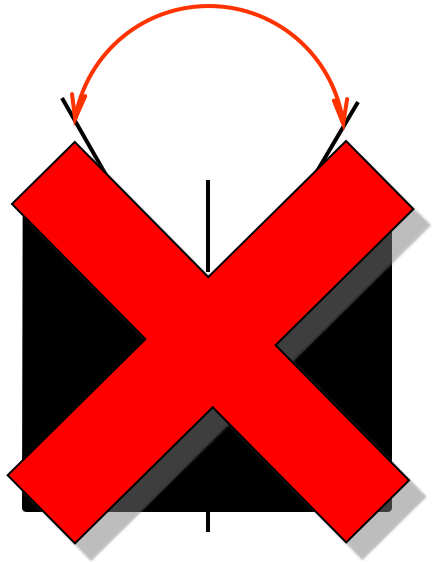
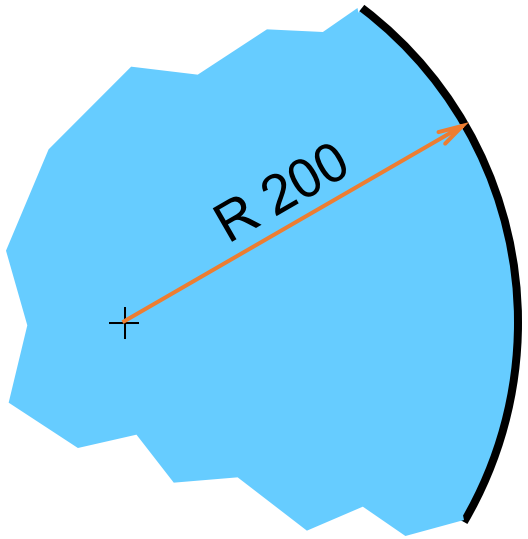


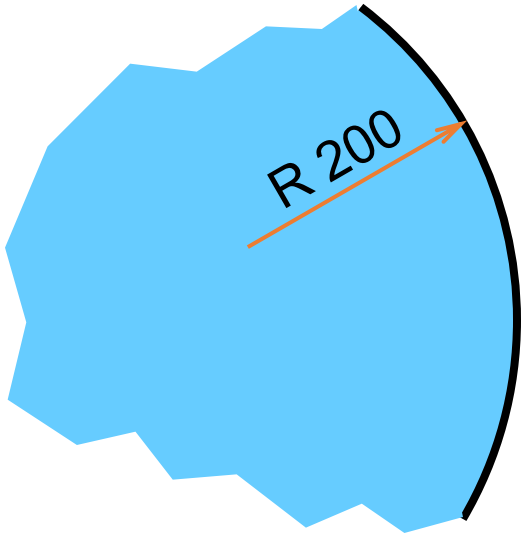
ARC

- Arcs are dimensioned by giving the **radius**, in the views in which their true shapes appear.

- The letter “R” is **always** lettered before the figures to emphasize that this dimension is radius of an arc.



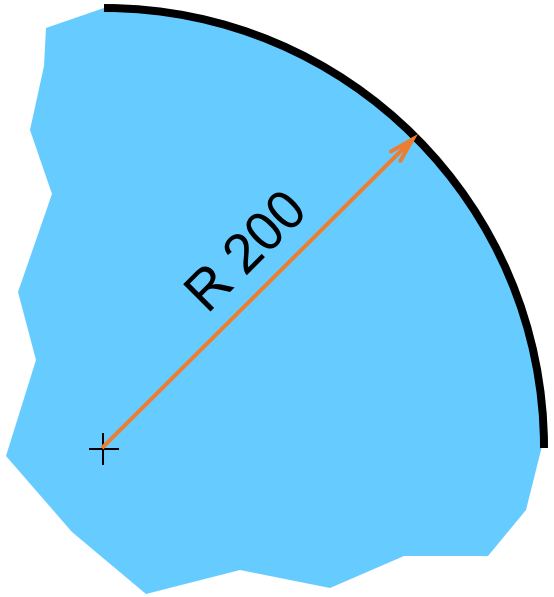
or



ARC

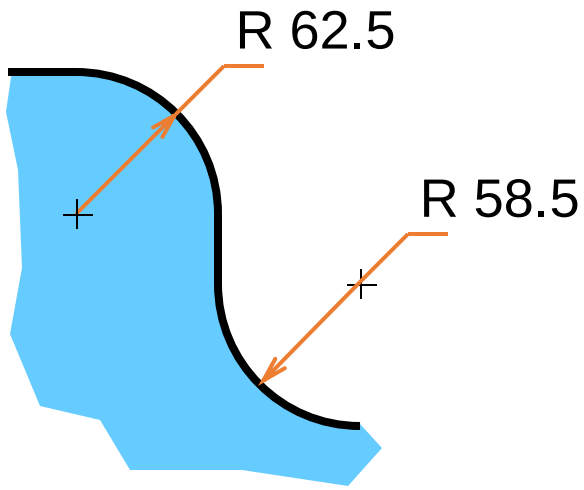
The dimension figure and the arrowhead **should be inside** the arc, where there is sufficient space.

Sufficient space for both.



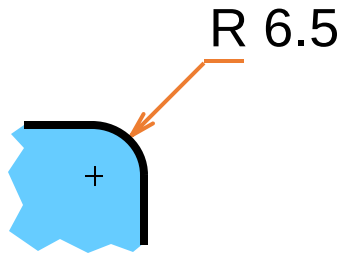
Sufficient space for arrowhead only.

Move figure outside



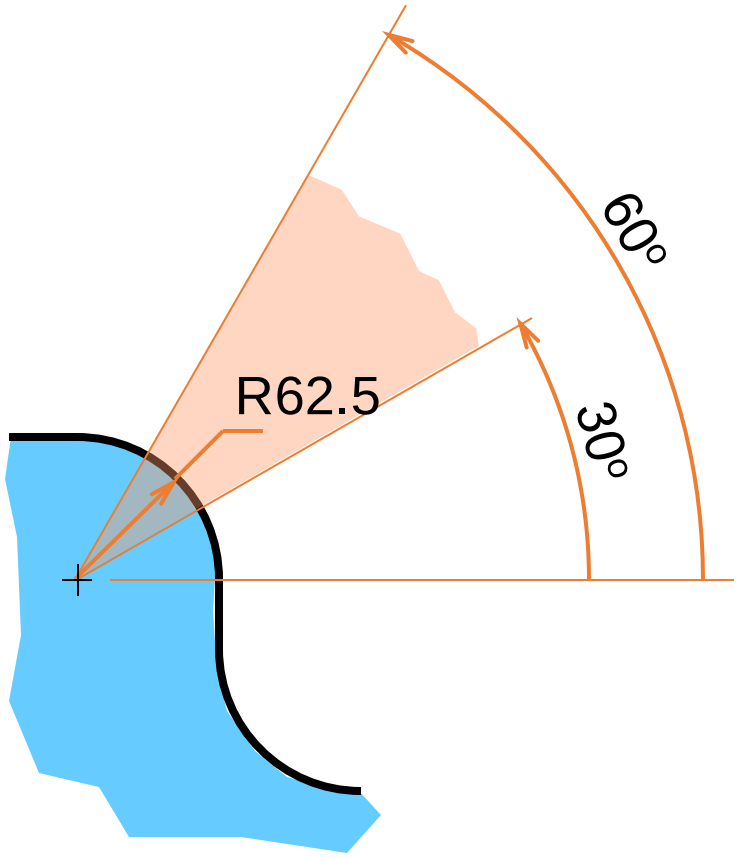
Insufficient space for both.

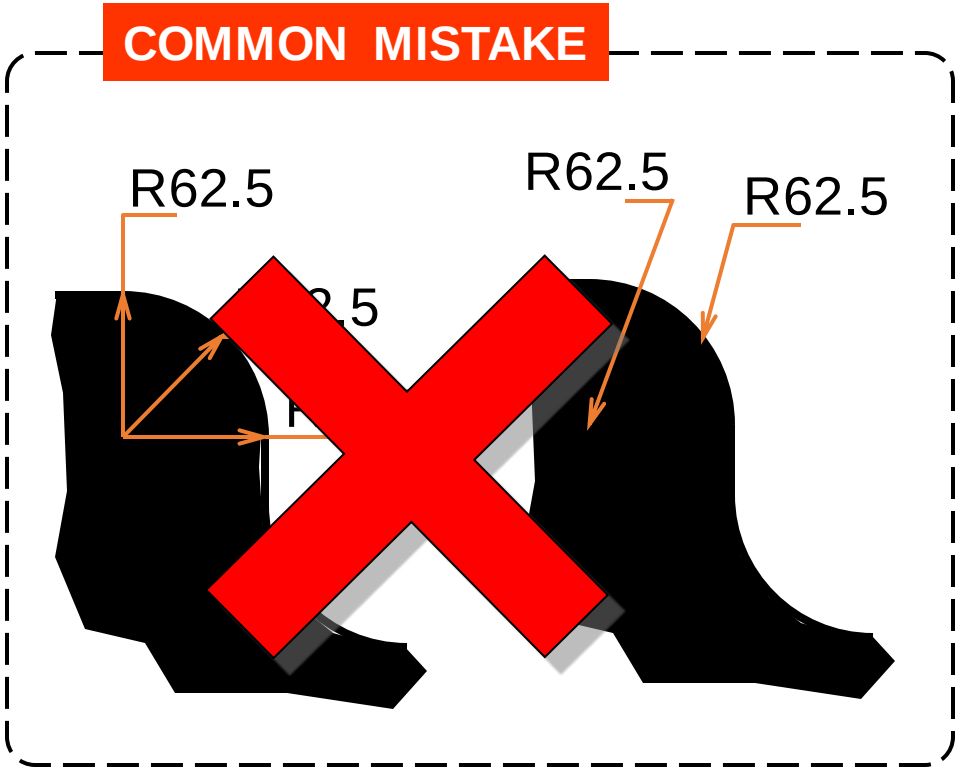
Move both figure and arrow outside



ARC

- Leader line **must** be **radial** and **inclined** with an angle between 30 ~ 60 degs to the horizontal.



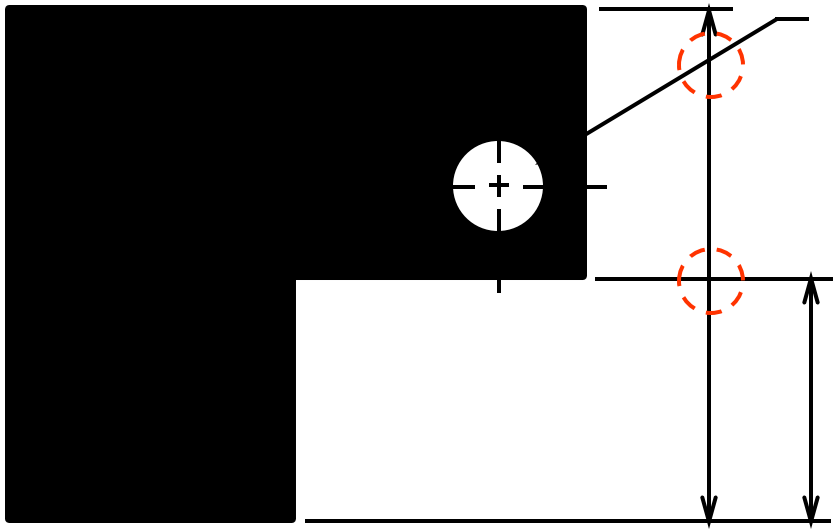


Placement of Dimensions

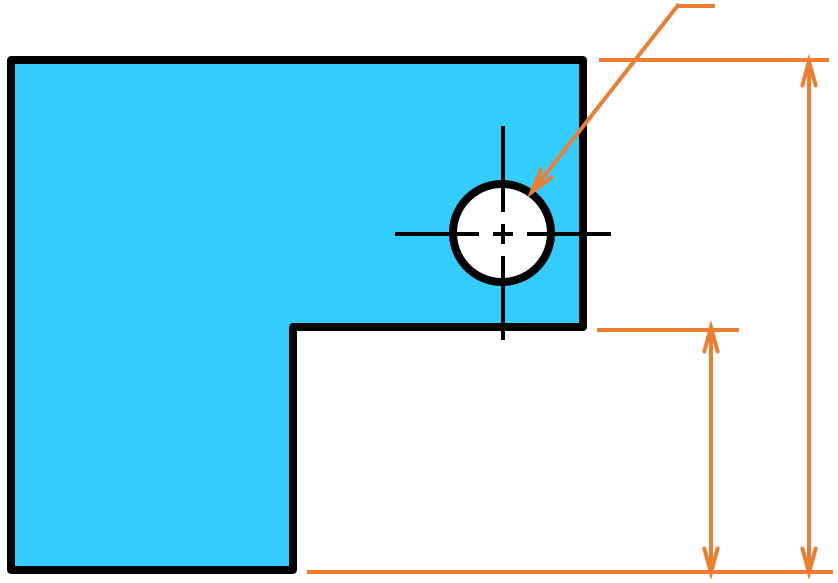
RECOMMENDED PRACTICE

1. Extension lines, leader lines **should not** cross dimension lines.

POOR



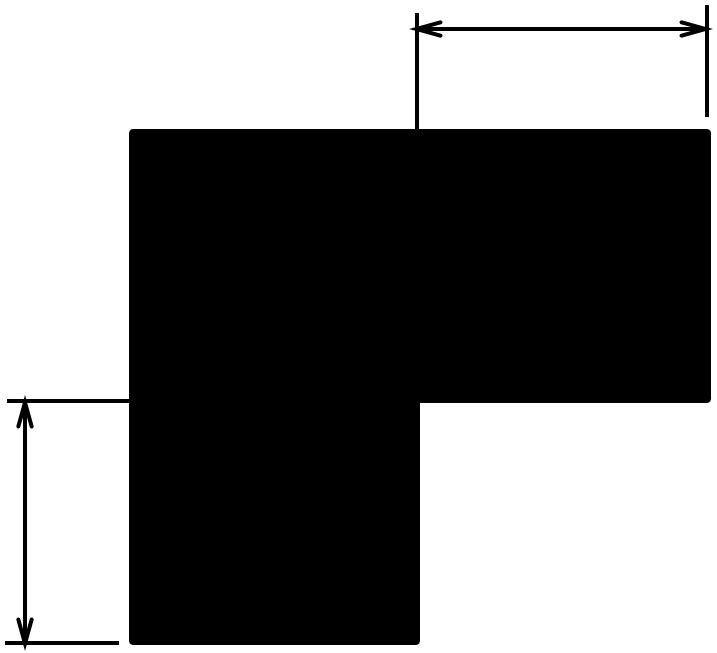
GOOD



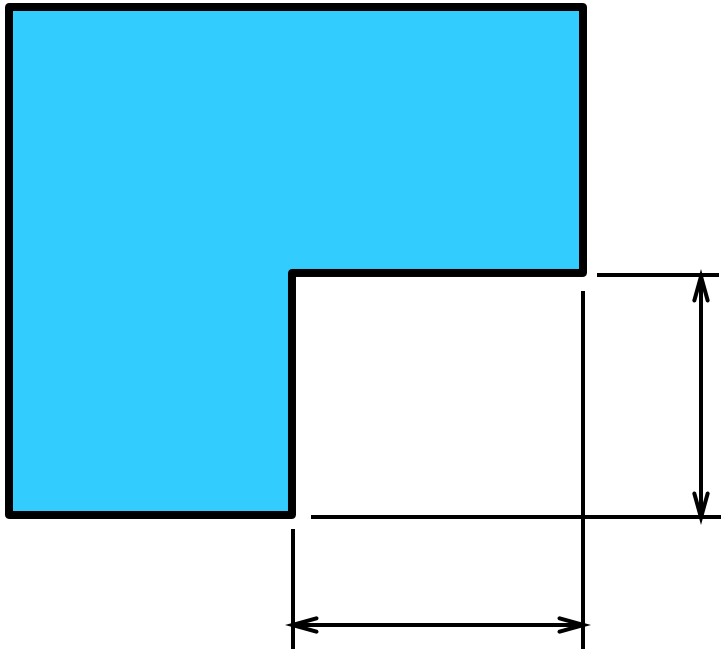
RECOMMENDED PRACTICE

2. Extension lines **should be** drawn from the nearest points to be dimensioned.

POOR



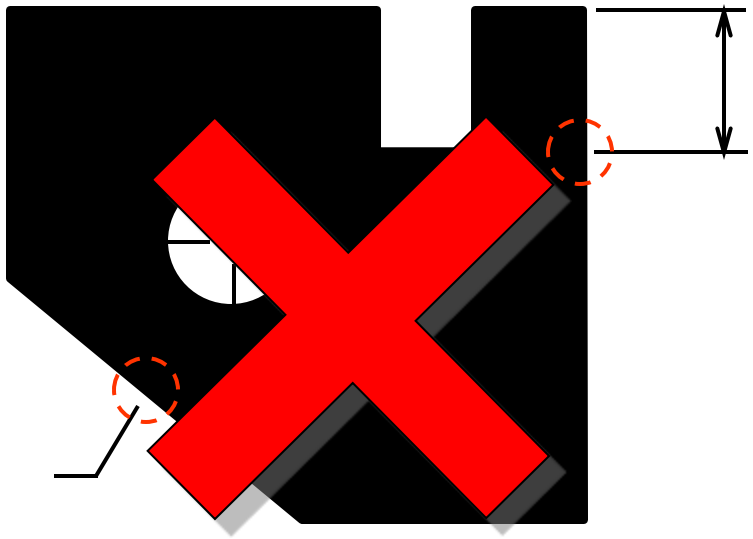
GOOD



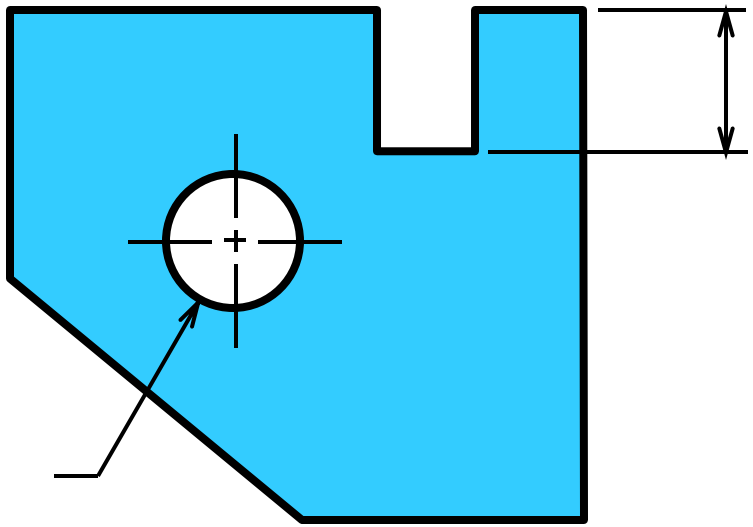
RECOMMENDED PRACTICE

*3. Extension lines of internal feature **can** cross visible lines **without** leaving a gap at the intersection point.*

WRONG



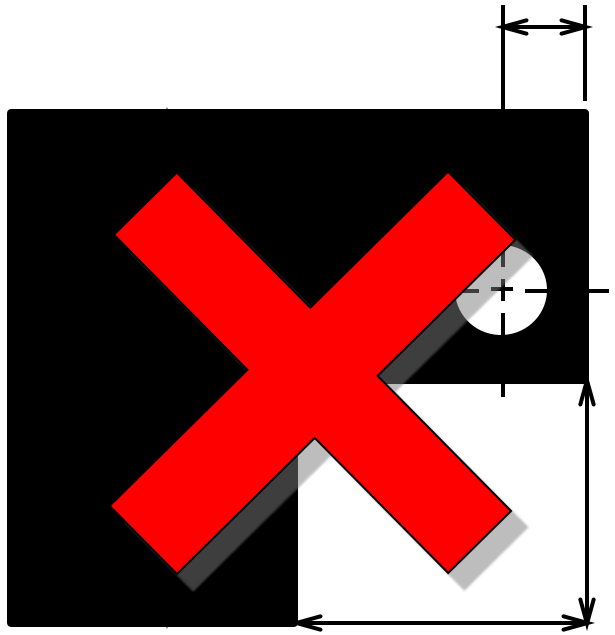
CORRECT



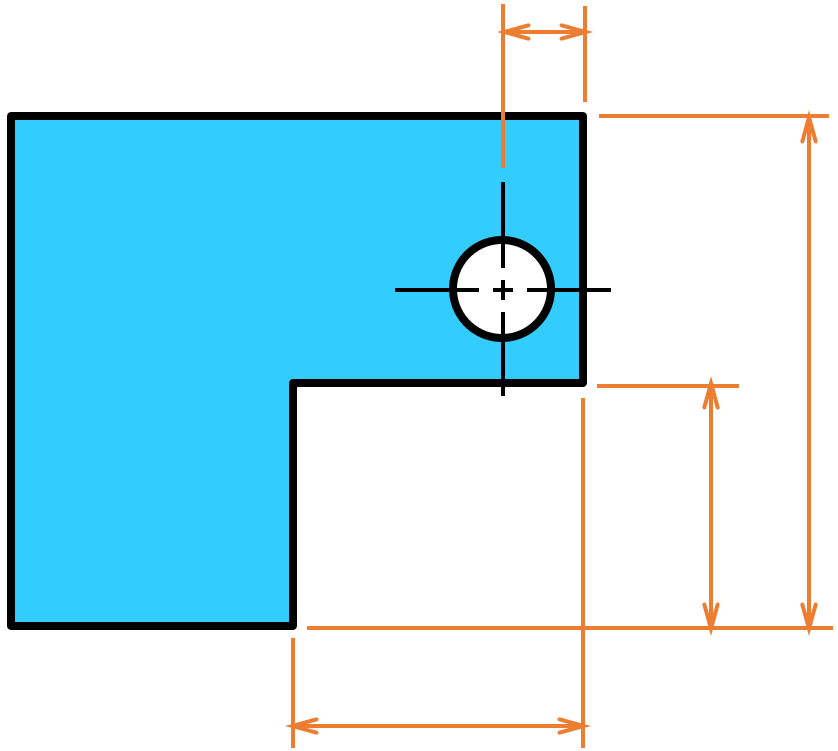
RECOMMENDED PRACTICE

*4. **Do not** use object line, center line, and dimension line as an extension lines.*

POOR



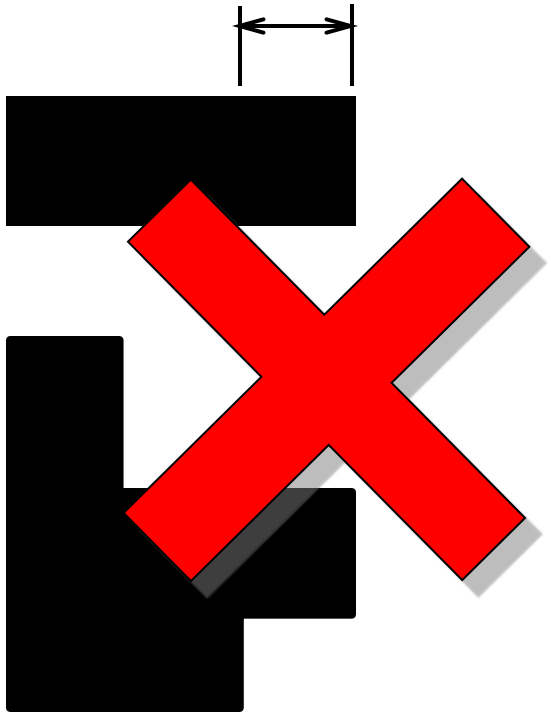
GOOD



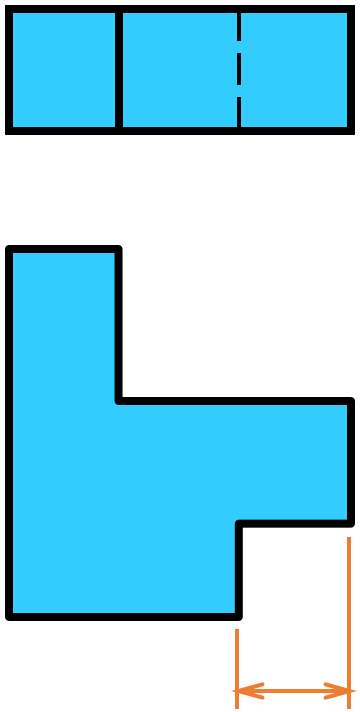
RECOMMENDED PRACTICE

*5. **Avoid** dimensioning hidden lines.*

POOR



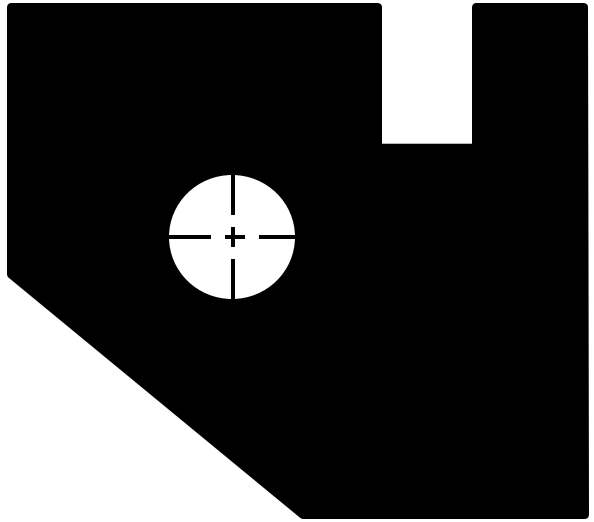
GOOD



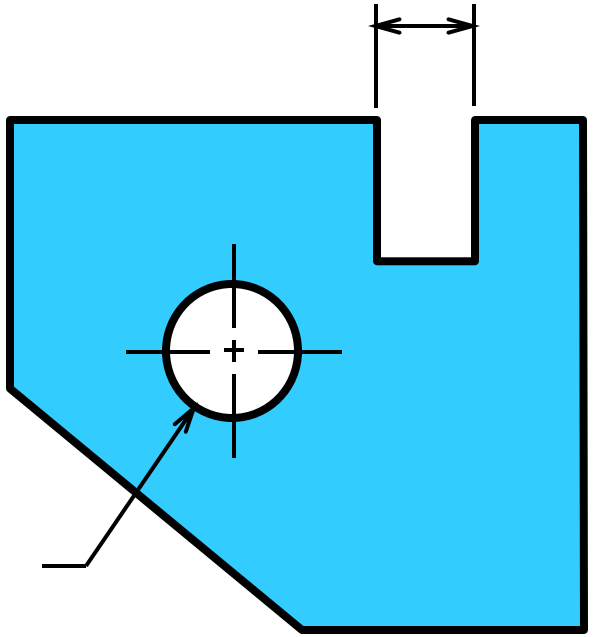
RECOMMENDED PRACTICE

6. Place dimensions **outside** the view, unless placing them inside improve the clarity.

POOR



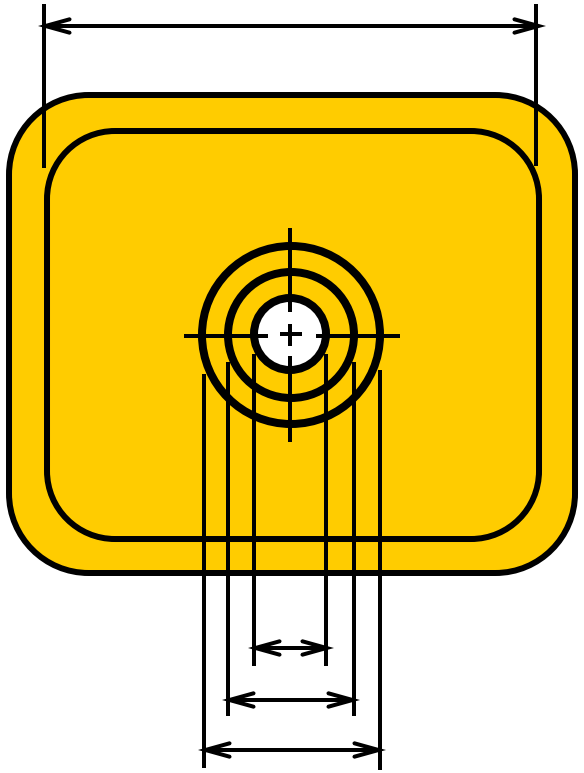
GOOD



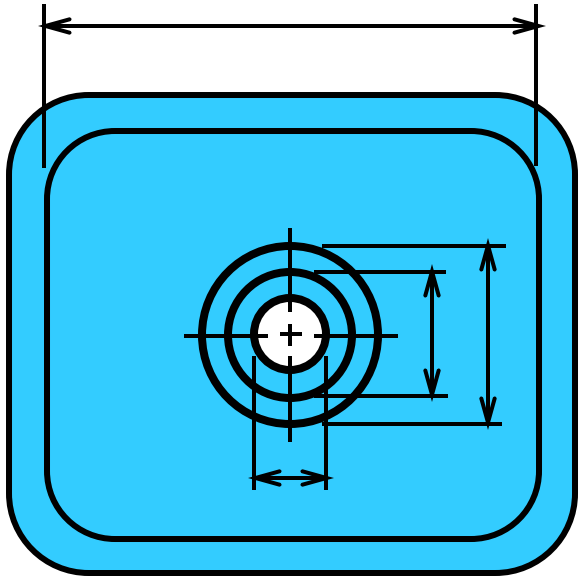
RECOMMENDED PRACTICE

6. Place dimensions **outside** the view, unless placing them inside improve the clarity.

JUST OK !!!



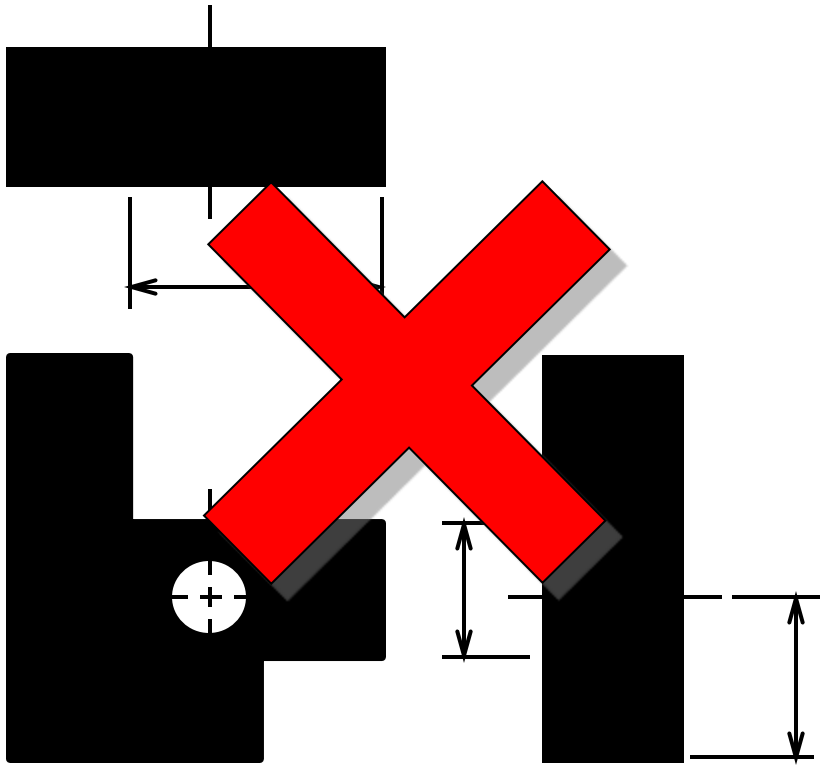
BETTER



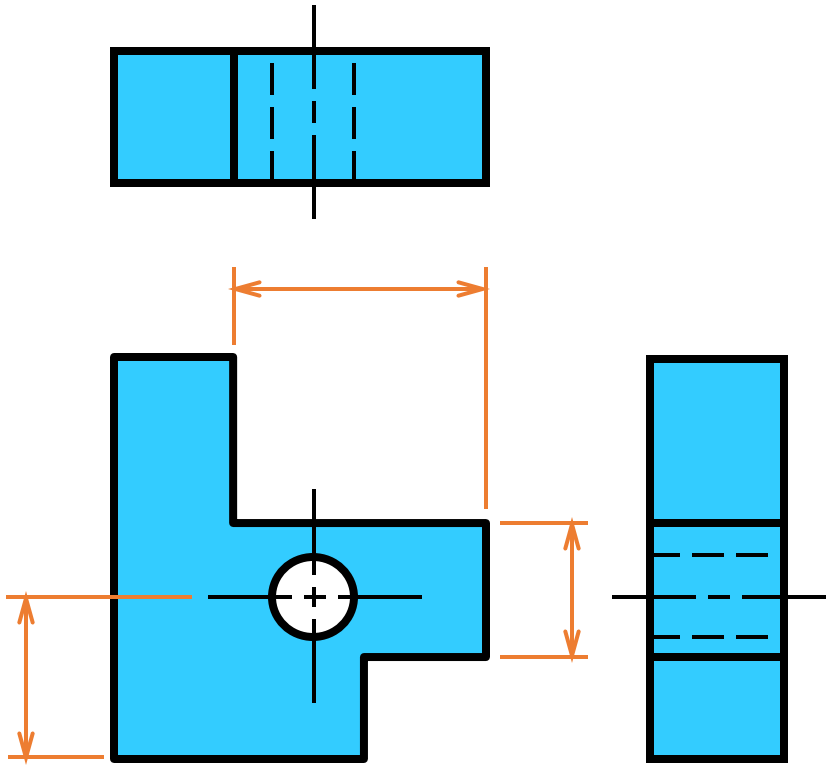
RECOMMENDED PRACTICE

7. Apply the dimension to the view that clearly show the shape or features of an object.

POOR



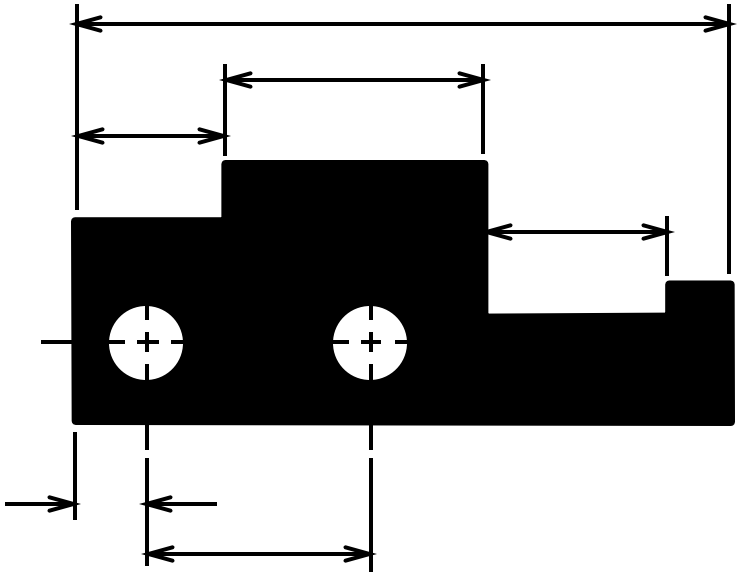
GOOD



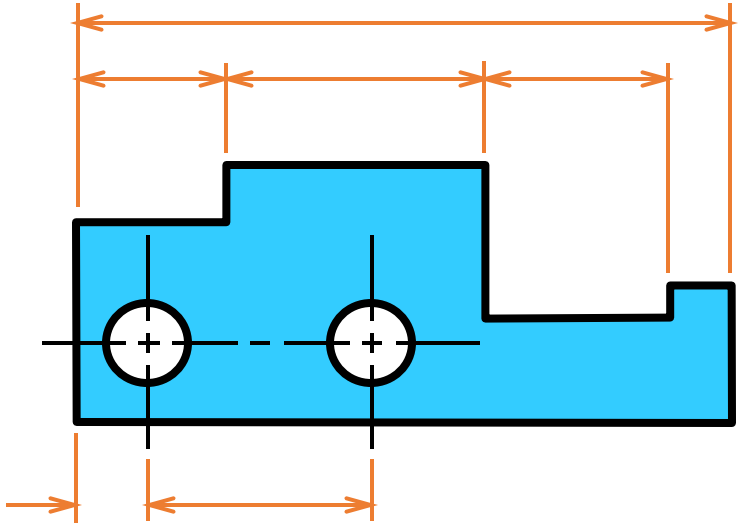
RECOMMENDED PRACTICE

8. Dimension lines should be lined up and grouped together as much as possible.

POOR



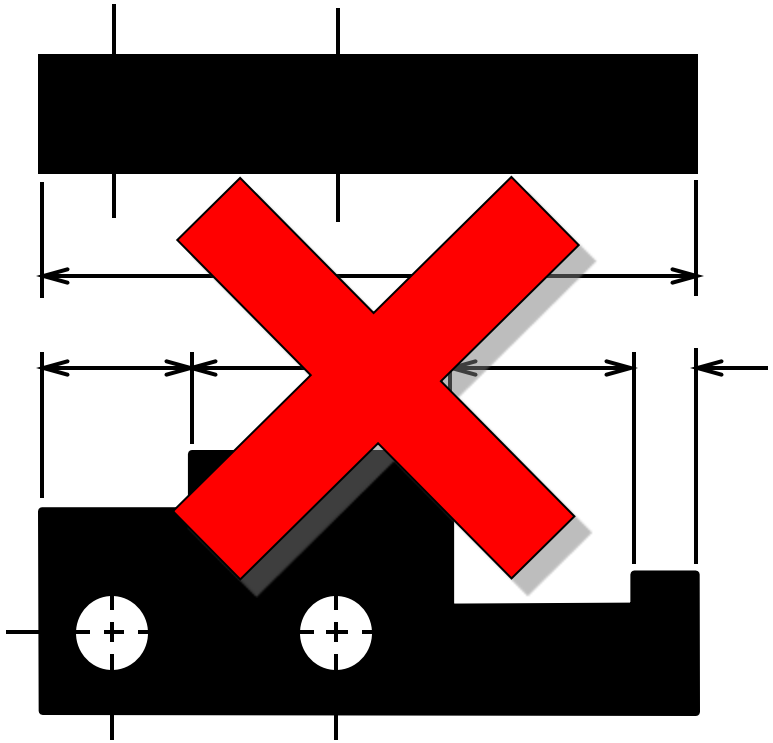
GOOD



RECOMMENDED PRACTICE

*9. **Do not** repeat a dimension.*

POOR



GOOD