

# Drawing Objects

## Description

In this activity the teacher will demonstrate the use of drafting equipment to create basic object shapes. Students will use a piece of paper with a title block to complete this activity. Students will practise lettering and line-weight techniques.

## Lesson Objectives

The student will be able to:

- Complete a board set-up
- Identify and appropriately use drafting tools
- Differentiate line weights
- Refine lettering techniques
- Create basic object shapes, based on instructions

## Assumptions

The student will:

- Have a basic knowledge of drafting tools and equipment
- Have a foundational understanding of how to appropriately use drafting equipment
- Know how to create a title block on which to complete this activity

## Terminology

**Border lines:** thick, dark lines used to create a solid border around a blank page.

**Drafting board:** a flat, smooth surface usually covered in vinyl to which paper is affixed. The drafting board has square, parallel edges that allow a T-square to slide easily.

**Drafting brush:** used to sweep away debris from a drawing so the full drawing is not smeared.

**Eraser shield:** a micro-thin piece of metal with cut-outs that allow the user to erase detailed sections of a drawing without erasing the rest of the drawing.

**Guide lines:** thin, light lines drawn using the lettering guide for evenly spaced letters.

**Layout lines:** very light lines used to lay out measurements before those measurements are drawn in heavy, dark lines (border lines).

**Lettering guide:** used to assist in the drawing of uniform lines to draw consistent, evenly spaced lettering.

**Lineweight:** the thickness and darkness of drawn lines.

**Masking tape** (drafting dots): holds drawing paper and/or vellum to the drafting board so the paper does not shift while drawing.



**Pencil:** a drawing utensil with a mechanical or solid core (lead). Leads range from hard to soft: 6H, 4H, 2H, H, HB, 2B, 4B, 6B. H is very hard with a fine point and B is extremely soft with a blunt point. A hardness of 2H is recommended for these activities.

**Precision drawing:** the act of creating drawings with specialized tools and equipment.

**Steel rule:** a straightedge made of rigid material and divided into specific increments, found both in metric and imperial units.

**Title block:** comprised of the information boxes found on the bottom right-hand corner of a drawing, the title block indicates drawing details such as the title, author name, scale, and date a drawing was created.

**Triangles** (right angle and isosceles): drafting guides made of hard, clear plastic that are used to draw lines at vertical and set angles (45°–90°–45°, 30°–60°–90°).

**T-square:** a precision drawing instrument that is used as a guide with other drafting equipment. The T-square has a 90° angle where the head and blade attach.

## Estimated Time

30–60 minutes

## Recommended Number of Students

20, based on *BC Technology Educators' Best Practice Guide*

## Facilities

- Regular classroom space with desks/chairs for all students
- Drafting boards (any large enough smooth, flat surface will also work)

## Tools

- T-square
- Steel rule
- Triangles (right angle and isosceles)
- Eraser shield
- Drafting brush
- Masking tape (drafting dots)
- Drafting board
- Lettering guide
- French curve/spline
- Circle template
- Compass
- 2H mechanical pencil

## Materials

- Handout for students with instructions (suggestion: develop a handout using the instructions from the teacher-led activity).

## Resources

- Drafting Dictionary Activity Plan

## Teacher-led Activity

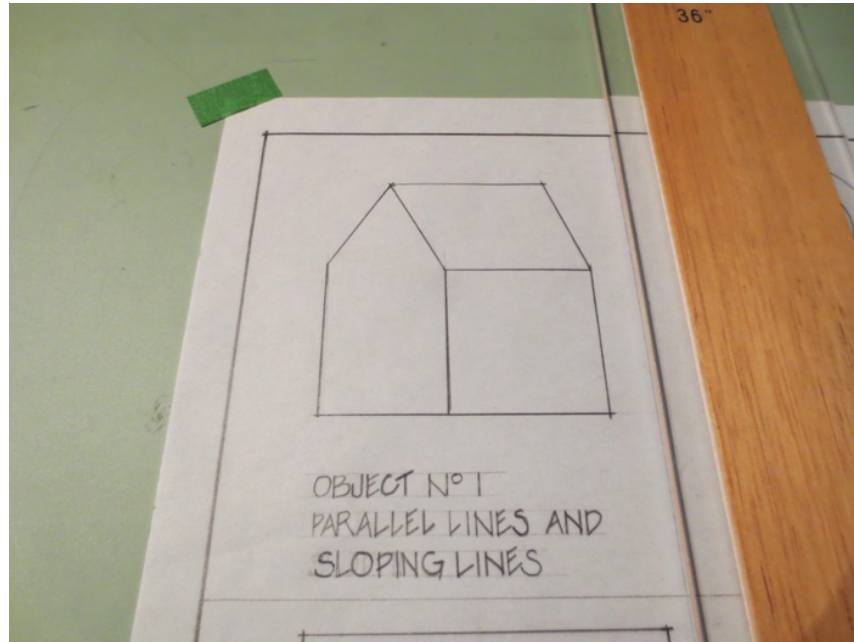
1. Gather all materials listed above.
2. Using the T-square and masking tape and/or drafting dots, align blank paper to your drafting board and securely tape down (Figure 1).



**Figure 1**—Secure paper to board

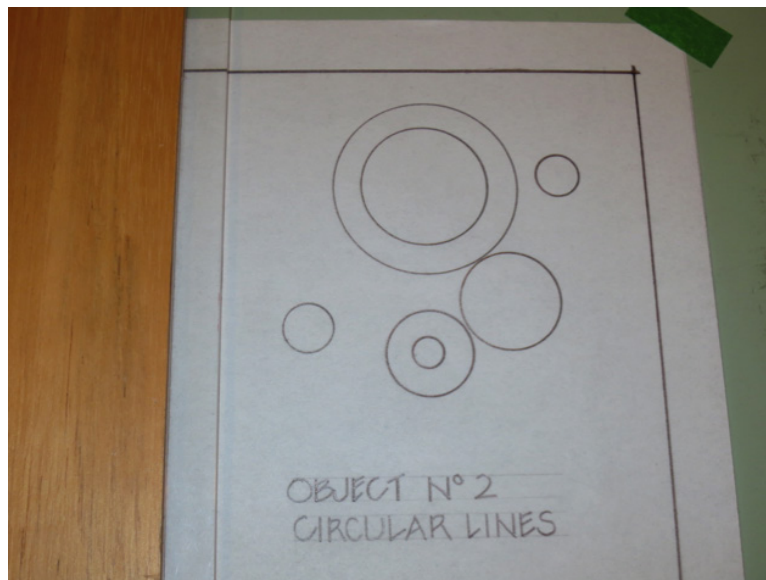
3. Using the steel rule, divide the drawing space of your paper into four even sections (each section should be  $3\frac{3}{4}$ " wide by  $4\frac{1}{4}$ " high). Draw these lines lightly (layout lines).

4. In the top left section, draw an object that focusses on sloping and parallel lines. Practise using the right angle, isosceles triangle, and T-square. Leave enough room underneath the object for the following label: OBJECT No. 1 PARALLEL LINES AND SLOPING LINES (Figure 2).



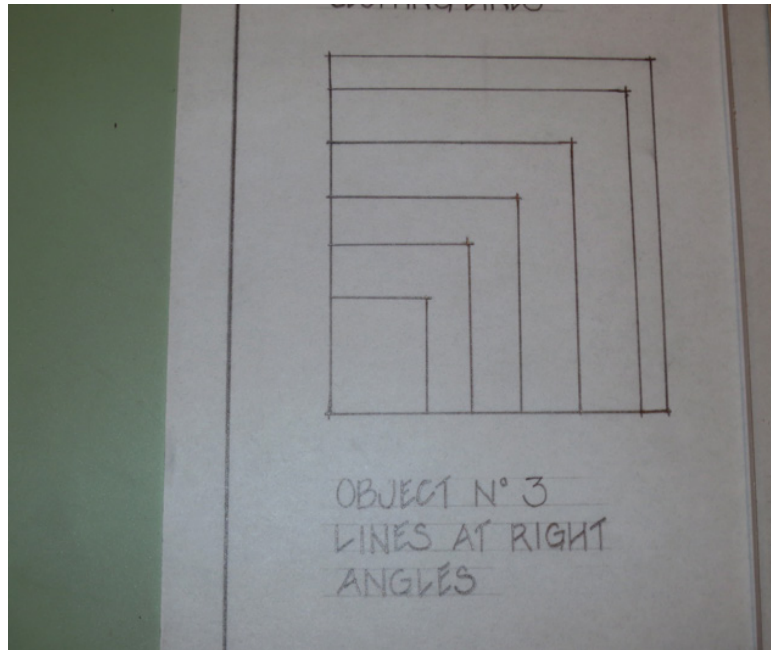
**Figure 2**—Parallel lines and sloping lines

5. In the top right section, students will draw an object that focusses on circular lines. Practise using the circle template and protractor. Leave enough room underneath the object for the following label: OBJECT No. 2 CIRCULAR LINES (Figure 3).



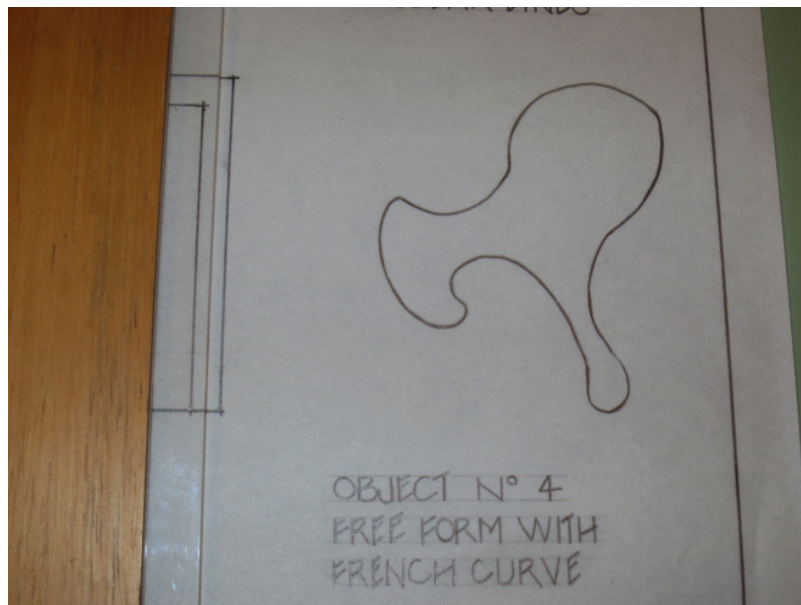
**Figure 3**—Circular lines

6. In the bottom left section, students will draw an object that focusses on lines at right angles. Practise using the right angle and isosceles triangles. Leave enough room underneath the object for the following label: OBJECT No. 3 LINES AT RIGHT ANGLES (Figure 4).



**Figure 4**—Lines at right angles

7. In the bottom right section students will draw an object that focusses on free-form lines. Practise using the French curve and/or spline too. Leave enough room underneath the object for the following label: OBJECT No. 4 FREE FORM WITH FRENCH CURVE (Figure 5).



**Figure 5**—Free form with French curve

8. Fill in the title block at the bottom of the page with the information below. Remind students that drafting convention requires that all lettering be done in CAPITALS.

ACTIVITY # 1	NAME
	DATE
OBJECTS	SCALE OF DRAWING 1:1
	PAGE 1 OF 1

## Student Activity

- Complete object shape drawings.
- Fill in title block with appropriate information.

## Extension Activity

- Practise drawing more objects, using all the tools in the Drafting Dictionary Activity Plan.
- Practise lettering when labelling object drawings.

## Assessment

- Student participation in discussion/demonstration
- Criteria for completed drawing:
  - Basic object shapes are drawn based on instructions.
  - Corners of borders are closed (horizontal and vertical lines cross).
  - Lettering is neat, even, and all uppercase.
  - Title block is filled out correctly with appropriate information.

## Appendix Acknowledgment

© Camosun College. Trades Access Common Core: *Competency D-3: Read Drawings and Specifications* (pp. 25–33). The Trades Access Common Core resources are licensed under the Creative Commons Attribution 4.0 Unported Licence (<http://creativecommons.org/licenses/by/4.0/>), except where otherwise noted.



## Appendix

### Describe lines, lettering, and dimensioning in drawings

The purpose of engineering drawings is to convey objective facts, whereas artistic drawings convey emotion or artistic sensitivity in some way.

Engineering drawings and sketches need to display simplicity and uniformity, and they must be executed with speed. Engineering drawing has evolved into a language that uses an extensive set of conventions to convey information very precisely, with very little ambiguity.

Standardization is also very important, as it aids internationalization; that is, people from different countries who speak different languages can read the same engineering drawing and interpret it the same way. To that end, drawings should be as free of notes and abbreviations as possible so that the meaning is conveyed graphically.

### Line styles and types

Standard lines have been developed so that every drawing or sketch conveys the same meaning to everyone. In order to convey that meaning, the lines used in technical drawings have both a definite pattern and a definite thickness. Some lines are complete and others are broken. Some lines are thick and others are thin. A visible line, for example, is used to show the edges (or “outline”) of an object and to make it stand out for easy reading. This line is made thick and dark. On the other hand, a centre line, which locates the precise centre of a hole or shaft, is drawn thin and made with long and short dashes. This makes it easily distinguishable from the visible line.

When you draw, use a fairly sharp pencil of the correct grade and try to maintain an even, consistent pressure to make it easier for you to produce acceptable lines (Figure 1). Study the line thicknesses (or “line weights”) shown in Figure 2 and practise making them.

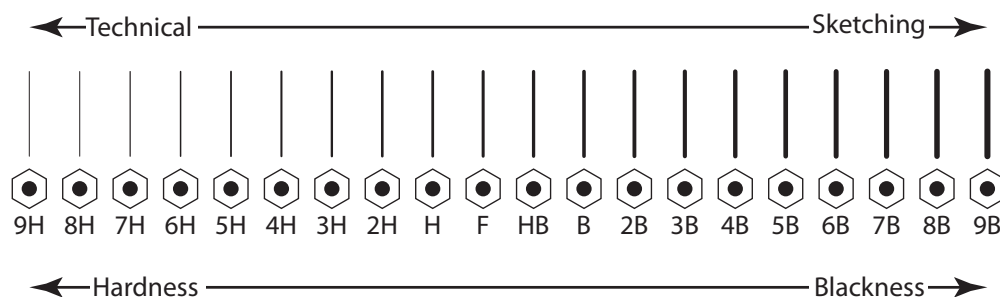


Figure 1 — Lead grade and usage

In computer drafting, the line shape remains the same, but line thickness may not vary as it does in manually created drawings. Some lines, such as centre lines, may not cross in the same manner as in a manual drawing. For most computer drafting, line thickness is not important.




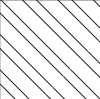

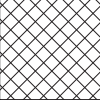
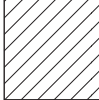


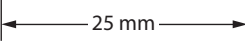
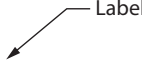


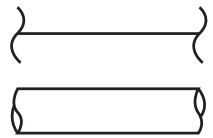
Type	Weight	Line	Description
Object line Margin line	Heavy		Solid line to show visible shape, edges, and outlines.
Hidden body line	Medium		Broken line of long and short dashes to show hidden object lines not visible to the eye.
Phantom line	Light		Broken line of short dashes to show alternate positions or movement of a part.
Section line	Light	 Steel  Copper/Brass  Lead  Cast iron/ General purpose	Unbroken lines arranged in a pattern, usually straight and at a 45° diagonal.
Projection line	Light		Unbroken lines that extend away from the object or feature for emphasis.
Centre line	Light		Broken line of long and short dashes to show the centre of an object.
Extension line/ Dimension line	Light		Extension lines are small lines that extend outward from an object or feature. Dimension lines span between the extension lines with arrowheads and a given dimension.
Leader line	Light		Unbroken line usually drawn at an angle often with a “dogleg” and an arrowhead. A dot is used in place of an arrowhead where a surface is referenced. Usually accompanied by a label.
Cutting plane line	Heavy		Broken line of one long and two short dashes to show an imaginary cross-section. The arrowheads show the direction from where the cross-section is viewed. A corresponding image will show the view of A.
Break lines for wood and metal	Heavy		Unbroken freehand or straight zig-zag lines to abbreviate longer spans of wood or metal.
Break lines for piping	Heavy		Curled lines to abbreviate a longer span of pipe.

Figure 2 — Weights of lines



To properly read and interpret drawings, you must know the meaning of each line and understand how each is used to construct a drawing. The ten most common are often referred to as the “alphabet of lines.” Let’s look at an explanation and example of each type.

## Object lines

Object lines (Figure 3) are the most common lines used in drawings. These thick, solid lines show the visible edges, corners, and surfaces of a part. Object lines stand out on the drawing and clearly define the outline and features of the object.

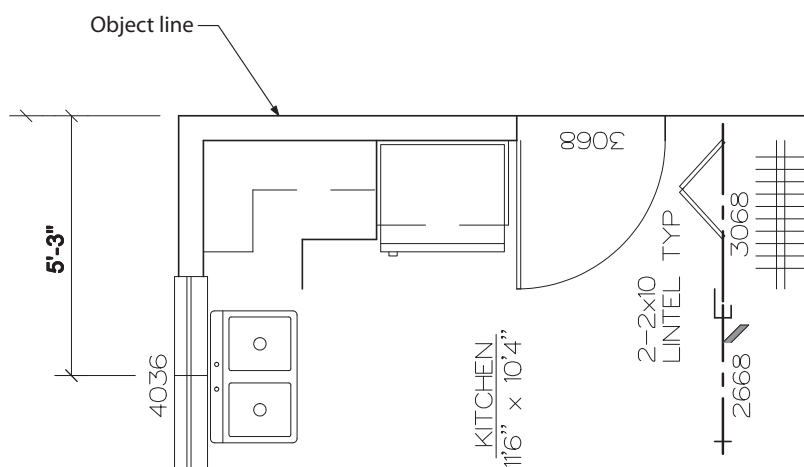


Figure 3 — Object lines

## Hidden lines

Hidden lines (Figure 4) are used to show edges and surfaces that are not visible in a view. These lines are drawn as thin, evenly spaced dashes. A surface or edge that is shown in one view with an object line will be shown in another view with a hidden line.

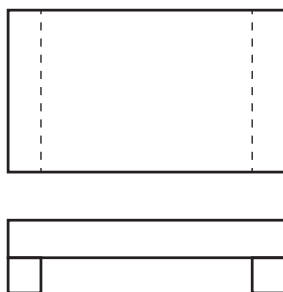


Figure 4 — Hidden lines

## Centre lines

Centre lines (Figure 5) are used in drawings for several different applications. The meaning of a centre line is normally determined by how it is used. Centre lines are thin, alternating long and short dashes that are generally used to show hole centres and centre positions of rounded features, such as arcs and radii. Arcs are sections of a circle, and radii are rounded corners or edges of a part. Centre lines can also show the symmetry of an object.

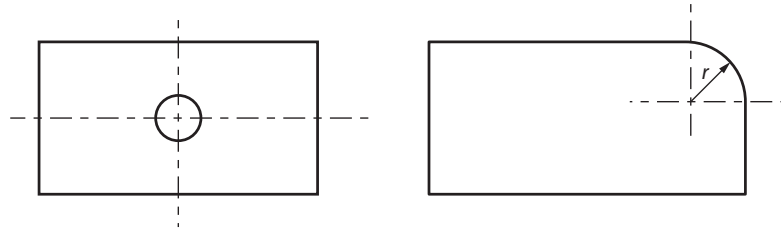


Figure 5 — Centre lines

## Dimension and extension lines

Dimension and extension lines (Figure 6) are thin, solid lines that show the direction, length, and limits of the dimensions of a part. Dimension lines are drawn with an arrowhead at both ends.

Extension lines are drawn close to, but never touching, the edges or surface they limit. They should be perpendicular, or at right angles, to the dimension line. The length of extension lines is generally suited to the number of dimensions they limit.

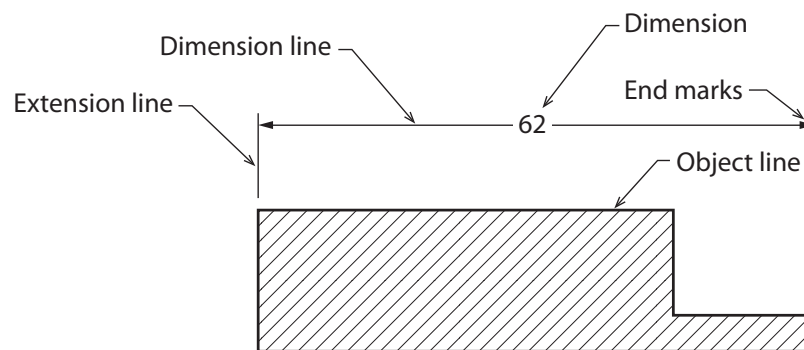


Figure 6 — Dimension and extension lines

## Leader lines

Leader lines (Figure 7) show information such as dimensional notes, material specifications, and process notes. These lines are normally drawn as thin, solid lines with an arrowhead at one end. They are bent or angled at the start, but should always end horizontal at the notation. When leader lines reference a surface, a dot is used instead of an arrowhead.

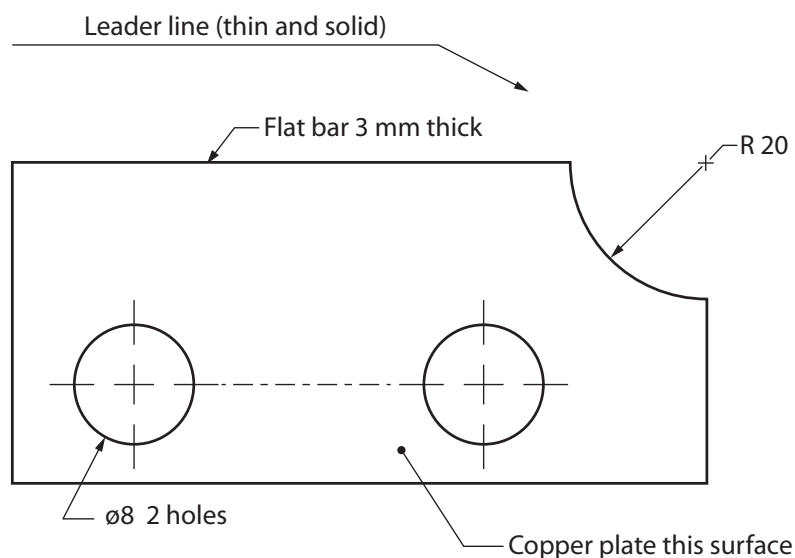


Figure 7 — Leader lines

Note that the symbol  $\varnothing$  is used to indicate a diameter rather than the abbreviation "DIA." The number that immediately follows this symbol is the diameter of the hole, followed by the number of holes that must be drilled to that dimension.

## Phantom lines

Like centre lines, phantom lines (Figure 8) are used for several purposes in blueprints. Phantom lines are used to show alternate positions for moving parts and the positions of related or adjacent parts, and to eliminate repeated details. Phantom lines are drawn as thin, alternating long dashes separated by two short dashes.

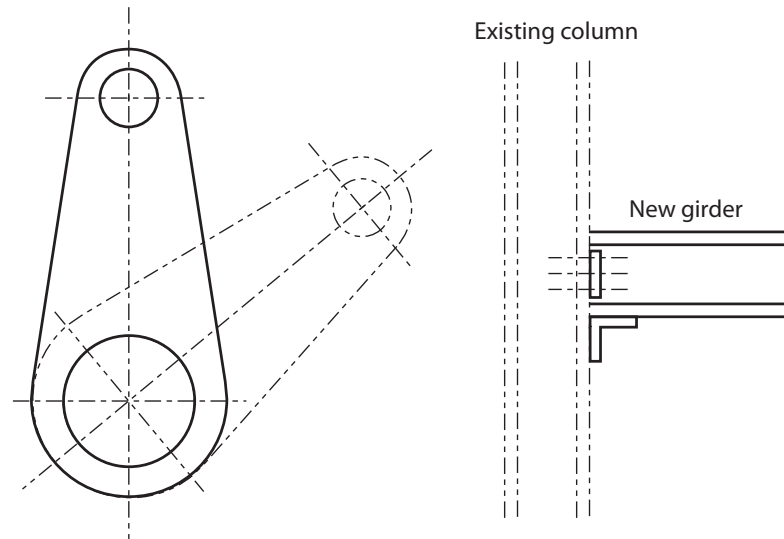


Figure 8 — Phantom lines

## Cutting plane lines

Cutting plane lines (Figure 9) show the location and path of imaginary cuts made through parts to show internal details. In most cases, sectional views (or views that show complicated internal details of a part) are indicated by using a cutting plane line. These lines are thick, alternating long lines separated by two short dashes. The arrowheads at each end show the viewing direction of the related sectional view. The two main types of cutting plane lines are the straight and the offset.

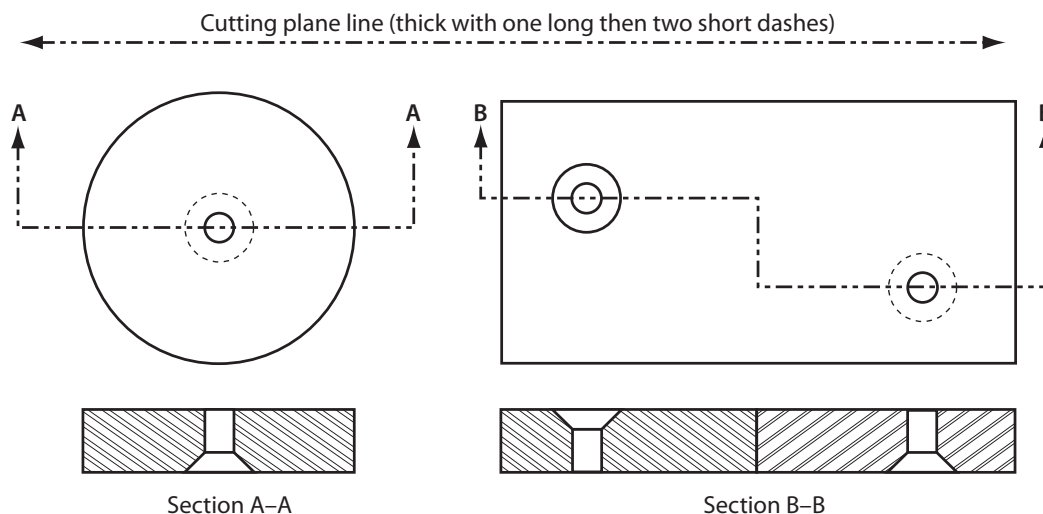


Figure 9 — Cutting plane lines

## Section lines

Section lines, also known as sectional lining, (Figure 10) indicate the surfaces in a sectional view as they would appear if the part were actually cut along the cutting plane line. These are solid lines that are normally drawn at 45 degree angles. Different symbols are used to represent different types of materials.

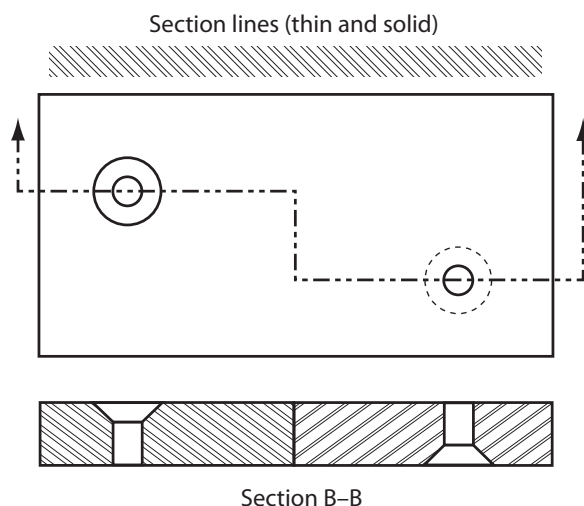


Figure 10 — Section lines combined with cutting plane lines

## Break lines

Break lines are drawn to show that a part has been shortened to reduce its size on the drawing. The two variations of break lines common to blueprints are the long break line and the short break line (Figure 11). Long break lines are thin solid lines that have zigzags to indicate a break. Short break lines are thick, wavy solid lines that are drawn freehand. When either of these break lines is used to shorten an object, you can assume that the section removed from the part is identical to the portions shown on either side of the break.

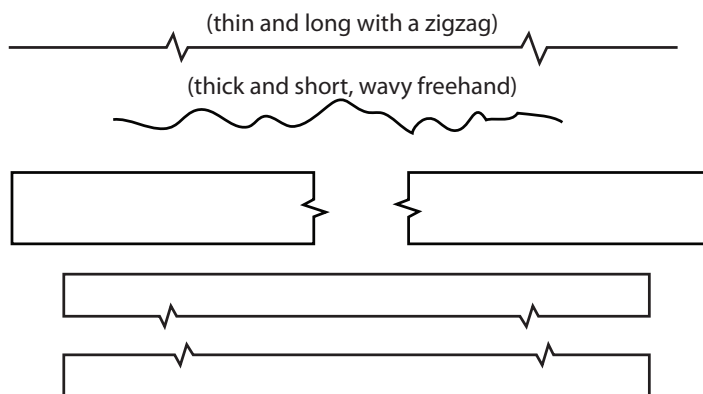


Figure 11 — Break line

## Standard lettering

The letters and numbers on a drawing or sketch are as important as the lines. Scribbled, smudged, or badly written letters and numbers can become impossible to read. This may lead to time-consuming and costly errors. Lettering is necessary to describe:

- the name or title of a drawing
- when it was made
- the scale
- who sketched it
- the dimensions
- the special notations that describe the size
- the materials to be used
- the construction methods

The American Standard Vertical letters (Figure 12) have become the most accepted style of lettering used in the production of manual drafting. This lettering is a Gothic sans serif script, formed by a series of short strokes.

Font styles and sizes may vary in computer drafting. Note that all letters are written as capital (upper case) letters. Practise these characters, concentrating on forming the correct shape. Remember that letters and numbers must be black so that they will stand out and be easy to read. Lettering and figures should have the same weight and darkness as hidden lines.

Title and drawing sizes = 6 mm ( $\frac{1}{4}$ " )

A B C D E F G H I J K L  
M N O P Q R S T U V W  
X Y Z 0 1 2 3 4 5 6 7 8 9

Dimension and notation sizes = 3 mm ( $\frac{1}{8}$ " )

A B C D E F G H I J K L  
M N O P Q R S T U V W  
X Y Z 0 1 2 3 4 5 6 7 8 9

Figure 12 — Standard lettering



## Abbreviations

Abbreviations are commonly used to help simplify a drawing and conserve space. Although many fields share common abbreviation conventions, there are also field- or trades-specific conventions that you will see as you become more specialized. Here is a common list of abbreviations that are used on drawings. Each trade will have specific abbreviations from this list, and therefore a set of drawings will usually include an abbreviation key.

AB	anchor bolt	HLS	holes	REF	reference
ABT	about	HSS	hollow structural steel	REQ'D	required
AUX	auxiliary	ID	inside diameter	REV	revision
BC	bolt circle	IN	inches	RF	raised face
BBE	bevel both ends	INT	internal	RH	right hand
BCD	bolt circle diameter	ISO	International Standards Org.	SCH	schedule
BOE	bevel one end	KP	kick plate	SI	International System of Units
BE	both ends	LH	left hand	SPECS	specifications
BL	baseline	LAT	lateral	SQ	square
BM	bench mark	LR	long radius	SM	seam
Btm	bottom	LG	long	SMLS	seamless
BP	base plate	MB	machine bolt	S/S	seam to seam
B/P	blueprint	MS	mild steel	SO	slip on
BLD	blind	MIN	minimum	SEC	section
C/C	centre to centre	MAX	maximum	STD	standard
COL	column	MAT'L	material	SS	stainless steel
CPLG	coupling	MISC	miscellaneous	SYM	symmetrical
CS	carbon steel	NC	national course	T	top
C/W	complete with	NF	national fine	T&B	top and bottom
CYL	cylinder	NO	number	T&C	threaded and coupled
DIA	diameter	MOM	nominal	THD	threaded
DIAG	diagonal	NTS	not to scale	TBE	threaded both ends
DIM	dimension	NPS	nominal pipe size	TOE	threaded one end
DWG	drawing	NPT	national pipe thread	THK	thick
EA	each	O/C	on centre	TOL	tolerance
EL	elevation	OA	overall	TOC	top of concrete
EXT	external	OD	outside diameter	TOS	top of steel
F/F	face to face	OR	outside radius	TYP	typical
FF	flat face	OPP	opposite	U/N	unless noted
FLG	flange	PAT	pattern	VERT	vertical
FW	fillet weld	PBE	plain both ends	WD	working drawing
Ga	gauge	POE	plain one end	WP	working point
Galv	galvanized	PSI	pounds per square inch	WT	weight
HVY	heavy	PROJ	project	W/O	without
HH	hex head	RD	running dimension	XH	extra heavy
HR	hot rolled	R or Rad	radius	XS	extra strong
HT	heat treatment	RND	round		