

6 Engineering: Practical Engineering Skills

Non-negotiable Knowledge (What you need to know)

- Engineering drawings- Standard conventions/ symbols

Key words/ terminology

engineering drawing	Technical drawing featuring instructions on how to manufacture a product
Schematics	Diagram representation of a circuit

Orthographic projection

Projection	Symbol
First angle	

First Angle Orthographic Projection

Commonly used in Europe and most of the world.

When drawing in first angle the top view is placed below the front view and the right side is drawn to the left side of the elevation

Third angle	
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Third Angle Projection

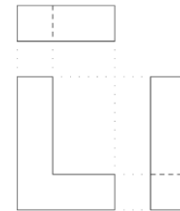
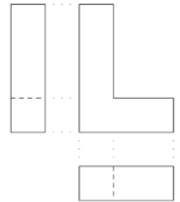
Most commonly used in America and Australia. When drawing in third angle the top view is placed above the front view and the right side is drawn to the right side of the elevation.

Further Reading

<http://www.technologystudent.com/designpro/orthogrp1.html>

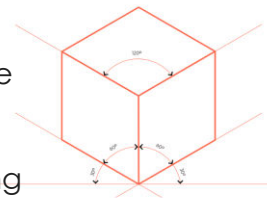
<http://www.technologystudent.com/designpro/orthogrp1.html>

<http://www.technologystudent.com/designpro/ortho2.htm>

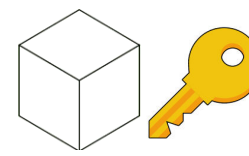


3D Isometric Projection

- Isometric projection is drawn with both sides at 30 degrees and 90 degree vertical lines. A 30° set square is used to read and produce drawings to ensure accuracy.
- This is the most commonly used method of 3D drawing used in formal technical sheets, as it is quick and gives a good representation of the object, especially when there is a circles (holes or cylinders) on the side faces.



A visible line is represented by a thick dark line, used to show the outline an objects visible edges and surfaces



A hidden line is represented by a series of short dashes and is used to represent the lines or features which are not visible from the direction of view in a drawing.

The hidden line should begin with a dash in contact with the line from which it starts.



A centre line is represented by a series of alternate short and long dashes.

This line is usually used to indicate the centre of holes, circles, fillets or circular edges in a drawing, Although it can also used to indicate the centre line of symmetry.

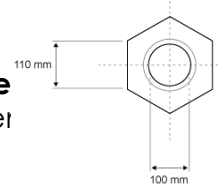
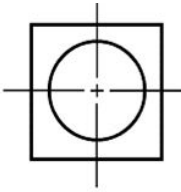
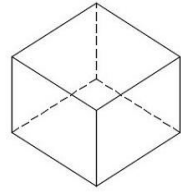
A centre line should always extend beyond the edges of a drawing.



A construction line is usually the first line to be drawn. They are very light and thin line use to construct layout work on a drafting sheet.

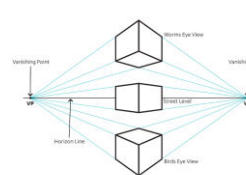
Line weight is irrelevant as they do not appear on a final drawing, so in hand drafting they should be dark enough to see, but light enough to be erased easily.

Dimension lines are drawn with an arrow on either end between two **extension line** with the dimension written alongside. The unit of measurement should also be given



3D 2 Point Projection

- Two point perspective drawing is a type of linear perspective. This method uses lines to create the illusion of space on a 2D drawing.
- Linear perspective uses a horizon line, vanishing points and lines of perspective that meet with the vanishing point.



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Non-negotiable Knowledge (What you need to know)

- The use of CAD
- How to use of CAM/ CNC machines to manufacture products

Computer aided design (CAD): the use of computer software to help when designing a product.

- It can be used to create drawings or schematics.
- CAD produces accurate designs that can be amended quickly and easily.
- It allows products and systems to be modelled and simulated.

3D CAD produces a three-dimensional model of a part.

Orthographic drawings

These can be sent directly to manufacturers easily.

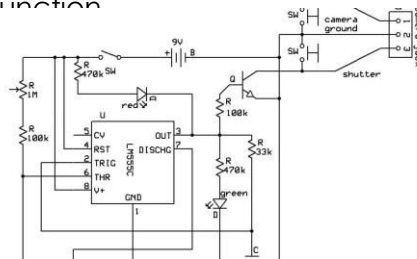
They include:

- how to assemble
- the product
- dimensions
- surface finish requirement
- parts list.

Schematics

CAD software selects suitable components to add to produce an electrical, electronic or pneumatic schematic.

Software will simulate how the system will function



2D CAM

In 2D CAM the cutting tools move in two axes: (x, z)

Examples-

Laser cutter, vinyl printer/cutter, PCB manufacture, CNC lathe.

CAM- Computer Aided Manufacture
Computer aided manufacture is when a computer is used to program and run machine tools.

CNC- Computer Numerical control CAM machines use computer numerical control (CNC).

- CNC uses a number system called machine code to control a machine.
- The machine code is stored as a program in the machine.
- Machine code controls the speed and feed rate of the cutter.
- CAD software is usually used to create the program for CAM.



CNC lathe, milling and routing

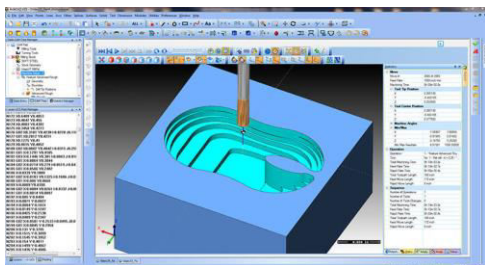
Advantages-

- More accurate
- Faster
- Continuous



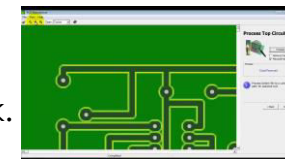
Virtual reality simulation

Models of a product can be produced and used to show how the product/system will operate.



CAM PCB manufacture

- Copper patterning prints a protective layer over the track layout design.
- Etching removes the unprotected copper layers to leave the track.
- CNC drilling drills holes for electronic components.



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Non-negotiable Knowledge (What you need to know)

- Destructive testing
- Non-destructive testing
- Material mechanical properties

Testing materials

Material properties

To be able to select the best material for an application it is important to understand each of the following properties:

- strength
- ductility
- malleability
- hardness
- toughness and brittleness
- stiffness

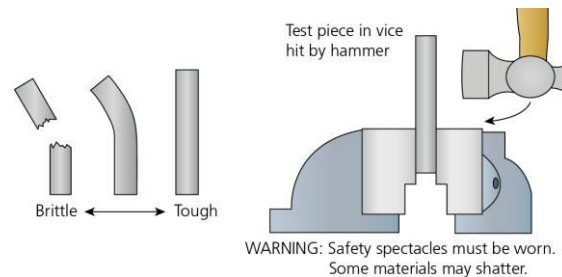
A materials test is used to check the working properties of a material. Material testing can be:

- non-destructive – the component or material can still be used after testing (e.g. visual testing)
- destructive – the component or material cannot be used after testing (e.g. tensile test or hardness test).

Further Reading

http://www.technologystudent.com/despro_fish/advance1.html

Toughness is the ability of a material to withstand an impact without breaking. Material samples are placed in a vice and hit with a hammer.

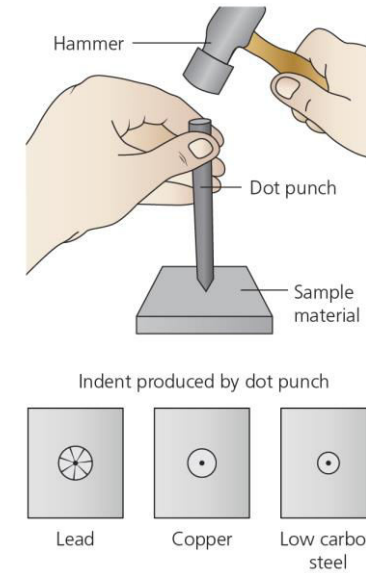


Hardness is the ability of a material to resist wear and abrasion. It can be measured by testing a material's resistance to surface indentation using a dot punch and a hammer.

Industrial tests for hardness

The **Rockwell hardness test** measures the depth of the indentation made by the testing machine as it forces an indenter under a load into the material being tested.

Other industrial hardness tests include the Brinell test and the Vickers pyramid test.



Swift Academies

The tensile test determines the strength of a material under tension. The **tensile strength** of a material is the maximum pulling/stretching force it can withstand before failure. A simple workshop test for tensile testing is to clamp material samples in a vice and to apply a load to the unclamped end.

