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| **3 Engineering representations** | | |
| Criteria | Range | Resource identified |
| 3.1 Drawings and information conveyed by drawings. | Computer aided design models | <https://www.autodesk.co.uk/solutions/cad-software> |
| <https://www.hubs.com/knowledge-base/3d-modeling-cad-software/> |
| <https://www.bbc.co.uk/bitesize/guides/zffhsrd/revision/7> |
| Freehand sketching | <https://www.youtube.com/watch?v=Ess0dmJB2lo> |
| <https://engineeringdrawingbasics.com/free-hand-sketching-in-engineering-graphics/> |
| <https://www.bbc.co.uk/bitesize/guides/z6jkw6f/revision/3> |
| Orthographic projection (first angle, third angle, section, assembly, general arrangement) | <https://www.makeuk.org/insights/blogs/how-to-read-engineering-drawings-a-simple-guide> |
| <https://designmuseumfoundation.org/orthographic-projection/> |
| <https://technologystudent.com/designpro/ortho1.htm> |
| <https://technologystudent.com/designpro/ortho2.htm> |
| <https://engineeringdrawingbasics.com/sections-and-section-views-on-engineering-drawings/> |
| Exploded views | <https://www.bbc.co.uk/bitesize/guides/zrx7xfr/revision/6> |
| <https://technologystudent.com/despro2/expld1.htm> |
| Block diagrams | <https://www.tutorialspoint.com/control_systems/control_systems_block_diagrams.htm> |
| <https://www.electronics-tutorials.ws/systems/closed-loop-system.html> |
| <https://www.electronics-tutorials.ws/systems/electronic-system.html> |
| <https://www.electronics-tutorials.ws/systems/open-loop-system.html> |
| <https://www.bbc.co.uk/bitesize/guides/z7pbn9q/revision/1> |
| <https://electronicsclub.info/blockdiagrams.htm> |
| Flowcharts | <https://en.wikipedia.org/wiki/Flowchart> |
| <https://www.smartdraw.com/flowchart/flowchart-symbols.htm> |
| <http://www.mrbillington.com/flowchart-programming.html> |
| <https://www.instructables.com/Starting-programming-with-a-flow-chart/> |

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|  | Circuit diagrams | <https://electronicsclub.info/circuitsymbols.htm> |
| <https://electronicsclub.info/circuitdiagrams.htm> |
| <https://www.savemyexams.co.uk/notes/a-level-physics-cie/10-d-c-circuits/10-1-dc-practical-circuits-kirchhoffs-laws/10-1-1-circuit-symbols/> |
| <https://isaacphysics.org/concepts/cp_electrical_components?stage=all> |
| Schematics (wiring diagrams, pneumatics, hydraulics) | <https://www.smartdraw.com/wiring-diagram/> |
| <https://www.youtube.com/watch?v=C2I68EUxJEc> |
| <https://library.automationdirect.com/pneumatic-circuit-symbols-explained/> |
| <https://www.e4training.com/hyd_princip/hydraulic_symbols1.php> |
| Scale | <https://sciencing.com/list-7612075-scales-used-technical-drawings.html> |
| <https://www.engineeringtoolbox.com/scaling-blueprint-drawings-d_1704.html> |
| Title block | <https://www.engineersedge.com/drafting/drawing_title_block.htm> |
| <https://roymech.org/Useful_Tables/Drawing/Title_blocks.html> |
| <https://www.makeuk.org/insights/blogs/how-to-read-engineering-drawings-a-simple-guide> |
| Projection symbols, view (elevation, plan, end, section, auxiliary) | <https://www.sciencedirect.com/topics/engineering/angle-projection> |
| <https://www.gdandtbasics.com/how-does-1st-angle-projection-work/> |
| <https://www.nda.ac.uk/blog/identify-plans-elevations-sections/> |
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| Types of line (outlines, hidden detail, centre line, projection, dimension, leader, construction) | <https://engineeringdrawingbasics.com/different-line-types-used-on-engineering-drawings/> |
| <https://www.cobanengineering.com/GeometricDimensioningAndTolerancing/TechnicalDrawingLines.asp> |
| <https://en.wikipedia.org/wiki/Engineering_drawing> |
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|  | Surface finish | <https://www.gdandtbasics.com/basics-of-surface-finish/> |
|  | <https://www.theengineerspost.com/surface-finish-surface-roughness-symbols/> |
|  | Manufacturing detail | <https://www.bluentcad.com/blog/difference-between-manufacturing-drawings-and-engineering-drawings/> |
|  | Standard features (screw threads, nuts, bolts, pins, repeated items, counterbore, countersink, centre mark) | <http://engineeringessentials.com/ege5/files/ege/dim/dim_page4d.htm> |
|  | <https://engineersbible.com/types-of-holes/> |
|  | <https://www.gdandtbasics.com/using-centerlines-correctly/> |
|  | <https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-C078E9E4-FF38-4BA7-B72B-F2DAB92AFC99-htm.html> |
|  | Abbreviations (across flats, centre line, diameter, drawing, material, square, chamfer, countersunk, hexagon head, radius, thread, undercut, pitch circle diameter) | <https://blog.draftsperson.net/acronyms-and-abbreviations-in-engineering/> |
|  | <https://en.wikipedia.org/wiki/Engineering_drawing_abbreviations_and_symbols> |
|  | <https://www.cnclathing.com/guide/engineering-drawing-abbreviations-and-symbols-technical-mechanical-design-symbols-cnclathing> |
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| 3.2 Dimensions and tolerancing on engineering drawings. | Dimensions (linear, diameter, radius, angular) |  |
|  | Tolerances | <https://engineeringdrawingbasics.com/how-are-tolerances-shown-on-an-engineering-drawing/> |
|  | <https://fractory.com/engineering-tolerances/> |
|  | <https://www.smlease.com/entries/tolerance/limits-fit-and-tolerance/> |
|  | Limits and fits | <https://www.joshuanava.biz/engineering-3/limits-and-fits.html> |
|  | <https://roymech.org/Useful_Tables/ISO_Tolerances.html> |
|  | <https://fractory.com/limits-and-fits/> |
|  | <https://en.wikipedia.org/wiki/Engineering_fit> |
|  | <https://fractory.com/engineering-tolerances/> |
|  | <https://www.smlease.com/entries/tolerance/limits-fit-and-tolerance/> |
|  | Geometric dimensioning and tolerancing (GDT) symbols (datum, parallelism, perpendicularity, concentricity, straightness) | <https://www.gdandtbasics.com/gdt-symbols/> |
|  | <https://en.wikipedia.org/wiki/Geometric_dimensioning_and_tolerancing> |