

# Technical Skills Booklet

## Mechanical Engineering: CAD



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**Contents**

Mechanical Engineering: CAD Overview .....2

Career Pathway .....2

Resources.....2

Project Specifications.....3

Pre-Competition Activity.....3

Competition Structure.....3

    Registration.....3

    Entry Stage .....3

    National Qualifier .....4

    WorldSkills UK Final.....4

Task Overview – National Qualifier .....4

    National Qualifier – sample competition project.....5

Task Overview – National Final .....8

    National Qualifier – sample competition project.....9

Pre-National Final Preparation .....13

    National finals training .....13

    National finals.....14

    Beyond the National finals .....14

# Mechanical Engineering: CAD

## Mechanical Engineering: CAD Overview

Computer Aided Design (CAD) is the use of an advanced computer systems to assist in the creation, modification, analysis, or optimisation of an engineering design project. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communication through documentation, and create a database for manufacturing. CAD output is often in the form of electronic files for print, design visualisation, 3D printing or directly linked to manufacturing processes.

Designers and engineers use CAD to create technical and engineering drawings and images that must clearly convey information such as materials, processes, dimensions and tolerances according to application-specific conventions. CAD is also used to produce computer animation for the special effects used in, for example, advertising and technical manuals.

CAD is an important industrial tool that supports the development of a project concept from inception to completion. It is extensively used in many applications, including automotive design, ship building, aerospace industries, and in industrial design. The CAD process and outputs are essential in the production of successful solutions for engineering and manufacturing problems.

Using CAD helps us to innovate and explore ideas, visualize concepts through photorealistic renderings and simulates how the design project will perform in the real world.

## Career Pathway

Computer Aided Design (CAD) software is used by designers, and technicians to develop ideas and produce designs and documentation, including product concepts, drawings, 3D models, and project management. Individuals looking to become a CAD Technician will need to find and fix inaccuracies and mistakes, as well as reading and interpreting engineering drawings.

The individual will need to be capable in doing mathematical calculations in their day-to-day tasks, have the ability to use a computer and main software packages. Have excellent design skills knowledge while working well with others and using initiative.

## Resources

For information and resources, including how to register, competition rules, and the steps to competing, Visit:

<https://worldskillsuk.org/champions/national-skills-competitions>

## Project Specifications

Projects will be designed to test competitors technical skills and knowledge in the following areas;

- Use of a CAD platform for the modelling of Mechanical and related engineering systems
- Current internationally recognized standards (ISO)
- Standards currently used and recognized by industry
- Use of operating system and file management in a CAD system
- Principles of technical drawing
- Create 2D detail technical drawings
- Create exploded isometric views
- 3D Modelling of components
- Creating simple to complex assembly models
- Mechanical systems and their functionality
- Create photo rendered images and creation of animations

## Pre-Competition Activity

Pre-competition competitors should try to familiarise themselves with competition style activities even if you have a fellow student to judge a completed work task during a practical session at college/training provider.

Also familiarise yourself with current industry processes and procedures for completing a range of tasks you may need to complete.

<https://www.worldskillsuk.org/wp-content/uploads/2022/02/Mechanical-Engineering-CAD-Pre-Passive-Activity-2022.pdf>

## Competition Structure

### *Registration*

Once you have completed your registration (and accepted all terms and conditions) you will be emailed a link to complete a entry online test.

### *Entry Stage*

The Entry Stage of the competition will be an online test aimed at challenging and assessing your knowledge of general and some specific topics of Mechanical Engineering CAD.

When the Entry Stage online test has been completed you will be notified to let you know if you have scored high enough to go through to the National Qualifiers.

**N.B**

The National Qualifier will be a digital competition and all details will be emailed to you well in advance of any of the competitions.

*National Qualifier*

Ensure you are ready to compete in your National Qualifiers by reviewing the project brief, core competencies, and marking guidelines below. These outline the type of tasks you will be expected to carry out.

Ask your lecturer/employer for help in any areas where you feel you could improve and try to gain practical experience in all the task areas of the competition.

*WorldSkills UK Final*

The eight highest scoring competitors from across all National Qualifiers will be invited to compete at Worldskills UK Finals.

Ensure you're ready to compete in your Worldskills UK Final by looking at the project brief below. This outlines the type of tasks you will be expected to carry out. Ask your lecturer/employer for help in any areas where you feel you could improve and try to gain practical experience in all the task areas of the competition. Attend training taking place prior to the finals.

**Task Overview – National Qualifier**

The Mechanical Engineering: CAD national qualifier will take place remotely.

You will be emailed a link and given specific details, date and times for you to complete the digital/online competition.

The competition will take 5 hours, you will need access to a computer/laptop with internet access, office 365 and Autodesk Inventor Professional (Version 2023 as a minimum) or Fusion.

Success in the National Qualifier will be achieved by completing as much of the task given as accurately as possible. Productivity and accuracy are two of the main contributors to a successful competition. Concentration and remaining focused are essential throughout the duration of the competition time.

*National Qualifier – sample competition project*

**2019 National Qualifier**

**MECHANICAL ENGINEERING CAD**

**Modelling from Detail Drawings & Creating Assemblies**



**Task:** Modelling from detail part drawings to create assemblies, animations and assembly drawings.

**Time:** 5.0 hours

**Given:** 10 Part Drawings, 2 Sub-Assembly Drawings, 1 Assembly Drawing, Given Data Set

**Task:**

1. Create 3D models for all of the parts shown on the part drawings.
2. Create the Carburetor Sub Assembly and Clutch Sub Assembly as Given.
3. Assemble the Engine Assembly in the correct assembly sequence as per parts list.
4. Reproduce the given Engine Assembly drawing on A2 paper.
5. Produce exploded Carburetor Sub Assembly drawing with parts list and balloons.
6. Produce an AVI file of the physical simulation clearly demonstrating the full functionality of the Engine assembly. The simulation should include:

| <b>Durations (s)</b> | <b>Description</b>   |
|----------------------|--|
| 0 – 2                | Show the Engine assembly in isometric view.  |
| 2 – 7                | Camera flyover (360°)  |
| 7 – 17               | Reduce visibility to 15% opacity on all parts and sub-assemblies to show the internal functionality of the Piston. Crank shaft should rotate a minimum of 1080°. |

17 – 20 Camera flyover view (360°) all parts should be 100% opaque on completion of simulation.

Save all files in a folder called 'Your Name' on the desktop.

### **USE OF COMPUTER:**

Use of the computer is allowed from the beginning of the competition time.

### **OUTPUT:**

Software Modeled Parts, Assemblies, Animations and Drawing Files.

### **NOTES:**

All marks are to be taken from digital files and printing is not required.

All rendering of animations must be completed within the competition time.

### **MARKING**

All Marking is Objective and broken down as follows:

| <b>Aspect</b>        | <b>Max Mark</b> |
|----------------------|-----------------|
| Part Modelling       | 45.00           |
| Assembly Modelling   | 25.00           |
| Assembly Drawing     | 14.00           |
| Exploded Drawing     | 10.00           |
| Functional Animation | 6.00            |
| <b>Total Marks</b>   | <b>100</b>      |

## Task Overview – National Final

The Mechanical Engineering: CAD national final will take place over two days of the competition.

### **One day task (six hours)** – Mechanical Design Challenge:

- Produce functional assembly(s) from given data
- Implement the design change
- Autodesk Inventor Design Accelerator may be used to generate parts and assemblies
- Produce assembly drawing(s) of design change
- Produce exploded views
- Produce physical simulations using Autodesk Inventor Studio
- Produce photo rendered images using Autodesk Inventor Studio.
- Prepare 3D models for 3D printing.

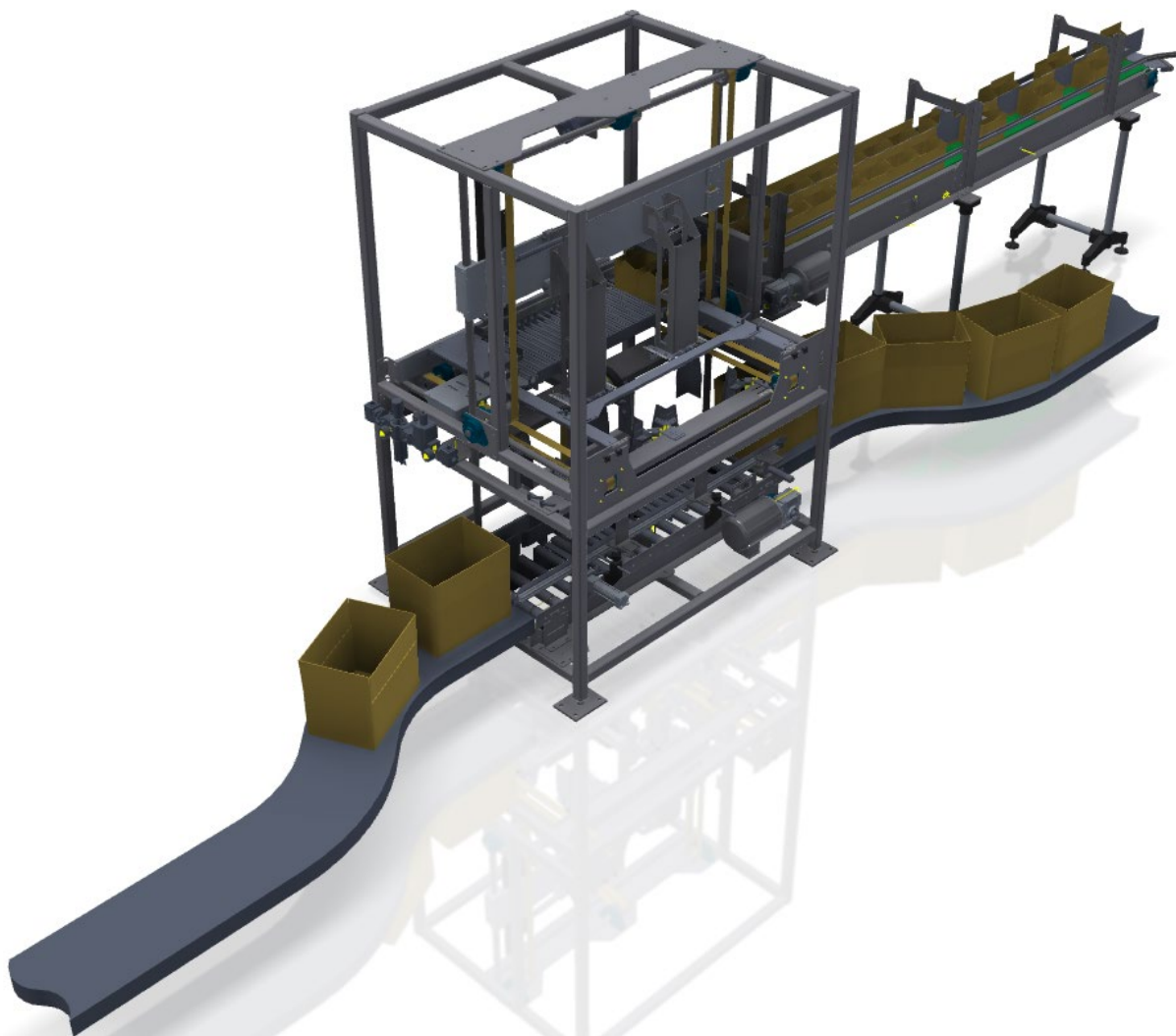
### **One day task (six hours)** – Mechanical Fabrication:

- To produce sheet metal parts and assemblies
- To produce metal frame parts and assemblies using Autodesk Inventor Frame Generator
- To add welded connections to parts and assemblies
- To add bolted connections to parts and assemblies
- To produce sheet metal and welding detail drawings.
- One animation showing full exploded or collapsing view sequence in file format .avi or other formats by request

The two-day National Final is a test of stamina, productivity, accuracy, and concentration. You will have to be able to work under pressure for long hours. The activities are more difficult at this level of competition than at the National Qualifier.

*National Qualifier – sample competition project*

**2018 NATIONAL FINAL**  
**MECHANICAL ENGINEERING CAD**  
**Mechanical Fabrication and Design Challenge**



**TASK:** Modelling from detail part drawings to create sheet metal parts and structural assemblies, animations and assembly drawings.

**Time:** 6.0 hours

**Given:** Part and Assembly Drawings, Sub-Assembly Drawings, Given Data Set

**Task:**

1. Create the frame assembly 539311L from given assembly and part drawings. Save assembly as 539311L\_V2.iam
2. Create 3D models for all of the sheet metal parts in the given drawings.
  - a. 540321 and 540318
  - b. 539609L and 540380L
  - c. 540326 and 540495L
3. Complete the Sub-Assembly OPT-539583 from the modelled and given parts as per the given drawing.
4. Create new iParts and iAssembly of the Support Legs for MOD-0110163, sizes as below:

| Leg Height | Base Width |
|------------|------------|
| 725mm      | 403mm      |
| 800mm      | 443mm      |
| 875mm      | 483mm      |
| 950mm      | 523mm      |
| 1025mm     | 563mm      |

Refer to given drawing for part details.

5. Suppress the existing Support Legs for MOD-0110163 and insert the correct newly created iAssembly. Refer to drawings for design details.
6. Assemble the complete Packaging Machine Assembly (2003115010162) in the correct assembly sequence as per parts list.
7. Produce an orthographic drawing with shaded isometric view of correct Leg iAssembly. Add an overlay view to show the minimum footplate position i.e. fully inserted. Add overall Height dimension for both footplate positions and overall Width dimension to the drawing views.
8. Produce a quality rendered image of the complete Packaging Machine Assembly in PNG format – image size 1024 x 748.
9. Produce the following animation in AVI format of the MOD-0110163 Assembly as follows:

| <b>Durations (s)</b> | <b>Description</b>  |
|----------------------|---|
| 0 – 2                | Show the assembly in isometric view. The original Leg Assembly should be visible. |
| 2–7                  | Camera flyover (360°)   |
| 7–10                 | Zoom in to show one of the Leg Assemblies   |
| 10-12                | Fade out the original Leg Assembly  |
| 13–15                | Show the new Leg iAssembly  |
| 15–19                | Show feet fully inserting to minimum height position                              |
| 19-21                | Zoom out to show full Assembly  |
| 21-23                | Show the assembly in isometric view. The new Leg iAssembly should be visible.     |

### **USE OF COMPUTER:**

Use of the computer is allowed from the beginning of the competition time.

### **OUTPUT:**

- Software Modelled Parts, Assemblies, Animations and Drawing Files.
- 1 (one) x printed Packaging Machine Assembly drawing on A2 sheet.
- 1 (one) x printed Leg iAssembly drawing on A2 sheet.
- 1 (one) x Rendered image of the complete Packaging Machine Assembly
- 1 (one) x Functional Animation

### **NOTES:**

- Rendering of animations must be completed within the 6 hour competition time.
- A maximum of 2 (two) test prints, per drawing, may be taken at any time during the duration of the competition.
- Final Printing may take place at the end of the 6 hours competition time.
- Missing information is to be completed at the competitor's discretion.
- All files are to be saved to a folder on your desktop which is named Day 1.

## MARKING

Total marks available for this task is 50 and is broken down into the following objective marks.

Objective marks as follows:

| Aspect               | Max Mark     |
|----------------------|--------------|
| Part Modelling       | 16.50        |
| Assemblies           | 15.50        |
| Assembly Drawings    | 7.00         |
| Rendered Image       | 4.00         |
| Functional Animation | 7.00         |
| <b>Total Marks</b>   | <b>50.00</b> |

## Pre-National Final Preparation

### *National finals training*

As part of the invitation to compete at the National finals, WorldSkills UK invites all competitors to a training event beforehand. This is an excellent opportunity for all competitors to boost their confidence in using the equipment in a safe environment while replicating the competition project and expectations. This training will not cover basic CAD skills and will be focused on providing an understanding of what to expect at the National Final.

This training will cover:

- Frame Generator
- Bolted Connections
- Weldments
- Sheet Metal
- Animation
- iParts and iAssemblies

This training will also be an opportunity to get to know the judges and fellow competitors.

## *National finals*

### What to expect

The National finals are the pinnacle of the competition cycle, where the best in the UK compete to be the number one. There are many skills in diverse sectors, so be prepared to do a lot of walking in potentially crowded areas as family, friends, and visitors try to get the best views of intense competitions.

The competition stand will be prepared with all the equipment necessary to compete.

## *Beyond the National finals*

Looking beyond the National finals, competitors have a host of opportunities.

Age-eligible competitors who show the highest level of skills, passion, and drive to compete may be invited to become a member of squad UK to compete for a place in team UK for EuroSkills and WorldSkills international competitions.

Those who are not eligible for international competitions may join the Champions programme, which allows continued involvement, including the opportunity to work with WorldSkills UK and visit schools, colleges, and events to inspire the next generations.

Alternatively, if you are interested in training, you could consider supporting WorldSkills UK with organising and training and even helping to run the National finals.

Get inspired and become a part of Team UK today!

## *Top Tips*

- Know Your Software Inside Out – Whether it's Autodesk Inventor or Fusion, be comfortable with modelling, assemblies, drawings, and animations.
- Keyboard Shortcuts & Customisation – Speed is key, so learn and use shortcuts, hotkeys and customised toolbars to reduce time spent navigating menus.
- Read instructions carefully before starting each task. Plan your time for each task that's to be completed.
- Study past WorldSkillsUK tasks and challenges to familiarise yourself with competition themes & expectations.
- Practice one or two small tasks and try to beat your own time or score several times.
- Save frequently.

