

MANUFACTURING AND ENGINEERING TECHNOLOGY

Mechanical Engineering CAD



WorldSkills Occupational Standards

WorldSkills Occupational Standards (WSOS)

Occupation description and WSOS

The name of the occupation is

Mechanical Engineering CAD

Description of the associated work role(s) or occupation(s)

Mechanical engineering computer aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of an engineering design. 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, manufacturing documentation, or other manufacturing processes.

The technical and engineering drawings and images must convey information such as materials, processes, dimensions and tolerances according to application-specific conventions. CAD may be used to design curves and figures in two-dimensional (2D) space or curves, surfaces and solids in three-dimensional (3D) space. 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 art and is the way projects come true. It is extensively used in many applications, including automotive, ship building and aerospace industries, and in industrial design. The CAD process and outputs are essential to successful solutions for engineering and manufacturing problems.

CAD software helps us explore ideas, visualize concepts through photorealistic renderings and movies, and simulates how a design project will perform in the real world.

General notes on the WSOS

The WSOS specifies the knowledge, understanding, and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSOS).

The skill competition is intended to reflect international best practice as described by the WSOS, and to the extent that it is able to. The Standard is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standard is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards. This is often referred to as the “weighting”. The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

Through the Test Project, the Marking Scheme will assess only those skills that are set out in the Standards Specification. They will reflect the Standards as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme will follow the allocation of marks within the Standards to the extent practically possible. A variation of up to five percent is allowed, provided that this does not distort the weightings assigned by the Standards.

WorldSkills Occupational Standards

Section	Relative importance (%)
1 Work organization and management	10

The individual needs to know and understand:

- The various purposes and uses for CAD designs
- Current internationally recognized standards (ISO)
- Standards currently used and recognized by industry
- Health and safety legislation and best practice including specific safety precautions when using a visual display unit (VDU) and in a work station environment
- Relevant theory and applications of mathematics, physics, and geometry
- Technical terminology and symbols
- Recognized IT systems and related professional design software
- The importance of accurate and clear presentation of designs to potential users
- The importance of effective communications and inter-personal skills between co-workers, clients and other related professionals
- The importance of maintaining knowledge and skill in new and developing technologies
- The role of providing innovative and creative solutions to technical and design problems and challenges

Section	Relative importance (%)
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry • Apply and promote health and safety legislation and best practice in the workplace • Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects • Access and recognize standard component and symbol libraries • Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings • Use recognized IT systems and related professional design software to consistently produce high quality designs and interpretations • Deal with systems problems such as error messages received, peripherals which do not respond as expected, and faults with equipment or connecting leads • Produce work that consistently meets high standards of accuracy and clarity in the design and presentation of designs to potential users • Effectively communicate and use interpersonal skills with co-workers, clients, and other related professionals to ensure that the CAD process meets requirements • Describe to clients and other professionals the role and purposes for CAD designs • Explain complex technical images to experts and non-experts, highlighting key elements • Maintain proactive continuous professional development in order to maintain current knowledge and skill in new and developing technologies and practices • Provide and apply innovative and creative solutions to technical and design problems and challenges • Visualize desired products in order to fulfil clients' briefs accurately 	
<p>2 Materials, software, and hardware</p>	<p>5</p>

The individual needs to know and understand:

- Computer operating systems to be able to use and manage computer files and software correctly
- Peripheral devices used in the CAD process
- Specific specialist technical operations within design software
- The range, types and uses of specialist product available to support and facilitate the CAD process
- The production process for designs
- The limitations of design software
- Formats and resolutions
- The use of plotters, printers, 3D printers and 3D scanners.

Section	Relative importance (%)
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The individual shall be able to:

- Power up the equipment and activate the appropriate modelling software
- Set up and check peripheral devices such as keyboard, mouse, 3D mouse, plotter, and printer
- Use computer operating systems and specialist software to create and manage and store files proficiently
- Select correct drawing packages from an on-screen menu or graphical equivalent
- Use various techniques for accessing and using CAD software such as a mouse, menu, or tool bar
- Configure the parameters of the software
- Plan production processes effectively to produce efficient work processes
- Use plotters and printers to print and plot work

3	3D modelling	30
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The individual needs to know and understand:

- Programmes in order to configure the parameters of the software
- Computer operating systems in order to use and manage computer files and software
- Mechanical systems and their functionality
- Principles of technical drawing
- How a component is assembled

The individual shall be able to:

- Model components, optimizing the constructive solid geometry
- Create families of components
- Ascribe characteristics to the materials (density)
- Ascribe colours and textures to the components
- Produce assemblies from 3D models of components
- Structure assemblies (sub-assemblies)
- Review base information to plan work effectively
- Access information from data files
- Model and assemble base components of project pieces
- Estimate approximate values for any missing dimensions
- Assemble modelled parts into sub-assemblies as required
- Apply graphics decals such as logos as required onto images
- Save work for future access

4	Create photo rendered images (2D) and creation of animations	10
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The individual needs to know and understand:

- The use of lighting, scenes and decals to produce photo rendered images
- How to demonstrate the working of an image

Section	Relative importance (%)
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The individual shall be able to:

- Save and label images to access for further use
- Interpret source information and accurately apply to the computer-generated images
- Apply material properties using information supplied from source drawings
- Create photo rendered images of components or assemblies
- Adjust colours, shading, backgrounds and camera angles to highlight key images
- Use camera settings to show better angles of the project
- Print completed images for presentation purposes
- Create functions relative to the operation of the system being designed, using industry programmes
- Create animations that demonstrate how different parts work are assembled

5	Reverse engineering of physical models	15
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The individual needs to know and understand:

- Materials and processes for obtaining unprocessed work pieces:
 - Castings
 - Welding
 - Machining
 - Simulation
- The process to transfer real objects to 3D images/3D models and then to technical drawings

The individual shall be able to:

- Determine dimensions on physical parts by using industry accepted instruments
- Create freehand sketches
- Use measuring instruments to produce accurate replicas
- Perform 3D Scans of models

6	Technical drawing and measuring	30
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The individual needs to know and understand:

- Working drawings in ISO standard together with any written instructions
- Standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard
- Rules of technical drawing and the prevailing latest ISO standard to govern these rules
- The use of manuals, tables, list of standards, and product catalogues

Section	Relative importance (%)
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Generate working drawings in ISO standard together with any written instructions • Apply standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard • Apply the rules of technical drawing and the prevailing latest ISO standard to govern these rules • Use manuals, tables, lists of standards, and product catalogues • Insert written information such as explanation balloons and parts lists with more than one column using annotation styles that meet ISO standards • Create 2D detail technical drawings • Create exploded isometric views 	
Total	100

References for industry consultation

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Occupational Standards on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (<http://www.ilo.org/public/english/bureau/stat/isco/isco08/>)
- ESCO: (<https://ec.europa.eu/esco/portal/home>)
- O*NET OnLine (www.onetonline.org/)

This WSOS appears to relate most closely to *Computer-Aided Manufacturing Operator*:
<http://data.europa.eu/esco/occupation/62979364-6fac-41f2-87ca-202bca19a6ab>

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Occupational Standards in place for WorldSkills Shanghai 2022.

Organization	Contact name
Lockheed Martin Corporation (Canada)	Vince DiPietro, Repair Engineering Manager, Aeronautics