

MANUFACTURING AND ENGINEERING TECHNOLOGY

# CNC Turning



## WorldSkills Occupational Standards

# WorldSkills Occupational Standards (WSOS)

## 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](http://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 (%)
<b>1 Work organization and management</b>	<b>5</b>

The individual needs to know and understand:

- The scope and limits of the workshop and the workspace
- Standards for the environment, safety, hygiene, and prevention of accidents
- Safety equipment (how to use, when to use, etc.)
- Different types of energy supplies for the CNC Lathe (electric, hydraulic, pneumatic)
- Basic Machine maintenance (Coolant-Maintenance, Machine-Lubrication, settings etc.)
- Machine Accessories such clamping devices, tailstock, part-catching devices, etc.
- The use and care of the available computer operating systems
- Programming, setting operating of CNC lathe with live tooling
- CNC-programming Systems (Din-ISO (G-Code writing), CAM software)
- Principles of technical design and process planning
- Mathematics, especially calculations in trigonometry
- Principles of cutting- and chip-removal technology
- The importance of effective communications and teamwork
- The importance of machinery-handbooks, datasheets, and tables
- The calibration, accuracy and use of measurement- and gauging tools

The individual shall be able to:

- Organize the workspace for optimal safety and performance
- Check the condition and functionality of the workspace, equipment, tools and materials
- Interpret and apply quality standards and regulations
- Promote and apply health and safety regulations and best practice
- Set up and operate CNC lathes safely
- Use computer related professional software effectively
- Consistently apply mathematical and geometrical principles for the programming processes of CNC Turning
- Select and apply appropriate cutting technology for the provided material, equipment and cutting tools
- Interpret and apply manufacturers' instructions
- Find appropriate data in a handbook, tables, or charts

Section	Relative importance (%)
<b>2 Interpret engineering drawings</b>	<b>10</b>

The individual needs to know and understand:

- ISO E and/or ISO A (European and American) drawing representation
- Technical terms and symbols used in drawings and plans
- Standards, symbols, and tables
- Technical data sheets
- Drawing legends

The individual shall be able to:

- Interpret engineering drawings and follow specifications
- Locate and identify dimensions of features
- Locate and identify surface finish requirements
- Locate and identify geometric specifications
- Make 3D mental representations of the parts
- Identify the materials that parts are made of
- Identify critical sequences (with a high possibility of damage or unsafe practice)

<b>3 Process planning</b>	<b>10</b>
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The individual needs to know and understand:

- The importance of good planning for reliable machining operation
- Successful timing of the selected sequences
- Identification of critical sections
- How material, tools and machine accessories will react in different cutting processes
- How material and clamping devices will react in the clamping process
- Methods of work holding techniques
- Methods to avoid crash or collision for the selected sequences
- The identification of work piece-features and the appropriate machining and measuring processes

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

- Imagine solutions with reference to the capacities of the workshop environment and the required work (size of batch, complexity)
- Identify the features of work pieces and the appropriate machining and measuring processes
- Identify and prepare the best work holding methods
- Identify, prepare, and calibrate the correct measuring tools
- Identify and prepare the correct cutting tools
- Identify critical sections (with a high possibility of damage or unsafe practice) and consider alternatives
- Imagine innovative ways of using the environment to solve technical issues
- Check if the potential solutions will be reliable until the end of the process
- Weigh each solution and choose the best (considering speed, safety, and price)
- Make a final choice and lock the strategy
- Plan the operations and sequences (machining strategy) based on specified data
- Create awareness actions for critical operations where no alternative is available

<b>4</b>	<b>Programming</b>	<b>10</b>
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The individual needs to know and understand:

- CNC Programming as the creation of a logical process plan
- Different methods and techniques to generate programs (manual, CAM etc.)
- CAM system programming and the techniques of tool-modelling and profile drawing
- Cutting effects on temperature, bending, force etc.
- Geometric complex constructions in work piece design
- Work holding devices
- Tool holding devices
- Machine-accessories
- How to select the cutting tools for machining the required materials and operations
- Mathematics (especially trigonometry)
- Speeds and feeds for different materials and tools and work holding devices
- How to choose the correct postprocessors
- Generating G-Code
- Dialoguing with the CNC Lathe
- How to use canned cycles to program work piece features (classic turning features as well as driven-tool features)

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

- Select the best methods according to the production type and part specification
- Use skill specific software and related hardware
- Generate programs using CAD/CAM systems
- Create CNC programs using the provided drawings and software
- Create or edit programs directly on the control (without CAD/CAM)

<b>5</b>	<b>Metrology</b>	<b>5</b>
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The individual needs to know and understand:

- Chip removal behaviour of provided materials and tools
- Temperature behaviour of provided materials, tools, and accessories
- Effects of cutting forces on material, tools, and accessories
- The range of tools and gauging instruments and their applications
- How temperature may influence measurements

The individual shall be able to:

- Select appropriate measuring- or gauging instruments
- Calibrate measuring tools
- Use selected tools to make measurements on all components on drawings
- The properties, uses, and handling of ferrous and non-ferrous materials

<b>6</b>	<b>Setting and operating CNC lathe</b>	<b>55</b>
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The individual needs to know and understand:

- The different steps that lead to the setup of the machine
- The different modes of machine operation
- The power up sequence
- How to initialize CNC lathes
- How to manipulate CNC lathes
- Mounting tools and setting tool parameters
- How to modify clamping devices, such as jaws, etc.
- How to transfer a CNC program to a CNC lathe, using provided software, cable, memory devices, or wireless technology
- How to test a programme, simulate, do a dry run etc.
- How to clamp a part correctly, and safely
- How to set a work shift and offset system
- How to run a programme safely
- How to stop and restart cycles
- How to make an emergency stop

Section	Relative importance (%)
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Follow their selected process strategy</li> <li>• Follow a given process- strategy (external CNC programme)</li> <li>• Upload generated CNC programmes to CNC lathes and perform test runs</li> <li>• Identify and designate the different machining processes on CNC lathes</li> <li>• Mount and align selected tools</li> <li>• Mount and align selected work holding devices</li> <li>• Mount and align selected accessories (Tailstock, Partscatcher, etc.)</li> <li>• Avoid vibration in the machining sequences</li> <li>• Apply burr-removal techniques on work pieces</li> <li>• Optimize machining strategies</li> <li>• Quickly react if anything goes wrong (making emergency stops)</li> <li>• obtain dimensions, geometries, surface roughness by interacting with CNC lathes</li> <li>• Make the final parts conform to blueprints</li> <li>• Report health, safety, and environmental issues to the appropriate personnel</li> <li>• Report equipment failure to the appropriate personnel</li> </ul>	
<b>7 Finalize and deliver work piece</b>	<b>5</b>
<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The procedures and calculations required for scheduling time with software and machinery</li> <li>• The importance of completing work pieces to the required standard within the given resources and capabilities</li> <li>• The circumstances in which referral should be made to other appropriate personnel</li> </ul>	
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Clean the parts</li> <li>• Deliver the parts, drawings and digital memory devices to the appropriate location and/or personnel as required by the organization</li> <li>• Dismount tools, clamping, accessories</li> <li>• Clean the machines</li> <li>• Set the environment to its initial state, ready for the next job</li> </ul>	
<b>Total</b>	<b>100</b>

## 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

- ISCO-08: (<http://www.ilo.org/public/english/bureau/stat/isco/isco08/>) ILO 7223
- ESCO: (<https://ec.europa.eu/esco/portal/home>)
- O\*NET OnLine ([www.onetonline.org/](http://www.onetonline.org/))

This WSOS appears most closely to relate to *“lathe and turning machine tool setters, operators, and tenders, metal and plastic”*:

<https://www.onetonline.org/link/summary/51-4034.00>.

and/or *“lathe and turning machine operator”*:

<http://data.europa.eu/esco/occupation/63042e8f-dd59-47fe-87f3-3b2ce21f196a>

Adjacent occupations can also be explored through these links.

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 2021.

Organization	Contact name
ABZ Braunau GmbH (Austria)	Dieter Geisberger, CEO
DMG MORI (Global)	Joerg Harings, Head of Training
DMG MORI Singapore PTE. LTD.	Kevin Goh, Technical Director
EMCO, GmbH (Austria)	Leopold Zerz, Sales Director
Siemens AG (Global)	Karsten Schwarz, Head of Training centre