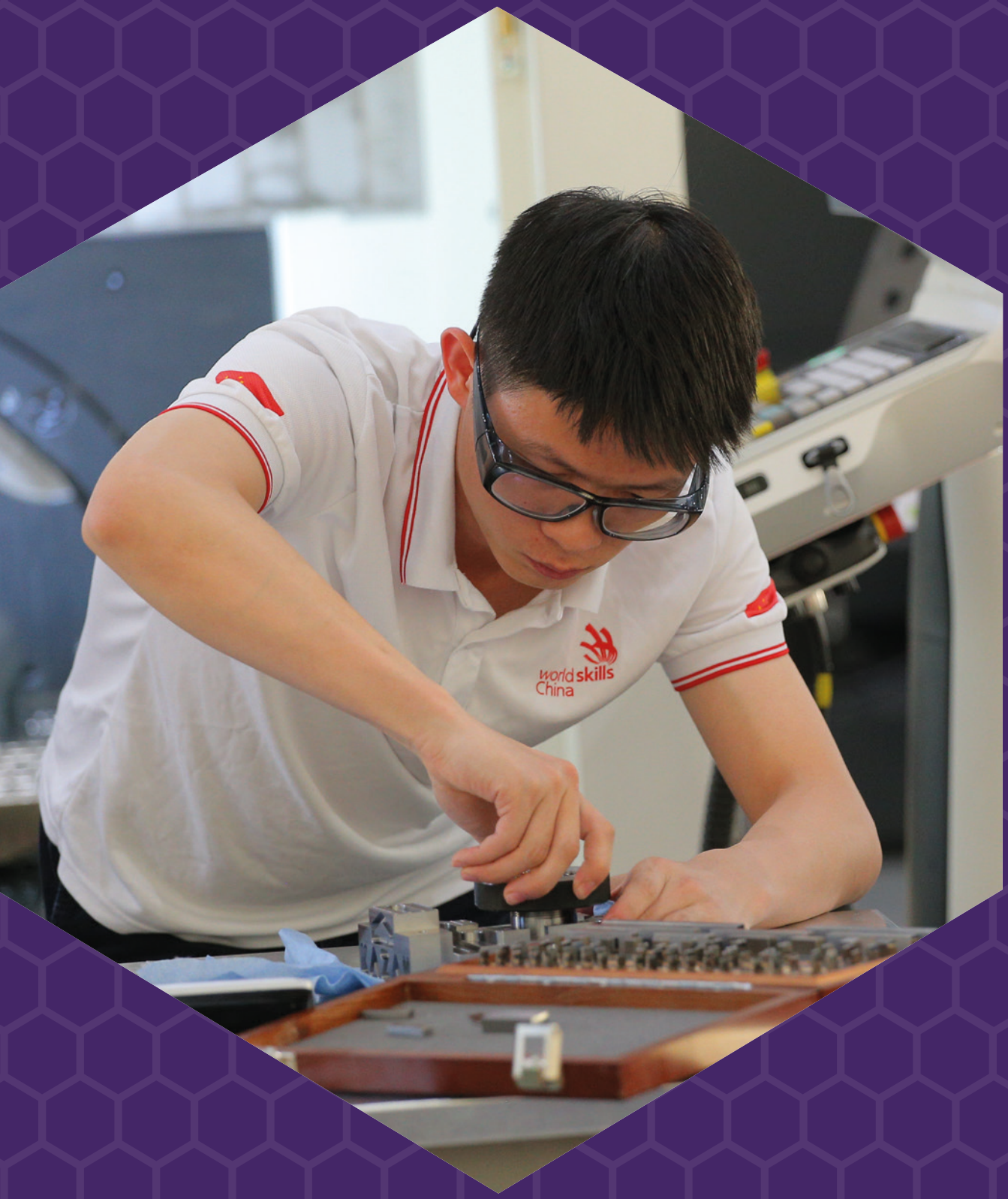
MANUFACTURING AND ENGINEERING TECHNOLOGY

CNC Milling



WorldSkills Occupational Standards

©WorldSkills International WSC2021^ V RNR / 6^BMB^ L hkkhm f

worldskills

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).

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 extent and impact of CNC-milling on modern life and industry
- Quality standards for materials and quality of metals
- Standards for the environment, safety, hygiene, and prevention of accidents at work
- Computer operating systems
- Mathematics, especially accurate and detailed calculations, and trigonometry
- Properties of materials, especially steel and aluminium
- Principles of technical design and process planning
- CNC equipment technology (Vertical and Horizontal Machining Centre)
- Programming by hand or CAM system software
- Cutting technology according to the parameters, material, equipment and cutting tools
- Health and safety regulations, legislation, and best practice
- The importance of adhering to manufacturers' operating instructions
- Ways to ensure the maintenance of sophisticated milling machines to promote efficient and reliable working
- The importance of effective communications and teamwork
- The importance of effective working methods with other professionals related to the CNC milling process

The individual shall be able to:

- Use computer related professional software
- Interpret and apply quality standards and regulations
- Promote and apply health and safety regulations and best practice
- Use IT and related professional software
- Apply mathematical and geometrical principles accurately for the preparation and programming processes for CNC milling
- Develop creative solutions to complex design or technology challenges

2	**Interpret engineering drawings and follow the specification**	**10**

The individual needs to know and understand:

- ISO 1 and/or ISO 3 (European and American) drawing representation
- Technical terms and symbols used in drawings and plans
- Standards, standards symbol, and tables
- Technical drawing legends

Section		Relative importance (%)
	The individual shall be able to: • Interpret and apply engineering drawings and follow specifications • Locate and identify main dimensions and secondary dimensions • Locate and identify ISO standards for surface finishes Locate and identify ISO standards for geometrical form and positional tolerances • Locate and identify ISO standards for geometrical form and positional tolerances	
3	**Process planning**	**15**
	The individual needs to know and understand: • The importance of good planning for the successful execution of programming and operation/machining • How to plan, based on the type of operation and the sequence (machining strategy) of the data that must be specified • Types of machining tools used in CNC technology including lathes, multi-axis spindles, wire electrical discharge machines, and milling machines • Methods of work holding according to the shape of the base material	
	The individual shall be able to: • Identify and set the different machining features • Identify the most efficient work holding solution to clamp the base material into the machine • Select the right cutting tools for machining • Define the cutting parameters as a function of the operation sequence, material type, and type of operation	
4	**Programming**	**20**
	The individual needs to know and understand: • Programming as the creation of a logical process plan • Different methods and techniques to generate the programs (CAM/CAD or manual) • CAM system programming • Skill related software	
	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 by using the CAD/CAM system with the format of the initial data • Start with drawings in paper format to create the geometry in wireframe and/or surface and/or solid	

Section		Relative importance (%)
5	**Metrology**	**10**
	The individual needs to know and understand: • The ranges of tools and gauging instruments and their applications • Main measuring techniques	
	The individual shall be able to: • Select and use appropriate measuring tools and instruments • Make measurements on threaded elements	
6	**Operating**	**15**
	The individual needs to know and understand: • The different steps that lead to setup machines • The different modes of machine operation	
	The individual shall be able to: • Prepare measurements and cutting tools • Identify and design the functional parameters for operation on the CNC milling machine	
7	**Machining**	**20**
	The individual needs to know and understand: • The different types of machine features • The machining sequence	

Section	Relative importance (%)

The individual shall be able to:
• Identify and designate the different machining processes on a CNC milling machine
• Optimize the machining strategy
• Define and adjust the cutting parameters as a function of the operation sequence, material type, type of operation, and CNC machine tool
• Start the cutting process from the raw material
• Solid block
• Perform the following machining operations:
  • Facing
  • Roughing and finishing
  • External contours
  • Island milling
  • Milling channels
  • Pocket (figurative)
  • Pocket (circular and rectangular)
  • Taper ribs
  • Thread milling
  • Internal
  • External
  • Canned cycles
  • Through hole boring
  • Blind hole boring
  • Reaming
  • Tapping
  • Drilling
  • 3D machining operations
  • Roughing
  • Finishing
• Tapping
• Drilling
• 3D machining operations
• Roughing
• Finishing	

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/) ILO 7223
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.**onet**online.org/)

The WSOS appears most closely to relate to: *Milling and Planing Machine Setters, Operators and Tenders*: https://www.onetonline.org/link/summary/51-4035.00

or *Milling Machine Operator*:
http://data.europa.eu/esco/occupation/a1c9f8b7-c4ce-4b15-ac3c- 3378c300d8f2

These links also enable a review of adjacent occupations.

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
GBR Mechanico Pte Ltd, (Asia)	Davizon Yee Khe Khum, Director
Hamilton Bonaduz AG, (Global)	Enrico Bellasi, Team Leader, Prototyping and Apprentices Mechanics
Prototyp-Werke GmbH (Global)	Wolfgang Lehmann, Team Leader Vocational Education
Sick Stegmann GmbH (Germany)	Stefan Mueller, Vocational Trainer
Siemens AG (Global)	Karsten Schwarz, Head of Training