

MANUFACTURING AND ENGINEERING TECHNOLOGY

Mechatronics



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).

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:

- Principles and applications of safe working generally and in relation to mechatronics
- The purposes, uses, care, and maintenance of all equipment and materials, together with their safety implications
- Environmental and safety principles and their application to good housekeeping in the work environment
- Principles and methods for work organization, control, and management
- Principles of team working and their applications
- The personal skills, strengths and needs that relate to the roles, responsibilities, and duties of others individually and collectively
- The parameters within which activities need to be scheduled

The individual shall be able to:

- Prepare and maintain a safe, tidy, and efficient work area
- Prepare self for the tasks in hand, including full regard to health, safety, and environment
- Schedule work to maximize efficiency and minimize disruption
- Select and use all equipment and materials safely and in compliance with manufacturers' instructions
- Apply or exceed the health and safety standards applying to the environment, equipment, and materials
- Restore the work area to an appropriate state and condition
- Contribute to team performance both broadly and specifically
- Give and take feedback and support

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| 2 Communication and interpersonal skills | 10 |
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The individual needs to know and understand:

- The range and purposes of documentation in both paper and electronic forms
- The technical language associated with the skill
- The standards required for routine and exception reporting in oral, written, and electronic form
- The required standards for communication with clients, team members, and others
- The purposes and techniques for generating, maintaining, and presenting records

| Section | Relative importance (%) |
|---------|-------------------------|
|---------|-------------------------|

The individual shall be able to:

- Read, interpret, and extract technical data and instructions from documentation in any available format
- Communicate by oral, written, and electronic means to ensure clarity, effectiveness, and efficiency
- Use a standard range of communication technologies
- Discuss complex technical principles and applications with others
- Complete reports and respond to issues and questions arising
- Respond to clients' needs face to face and indirectly
- Arrange to gather information and prepare documentation as required by the client

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| 3 | Developing mechatronics systems | 15 |
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The individual needs to know and understand:

- Principles and applications for:
 - Designing, assembling, and commissioning a mechatronics system
 - The components and functions of hydraulic and pneumatic systems
 - The components and functions of electrical and electronic systems
 - The components and applications of electrical drives
 - The components and applications of robotics and handling systems
 - The functions and applications of HMI and Vision Systems devices
 - The components and functions of PLC systems
 - The components and functions of safety devices
- Principles and applications of design and assembly of mechanical systems including pneumatic and/or hydraulic systems and safety devices, their standards, and their documentation
- Physical characteristics and applications of fluids and intelligent sensors
- Principles and applications for incorporating robots within the system

The individual shall be able to:

- Carry out systems design for given industrial applications
- Identify and resolve areas of uncertainty within the briefs or specifications
- Optimize the design within the parameters of the specification
- Assemble machines according to documentation
- Connect wires and tubes according to industry standards
- Incorporate robots within systems as required
- Incorporate HMI devices within the system
- Incorporate Safety devices within the system (Emergency-Stop, Safety-Sensors, Relays etc...)
- Install, set up and adjust as required the mechanical, pneumatics, electrical, and sensor systems to mechatronic systems
- Use complex sensors like Vision Systems, colour sensors, incremental systems, and parameterize them with the standard manuals
- Commission machines with the use of auxiliary equipment and a PLC, using their standards and documentation

| Section | Relative importance (%) |
|---------------------------------------|-------------------------|
| 4 Using industrial controllers | 20 |

The individual needs to know and understand:

- The functions, structures, and operating principles of PLCs (industrial controllers)
- The configuration of the industrial controller
- Industrial networks/bus systems
- The different interfaces for special signals like fast counters and also communications to periphery intelligent systems

The individual shall be able to:

- Integrate and connect PLCs to mechatronics systems
- Set-up an industrial network/bus system for communication between industrial controllers, HMI device or other distributed devices
- Make the necessary configurations of industrial controllers
- Configure all aspects of PLCs as required, together with the associated control circuitry for correct operation
- Set-up proper communications between and among controllers

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| 5 Software programming | 20 |
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The individual needs to know and understand:

- The methods by which software programmes relate to the actions of machinery.
- How to programme using standard industrial software
- How to create HMI interactive graphics
- How a software program relates to the action of machinery and systems

The individual shall be able to:

- Write programmes to control a mechatronic system
- Visualize the process and operation using software
- Programme PLCs, including digital and analogue signal processing and industrial field buses
- Programme HMI devices
- Programme useful and correct handshakes between PLCs.

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| 6 Circuit schematics | 10 |
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The individual needs to know and understand:

- The principles, applications, and standards for circuit schematics
- Methods for designing and assembling electrical circuits in mechatronic systems

| Section | Relative importance (%) |
|--|-------------------------|
| <p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Read and use pneumatic, hydraulic, and electrical circuit schematics • Design the circuits using modern software tools | |
| 7 Analysis, commissioning, and maintenance | 15 |
| <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • Criteria and methods for testing equipment and systems • Strategies for problem solving (fault finding, optimization) • Techniques and options for making repairs • Strategies for problem solving • Principles and techniques for generating creative and innovative solutions • Principles and applications of Total Productive Maintenance (TPM) | |
| <p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Test run individual modules and assembled systems • Review each part of the process against established criteria • Find faults in a mechatronic system using appropriate analytical techniques • Collect data with representations as diagrams (digitalization) • Repair components efficiently • Optimize the operation of mechatronic systems through analysis and problem solving • Optimize the operation of each module of mechatronics systems • Optimize the operation of mechatronic systems as a whole • Present assemblies to clients and respond to questions | |
| 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/)

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 |
|---|--|
| AZM Ausbildungszentrum Mittelland (Switzerland) | Gabriel Bolliger, Trainer VET Mechatronics |
| Forschungszentrum Jülich GmbH (Germany) | Mark Reuter |