Technical Description
Mechatronics

WorldSkills International, by a resolution of the Competitions Committee and in accordance with the Constitution, the Standing Orders, and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

The Technical Description consists of the following:

1 Introduction

1.1 Name and description of the skill competition

1.1.1 The name of the skill competition is

Mechatronics

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

Mechatronics combines skills in mechanics, pneumatics, hydraulics, electrics, electronics, computer technology, production digitalization technology (industrial ioT: RFID, NFC, wireless communication, PLC web-server, Cyber Security, Vision Systems, Augmented reality, etc), robotics and systems development. The computer technology element covers the programming of PLC's, robots and other handling systems and information technology applications, programmable machine control systems, and technology which enable communication between machines, equipment, and people.

Mechatronics technicians design, build, commission, maintain, repair, and adjust automated industrial equipment, and also program equipment control systems and human machine interfaces (HMI). They are also able to handle fluids in the field of industrial applications. Outstanding mechatronics technicians are able to meet a variety of needs within industry. They carry out mechanical maintenance and equipment building. They also deal with equipment for information gathering, components (sensors), and regulating units.

The mechatronics Technician abides by safety procedures and standards for industrial contexts, mostly where machinery is involved. They also know the importance of safety devices and know how to install them.

Industrial applications include automated production and process lines that include assembly, packaging, filling, labelling, and testing, as well as automated distribution and logistics systems.

1.1.3 Number of Competitors per team

Mechatronics is a team skill with two Competitors per team.

1.1.4 Age limit of Competitors

The Competitors must not be older than 25 years in the year of the Competition.

1.2 The relevance and significance of this document

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods, and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

1.3 Associated documents

Since this Technical Description contains only skill-specific information it must be used in association with the following:

• WSI – Code of Ethics and Conduct
• WSI – Competition Rules

- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations
- WorldSkills Standards and Assessment Guide (skill-specific)

2 The WorldSkills Occupational Standards (WSOS)

2.1 General notes on the WSOS

The WSOS specifies the knowledge, understanding, skills, and capabilities that underpin international best practice in technical and vocational performance. These are both specific to an occupational role and also transversal. Together they 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, to the extent that it can. 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 and capabilities that are set out in the WorldSkills Occupational Standards. 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, if this does not distort the weightings assigned by the Standards.

2.2 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 • Work efficiently to avoid waste of material and waste of energy	
2	**Communication and interpersonal skills**	**10**
	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	
3	**Developing mechatronics systems**	**15**

	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	
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, also OPC-UA • 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, other electronics and distributed devices as well with a PC via OPC-UA • 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	
5	**Software programming**	**20**
	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	

Section		Relative importance (%)
	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	
6	**Circuit schematic**	**10**
	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	
	The individual shall be able to: • Read and use pneumatic, hydraulic, and electrical circuit schematics • Design the circuits using modern software tools	
7	**Analysing, commissioning, and maintenance**	**15**
	The individual needs to know and understand: • 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)	
	The individual shall be able to: • 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 • Measure consumed energy with sensors and measuring devices	

Section	Relative importance (%)
Total	**100**

3 The Assessment Strategy and Specification

3.1 General guidance

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: Measurement and Judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards. The Test Project is the assessment vehicle for the skill competition, and therefore also follows the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed, developed, and verified through an iterative process, to ensure that both together optimize their relationship with the Standards and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, to demonstrate their quality and conformity with the Standards.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors for quality assurance and to benefit from the capabilities of the CIS.

4 The Marking Scheme

4.1 General guidance

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the WorldSkills Competition, in that it ties assessment to the standard that represents each skill competition, which itself represents a global occupation. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards.

By reflecting the weightings in the Standards, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill competition and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards, if there is no practicable alternative.

For integrity and fairness, the Marking Scheme and Test Project are increasingly designed and developed by one or more Independent Test Project Designer(s) with relevant expertise. In these instances, the Marking Scheme and Test Project are unseen by Experts until immediately before the start of the skill competition, or competition module. Where the detailed and final Marking Scheme and Test Project are designed by Experts, they must be approved by the whole Expert group prior to submission for independent validation and quality assurance. Please see the Competition Rules for further details.

Experts and Independent Test Project Designers are required to submit their Marking Schemes and Test Projects for review, verification, and validation well in advance of completion. They are also expected to work with their Skill Advisor, reviewers, and verifiers, throughout the design and development process, for quality assurance and in order to take full advantage of the CIS's features.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition. Skill Advisors actively facilitate this process.

4.2 Assessment Criteria

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived before, or in conjunction with, the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards; in others they may be different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme as a whole must reflect the weightings in the Standards.

Assessment Criteria are created by the person or people developing the Marking Scheme, who are free to define the Criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I). **The Assessment Criteria, the allocation of marks, and the assessment methods, should not be set out within this Technical Description. This is because the Criteria, allocation of marks, and assessment**

methods all depend on the nature of the Marking Scheme and Test Project, which is decided after this Technical Description is published.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria and Sub Criteria.

The marks allocated to each Criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each Aspect within that Assessment Criterion.

4.3 Sub Criteria

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form. Each marking form (Sub Criterion) contains Aspects to be assessed and marked by Measurement or Judgement, or both Measurement and Judgement.

Each marking form (Sub Criterion) specifies both the day on which it will be marked, and the identity of the marking team.

4.4 Aspects

Each Aspect defines, in detail, a single item to be assessed and marked, together with the marks, and detailed descriptors or instructions as a guide to marking. Each Aspect is assessed either by Measurement or by Judgement.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it. The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the Standards. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1 refers.)

		CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE
		A	B	C	D	E	F	G	H			
STANDARDS SPECIFICATION SECTION	1	5.00								5.00	5.00	0.00
	2		2.00					7.50		9.50	10.00	0.50
	3								11.00	11.00	10.00	1.00
	4			5.00						5.00	5.00	0.00
	5				10.00	10.00	10.00			30.00	30.00	0.00
	6		8.00	5.00				2.50	9.00	24.50	25.00	0.50
	7			10.00				5.00		15.00	15.00	0.00
TOTAL MARKS		5.00	10.00	20.00	10.00	10.00	10.00	15.00	20.00	100.00	100.00	2.00

SAMPLE OF TABLE FROM CIS

4.5 Assessment and marking

There is to be one marking team for each Sub Criterion, whether it is assessed and marked by Judgement, Measurement, or both. The same marking team must assess and mark all Competitors. Where this is impracticable (for example where an action must be done by every Competitor simultaneously, and must be observed doing so), a second tier of assessment and marking will be put in place, with the approval of the Competitions Committee Management Team. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (Section 4.6 refers.)

4.6 Assessment and marking using Judgement

Judgement uses a scale of 0-3. To apply the scale with rigour and consistency, Judgement must be conducted using:

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts, or separate guidance notes). This is documented in the Standards and Assessment Guide.
- the 0-3 scale to indicate:
  ◦ 0: performance below industry standard
  ◦ 1: performance meets industry standard
  ◦ 2: performance meets and, in specific respects, exceeds industry standard
  ◦ 3: performance wholly exceeds industry standard and is judged as excellent

Three Experts will judge each Aspect, normally simultaneously, and record their scores. A fourth Expert coordinates and supervises the scoring, and checks their validity. They also act as a judge when required to prevent compatriot marking.

4.7 Assessment and marking using Measurement

Normally three Experts will be used to assess each Aspect, with a fourth Expert supervising. In some circumstances the team may organize itself as two pairs, for dual marking. Unless otherwise stated, only the maximum mark or zero will be awarded. Where they are used, the benchmarks for awarding partial marks will be clearly defined within the Aspect. To avoid errors in calculation or transmission, the CIS provides a large number of automated calculation options, the use of which is mandated.

4.8 The use of Measurement and Judgement

Decisions regarding the choice of criteria and assessment methods will be made during the design of the competition through the Marking Scheme and Test Project.

4.9 Skill assessment strategy and procedures

WorldSkills is committed to continuous improvement including reviewing past limitations and building on good practice. The following skill assessment strategy and procedures for this skill competition take this into account and explain how the marking process will be managed.

The Competition Information System (CIS) will perform the calculations required for the allocation of time points. The assessment criteria must relate to the WorldSkills Occupational Standards in section 2.

The following criteria shall be added to the evaluation:

- Mechanical assembly (Assembly must ensure correct functioning of the system);
- The wiring of I/Os must be according to the given I/O table; Assessment can be based on wiring, function and/or position and adjustment;
- The maximum value of the time points will not exceed 20% of the total mark for the competition.

Competitors may not modify work pieces in any way during competition. Exceptions will be announced by the Chief Expert.

The main sponsor's support team provides spare and replacement parts for Competitors only during competition time. Exceptions will be announced by the Chief Expert. Assessment best

practices and procedures are described in the WorldSkills Standards and Assessment Guide and is shared with the Experts via the WorldSkills website.

Both Competitors in the team being assessed have to be present during the PLC-Function assessment procedure. Allocation assessment for In- and Output Signals as well the Professional Practice and HMI Judgment will be assessed without the present of the Competitors. Note: Experts are allowed to switch off the main power switch for the Workshop after the total assessment.

5 The Test Project

5.1 General notes

Sections 3 and 4 govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the applied knowledge, skills, and behaviours set out in each section of the WSOS.

The purpose of the Test Project is to provide full, balanced, and authentic opportunities for assessment and marking across the Standards, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme, and Standards will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards or affect the balance of marks within the Standards other than in the circumstances indicated by Section 2. This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards. Section 2.1 refers.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work. The Test Project will not assess knowledge of WorldSkills rules and regulations.

Most Test Projects and Marking Schemes are now designed and developed independently of the Experts. They are designed and developed either by the Skill Competition Manager, or an Independent Test Project Designer, normally from C-12 months. They are subject to independent review, verification, and validation. (Section 4.1 refers.)

The information provided below will be subject to what is known at the time of completing this Technical Description, and the requirement for confidentiality.

Please refer to the current version of the Competition Rules for further details.

5.2 Format/structure of the Test Project

The Test Project is a series of separately assessed modules.

5.3 Test Project design requirements

Test Projects should reflect the purposes, structures, processes, and outcomes of the occupational role they are based on. They should aim to be a small-scale version of that role. Before focusing on practicalities, SMTs should show how the Test Project design will provide full, balanced, and authentic opportunities for assessment and marking across the Standards, as set out in Section 5.1.

The Test Project is a series of separately assessed modules.

5.4 Test Project coordination and development

The Test Project MUST be submitted using the templates provided by WorldSkills International (www.worldskills.org/expertcentre). Use the Word template for text documents and DWG template for drawings.

5.4.1 Test Project coordination (preparation for Competition)

Coordination of the Test Project/modules will be undertaken by the Skill Competition Manager.

5.4.2 Who develops the Test Project/modules

The Test Project/modules are developed by an Independent Test Project Designer in collaboration with the Skill Competition Manager and the main sponsor.

5.4.3 When is the Test Project developed

The Test Project/modules are developed according to the following timeline:

Time	Action
Six (6) months prior to the Competition	Development of used equipment finished at main sponsor and order process starts Test of developed equipment Concept check by Independent Test Project Designer, main sponsor, and Skill Competition Manager
Three (3) months prior to the Competition	2nd test with equipment delivery at main sponsor
Two (2) months prior to the Competition	Draft task CIS – Template and task description ready to check with the Skill Advisor
One (1) month prior to the Competition	The Test Project documents are sent to the WorldSkills International Skills Competitions Administration Manager
At the Competition on C-4	The Test Project/modules are presented to Experts
At the Competition eat the beginning of each Competition Day.	The Test/Project modules are presented to Competitors

5.5 Test Project initial review and verification

The purpose of a Test Project is to create a challenge for Competitors which authentically represents working life for an outstanding practitioner in an identified occupation. By doing this, the Test Project will apply the Marking Scheme and fully represent the WSOS. In this way it is unique in its context, purpose, activities, and expectations.

To support Test Project design and development, a rigorous quality assurance and design process is in place (Competition Rules sections 10.6-10.7 refer.) Once approved by WorldSkills, the Independent Test Project Designer (ITPD) is expected to identify one or more independent expert(s), and trusted individuals initially to review the Independent Test Project Designer's ideas and plans, and subsequently to verify the Test Project, prior to validation.

A Skill Advisor will ensure and coordinate this arrangement, to guarantee the timeliness and thoroughness of both initial review, and verification, based on the risk analysis that underpins Section 10.7 of the Competition Rules.

5.6 Test Project validation

The Skill Competition Manager coordinates the validation of the Test Project/modules and will ensure that it can be completed within the material, equipment, knowledge, and time constraints of Competitors.

5.7 Test Project circulation

The Test Project/modules are not circulated prior to the Competition. The Test Project/modules are presented to Experts on C-4 and to Competitors at the beginning of each Competition Day.

Following information will be shared via the Mechatronics WorldSkills Discussion Forum prior to the Competition:

Time	Activity
Six (6) months prior to the Competition	The known stations and the robot type/Ready to use Station will be circulated via the WorldSkills Discussion Forum. The "Dangerous Tools" list with prohibited tools is circulated via the WorldSkills Discussion Forum.
Three (3) months prior to the Competition	Documentation about used new technology that should be trained on will be circulated via the WorldSkills Discussion Forum. No details about the module content and Function to be shared.
One (1) month prior to the Competition	Documentation about used new technology that Competitors have to know and use will be circulated via the WorldSkills Discussion Forum.

5.8 Test Project change

Due to the Test Project being developed by an Independent Test Project Designer (ITPD) there is no change required to be made to the Test Project/modules at the Competition. Exceptions are amendments to technical errors in the Test Project documents and according to infrastructure limitations.

5.9 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from www.worldskills.org/infrastructure located in the Expert Centre. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

6 Skill management and communication

6.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the WorldSkills skill-specific Discussion Forum. (http://forums.worldskills.org). Skill related decisions and communication are only valid if they take place on the WorldSkills Discussion Forum. The Chief Expert (or an Expert Lead appointed by the Skill Management Team) will be the moderator for this Discussion Forum. Refer to the Competition Rules for the timeline of communication and competition development requirements.

6.2 Competitor information

All information for registered Competitors is available from the Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

• Competition Rules
• Technical Descriptions
• Mark Summary Form (where applicable)
• Test Projects (where applicable)
• Infrastructure List
• WorldSkills Health, Safety, and Environment Policy and Regulations
• Other Competition-related information

6.3 Test Projects and Marking Schemes

Circulated Test Projects will be available from www.worldskills.org/testprojects and the Competitor Centre (www.worldskills.org/competitorcentre).

6.4 Day-to-day management

The day-to-day management of the skill competition during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and the Expert Leads. The Skill Management Plan is progressively developed in the six (6) months prior to the Competition and finalized at the Competition. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

6.5 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

Topic/task	Best practice procedure
Filming and photography	• After completion of all modules of the Test Project the Skill Competition Manager or Chief Expert will provide a 30 minutes timeslot to take pictures and filming in the workshops before the packaging of equipment starts.
Auxiliary resources for Interpreter	• Interpreter can use auxiliary resources in paper forms for the translation in front of the Competitors.
WorldSkills Standards and Assessment Guide	• Experts and Competitors shall bring at least one printed copy of the worldSkills Standards and Assessment Guide.

7 Skill-specific safety requirements

7.1 Personal Protective Equipment

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations.

Task	Ear Protection*	Safety glasses with side protection	Safety shoes with protective cap	Sturdy shoes	Tight fitting work clothes (long trousers
General PPE for safe areas				√	√
Using tubes longer than 500 mm, not fixed during commissioning		√	√		√
During working/ commissioning time in the workshop	√		√		√
During drilling, cutting, and using electrical screwdrivers	√	√	√		√
When Experts and interpreters entering the Competitor's workstation			√		√
During working on systems or sub systems with connected and activated compressed air	√	√	√		√
During working in the front of the monitor for programming	√		√		√

*Optional to ensure communication between the Competitors in the team.

The use of folding knives or knives with a fixed blade is prohibited due to the risk of injury.

8 Materials and equipment

8.1 Infrastructure List

The Infrastructure List details all equipment, materials, and facilities provided by the Competition Organizer.

The Infrastructure List is available at www.worldskills.org/infrastructure.

The Infrastructure List specifies the items and quantities requested by the Skill Management Team for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

At each Competition, the Skill Management Team must review and update the Infrastructure List in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition for the upcoming WorldSkills Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

8.2 Competitors toolbox

Competitors may bring more than one toolbox with the total external volume not exceeding 1.60 m³.

(Volume = Length x Height x Width, or V = L x H x W)

See Competition Rule 9.7.4 referring to the size of toolbox being exceeded.

Suitcases must be stored by the Competitors, not in the workshop.

8.3 Materials, equipment, and tools supplied by Competitors

Any commercially available tools may be used. This is subject to approval by the Workshop Manager from a safety perspective but must not taken away from commonly used "tools of the trade" as used by the Competitors in their everyday job. The use of dangerous tools is prohibited which is also documented in the "Dangerous Tools" list circulated six (6) months prior to the Competition via the WorldSkills Discussion Forum.

Competitors must supply their own tools:

Description	Quantity	Photo
Steel rule or measuring tape, at least 200 mm long	1-2	
Open-jawed spanners size 6 mm – 19 mm	1-2	
Adjustable spanner	1-2	
Socket set, 4 mm – 13 mm	1-2	
Side cutter	1-2	
Insulation-stripping tool	1-2	
Cable outer isolation remover tool	1-2	

Description	Quantity	Photo
Long nosed pliers set	1-2	
Standard pliers	1-2	
Wire end sleeve crimper	1-2	
Allen screwdriver, 0.9, 1.3, 1.5 – 8	1-2	
Screwdriver, cross-head or Philips, PZ0, PZ1, PZ2, PH0, PH1	1-2	

Description	Quantity	Photo
Screwdriver, flat, 2.5; 4.0; 6.5; 1.2 - 1.6	1-2	
Torx Set	1-2	
Tubing cutter; opening only 8 mm for safety reasons	1-2	
Fibre-optic cable cutter	1-2	
Small bench vice with G-Clamp	1	
Junior hacksaw	1	
Deburring tool	1	

Description	Quantity	Photo
Metal file	1	
Multimeter	1	
Dustpan and brush	1	
Hand Vacuum cleaner	1	

-
- When some special tools are needed, then this will be announced via the WorldSkills Discussion Forum;
- Competitors must bring at least three PLC's or one master PLC and distributed I/O system. The distributed I/O must be placed in/on separate stations. All PLCs or distributed I/O need to have at least 16 digital inputs and 16 digital outputs. At least one PLC/distributed I/O must have min. of two analogue inputs and one analogue output. SysLink and D-sub cables (reference main sponsor) are used to connect the PLC's/distributed I/O to digital and analogue terminals. The I/O cables specification will be announced by the Chief Expert via the WorldSkills Discussion Forum prior to the competition (at least six (6) months prior to the Competition);
- The minimum number of PLCs/distributed I/O (exact specification) required for the competition will be announced by the Chief Expert via the WorldSkills Discussion Forum prior to the Competition (at least six (6) months prior to the competition);
- Competitors must bring one HMI device (screen size approx. 5-7" and with at least 16 colour) in a frame that can be assembled on the front or on top of the profile plate (examples can be provided via the WorldSkills Discussion Forum). When HMI device is not required, then this will be announced on the WorldSkills Discussion Forum at least six (6) months prior to the competition;

- The PLCs need a wired network/bus system for communication between PLCs, HMI device, and system hardware. Therefore, Competitors have to bring with them network/bus system components;
- Competitors must supply computers, PLC, and HMI device programming software;
- Competitors must bring one Tablet device per Team for the work in the workshop and briefing area. App specification will be announced in the WorldSkills Forum. When the Tablet device is not required, then this will be announced via the WorldSkills Discussion Forum at least three (3) months prior to the competition;
- Software requirements must be specified three (3) months prior to the competition (if required);
- Last version will be announced via the WorldSkills Discussion Forum one (1) month prior to the Competition;
- The team is responsible for the provision of connectors, adaptors, plugs, and interfaces suitable for the Host Country/Region and for the PLC to any station;
- Competitors may supply their own consumables. A list of consumables will be announced on the WorldSkills Discussion Forum six (6) months prior to the competition;
- Competitors are not allowed to use prepared cables and tubes;
- Competitors are allowed to prepare air infrastructure during Familiarization Day;
- The electrical tool check will be done during Familiarization Day.

8.4 Materials, equipment, and tools supplied by Experts

Experts are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

Experts are responsible that Interpreters bring their PPE.

Furthermore they need to bring:

- Stopwatch;
- A printed copy of the WorldSkills Standards and Assessment Guide. Last version will be published via the WorldSkills website latest one (1) month prior to the Competition;

In case Experts are required to bring something with them, then this will be announced via the WorldSkills Discussion Forum at least one (1) month prior to the Competition.

## 8.5 Materials and equipment prohibited in the skill area

Competitors and Experts are prohibited to bring any materials or equipment not listed in section 8.3 and section 8.4.

- Competitors may not supply components as spare parts;
- List of tools not allowed will be announced via the WorldSkills Discussion Forum at least six (6) months prior to the competition.

8.6 Proposed workshop and workstation layouts

Workshop layouts from previous competitions are available at www.worldskills.org/sitelayout.

Example workshop layout
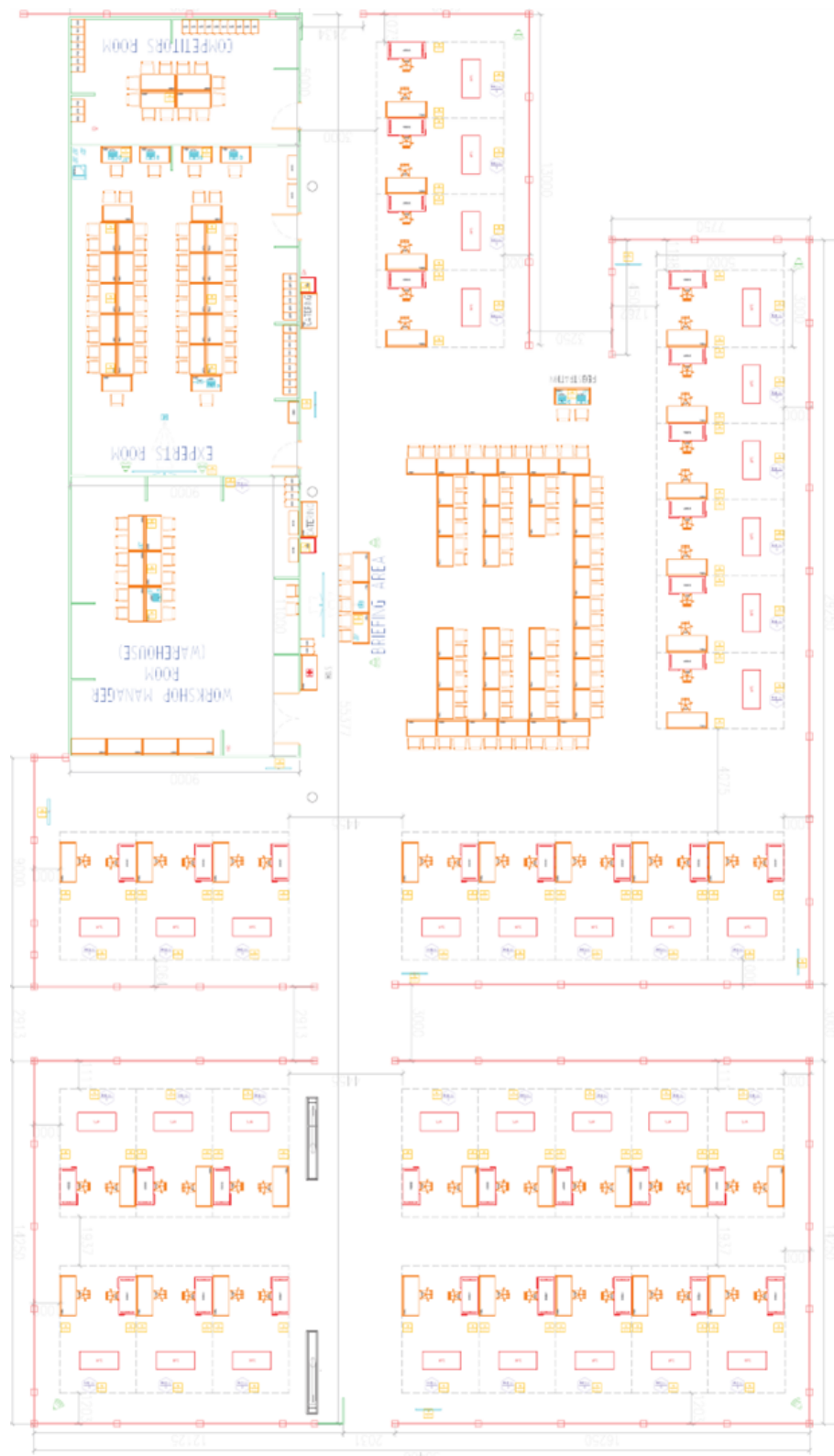
9 Skill-specific rules

9.1 General notes

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, Internet access, procedures and workflow, and documentation management and distribution. Breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System.

9.2 Skill-specific rules

Topic/task	skill-specific rule
Use of technology – USB, memory sticks	• Competitors are only allowed to use memory sticks provided by the Competition Organizer. • Memory sticks or any other portable memory devices provided by the Competition Organizer cannot be taken outside the workshop. • Memory sticks or other portable memory devices are to be submitted to the Chief Expert at the end of each day for safe keeping. These are returned at the beginning of each competition day.
Use of technology – personal laptops, tablets, and mobile phones	• Experts and Interpreters are allowed to use personal laptops, tablets, electronic translators, and mobile phones in the Expert room only. If these are brought into the workshop then they must be locked in the locker each day and can only be removed from the workshop at the end of C4. This rule is valid for C-4 until C4. • Skill Competition Manager and Chief Expert are allowed to use personal laptops, tablets, electronic translators, and mobile phones anywhere in the workshop for the purpose of competition management. • Competitors are not allowed to bring personal laptops, tablets, or mobile phones into the workshop. If these are brought into the workshop then they must be locked in the locker each day and can only be removed from the workshop at the end of C4. This rule is valid for C-2 until C4.
Filming and photography	• Filming or photographing at workstations during the Competition Days is strictly prohibited for all persons in the workshop. The Skill Competition Manager can nominate an independent person to do that in agreement with the Chair and Vice of the Competitions Committee or WorldSkills Director of Skills Competitions. The pictures/film will be provided to the Experts after the competition.

10 Visitor and media engagement

10.1 Engagement methods

Following is a list of possible ways to maximize visitor and media engagement:

The following ideas may be considered to maximize visitor and media engagement and is the responsibility of the Competition Organizer:

• Display screens - some web cams could be dispatched on the Competition area and show details of the task to the public and on a website;
• Test Project descriptions;
• Enhanced understanding of Competitor activity;
• Competitor profiles - For each Competitor team provide a sticker with the national flag, the name of the Competitor and a brief description of their studies;
• Daily reporting of Competition status;
• Do it yourself workshop - in the Mechatronic workshop provide an area where young people and public could implement Mechatronic systems. This activity could be managed by a couple of students of Mechatronics studies from the Host Country/Region. Those students could explain the way to become a Mechatronic technician and answer public questions;
• Display a video(s), which show how Mechatronics technicians work, what they do in their everyday work, how the machines work (which they build, maintain and repair), and what they do and learn in schools;
• Developing Mechatronics Test Projects in different countries/regions and presenting awards at the Competition;
• Support live streams by the Competition Organizer.

Mechatronics

11 Sustainability

11.1 Sustainable practices

This skill competition will focus on the sustainable practices below:

• Recycling;
• Use of "green" materials;
• Use of completed Test Projects after Competition;
• Transmission of the Test Project digitally to the Competitor's computer immediately prior to starting the Test Project;
• No Test Project printing;
• Use of local W-Lan with server function (used and piloted during WSC2022SE).

Mechatronics

12 References for industry consultation

12.1 General notes

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/)

12.2 References

This WSOS appears most closely to relate to Mechatronics Engineering Technician: http://data.europa.eu/esco/occupation/edf2e989-d7c5-496e-b365-81fc5cb9eb39.

Other adjacent occupations can be explored through these links.

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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 Lyon 2024.

Organization	Contact name
AVM Engineering AG	Patrik Reichmuth, Project Leader
Festo K.K.	Hisashi Hayashi, Manager of Didactic Department
Müller Martini AG	Janick Suter, Vocational Trainer
Rogers Germany GmbH	Johannes Strößner, Deputy Industrial Training Manager

13 **Appendix**

13.1 **Appendix information**

Not applicable.