Technical Description
Mechatronics

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, electronics, computer technology, production digitalization technology (RFID, NFC, wireless communication, PLC web-server, Internet of things, 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. 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 more common and visible mechatronics appliances include shop tills (belt and cash register assemblies) and automated bottle machines.

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

1.2 The content, relevance and significance of this document

This document incorporates a Role Description and Occupational Standards which follow the principles and some or all of the content of the WorldSkills Occupational Standards. In doing so WSE acknowledges WorldSkills International's (WSI's) copyright. WSE also acknowledges WSI's intellectual property rights regarding 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:

• WSE – Competition Rules
• WSI – WorldSkills Occupational Standard framework
• WSE – WorldSkills Europe Assessment Strategy
• WSE – Online resources as referenced in this document
• WSE – Code of Ethics and Conduct
• Host Country – Health and Safety regulations

2 The Occupational Standards

2.1 General notes regarding WSOS / WSEOS

Where appropriate WSE has utilised some, or all, of the WorldSkills International Occupational Standards (WSOS) for those Skills Competitions that naturally align between the two international competitions. Where the Skill is exclusive to the EuroSkills Competition, WorldSkills Europe has developed its own Occupational Standards (WSEOS) using the same principles and framework to that used for the development of the WSOS. For the purposes of this document the use of the words "Occupational Standards" will refer to both WSOS and WSEOS.

The Occupational Standards 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. Helpfully, for the global consultation on the WSOS in 2014-2021, around 50 percent of responses came from European industry and business.

Each Skill Competition is intended to reflect international best practice as described by the Occupational Standards, and to the extent that it is able to. The Occupational Standards 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 not be separate tests of knowledge and understanding.

The Occupational Standards are 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 Occupational Standards. The sum of all the percentage marks is 100.

The Marking Scheme and Test Project will assess only those Skills that are set out in the Occupational Standards. They will reflect the Occupational Standards as comprehensively as possible within the constraints of the Skill Competition.

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

2.2 Occupational Standards

Section		Relative importance (%)
1	**Work organization and self-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	

Section			Relative importance (%)
		• 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 and safety • 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	
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	
		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	

Section		Relative importance (%)
	• 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 hydraulics and pneumatics systems
	  ◦ the components and functions of electrical and electronic systems
	  ◦ the components and applications of electrical-drives
	  ◦ the components and applications of industrial robotics systems
	  ◦ the components and functions of PLC systems
	  ◦ the components and function for machine safety systems
	
	• principles and applications of design and assembly of mechanical systems including pneumatic and/or hydraulic systems, their standards and their documentation
	• principles and applications for incorporating industrial 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 industrial robots within systems as required • install, set up and adjust as required the mechanical, electrical and sensor systems • 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 • the functions and structures of industrial controllers (PLCs) • the configuration of the industrial controller • Industrial networks/bus systems, also OPC-UA and IO-Link • the methods by which software programs relate to the actions of machinery	

Section		Relative importance (%)
	The individual shall be able to: • connect PLCs to mechatronics systems • Set-up an industrial network/bus system for communication between industrial controllers and HMI device, other electronics and distributed devices as well with a PC via OPC-UA • make the necessary configurations of industrial controllers and distributed I/O devices also via IO-Link • configure all aspects of PLCs as required, together with the associated control circuitry for correct operation	
5	**Software programming**	**20**
	The individual needs to know and understand: • how to program using standard industrial software • how a software program relates to the action of machinery and systems	
	The individual shall be able to: • write programs to control a machine • visualize the process and operation using software • program PLCs, including digital and analogue signal processing and industrial field buses	
6	**Circuit schematics**	**10**
	The individual needs to know and understand: • the principles and applications for circuit schematics • methods for designing and assembling electrical circuits in machine and controller systems	
	The individual shall be able to: • read and use pneumatic, hydraulic and electrical circuit schematics • design the circuits using modern software tools	
7	**Analysis, commissioning and maintenance**	**15**
	The individual needs to know and understand: • criteria and methods for testing equipment and systems • analytical techniques for fault finding • 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)	

Section	Relative importance (%)
The individual shall be able to: • test run individual modules and assembled systems • review each part of the assembly process against established criteria • find faults in a mechatronic system using appropriate analytical techniques • repair components efficiently • optimize the operation of the machinery through analysis and problem solving • optimize the operation of each module of the mechatronics system • optimize the operation of the mechatronic system as a whole • present the assembly to the client and respond to questions • measure consumed energy with sensors and measuring devices	
Total	**100**

3 The assessment approach & principles

3.1 General guidance

Note: this Section and Section 4 summarize a great deal of new information and guidance regarding assessment. Please refer to the Competition Rules for greater detail.

The Competition Committee (CC) establishes the principles and techniques to which assessment at the EuroSkills Competition must conform.

Expert assessment practice lies at the heart of the EuroSkills 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 EuroSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the EuroSkills Competition falls into two broad types: measurement and judgement. All assessments will be governed by explicit benchmarks, referenced to best practice in industry and business.

The Marking Scheme must include these benchmarks and follow the weightings within the Occupational Standards. The Test Project is the assessment vehicle for the Skill Competition, and also follows the Occupational Standards. The CIS enables the timely and accurate recording of marks, and has expanding supportive capacity.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed and developed through an iterative process, to ensure that both together optimize their relationship with the Technical Description and the principles for assessment as set out in the WSE Assessment Strategy. They will be agreed by the Experts and submitted to WSE for approval together, in order to demonstrate their quality and conformity with the Occupational Standards.

Prior to submission for approval to WSE, the Marking Scheme and Test Project will be reviewed by the WSE Skill Advisors in order 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

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 Assessment overview

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

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 as 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.

During the evaluation with measurement method, only 3+1 experts and competitors can be inside the working area.

Competitors can ask for a second chance by using a second chance voucher during the evaluation of PLC program. Exceptions will be announced in Test Project.

Professional Practice Judgement maybe to done by independent and external assessors with a Practical test and training on C-1. (tbc)

4.10 Skill Assessment Procedures - Mark distribution

This section defines the assessment criteria and the number of marks (judgement and measurement) awarded. The total number of marks for all assessment criteria must be 100. The table below is advisory only for the development of the Test Project and Marking Scheme.

Section	Criterion	Marks		
Task		Judgement	Measurement	Total
A	Assembly, programming and commissioning of a Station (Task A1) and Maintenance and troubleshooting (Task A2)	7	26	33
B	Assembly, programming and commissioning of a production line (Task B)	7,5	26,5	34
C	Optimizing of a production line (Task C1) Maintenance and troubleshooting in a production line (Task C2)	5	28	33
	Total =	19,5	80,5	100

This mark distribution is given as an example only and doesn't match the evaluation sheets provided for each task.

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 skills in each section of the Occupational Standards.

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

The Test Project will not cover areas outside the Occupational Standards, or affect the balance of marks within the Occupational Standards other than in the circumstances indicated by Section 2.1.

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 the EuroSkills Competition's rules and regulations.

This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standard Specification. Section 2.1 refers.
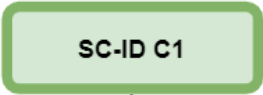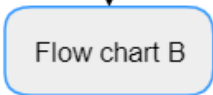
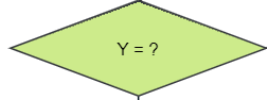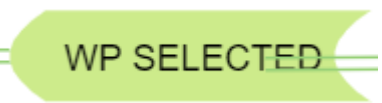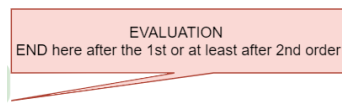## 5.2 Format/ structure of the Test Project
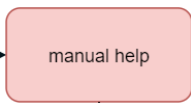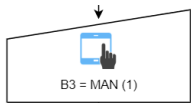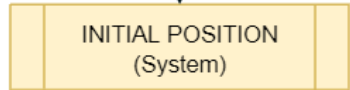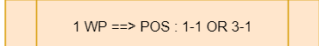
- Test Project with separately assessed modules

5.3 Test Project design requirements

Overall the Test Project must:

- Be modular.
- Be accompanied by a marking scale that will be finalized at the competition in accordance with Section 5.
- Be validated according to Section 5.5.
- Be supplied at the Competition site for Expert teams to develop the project with fully functioning equipment. This is to allow the Experts to form a consistent evaluation of the tasks with the working models.
- Be supplied with documentation clarifying the operation of special or new equipment for the Experts to finalize the Test Project.
- Be supplied with a library of photographs or drawings to clarify requirements of the tasks.
- The Flow Chart follows the following legend:

SC-ID C1	SC-ID C2	Flow chart B
Jump mark - from	Jump mark - to	Jump mark – to new page

manual help	B3 = MAN (1)	L2 : ON
Info for Action	Action to operate / hands-on	Status of lights / display
INITIAL POSITION (System)	1 WP ==> POS : 1-1 OR 3-1	
Init - movement	Process - movement	
INITIAL POSITION? (Evaluation)	Y = ?	
Decision from process results	Decision from value table	
WP SELECTED	see value table below	EVALUATION END here after the 1st or at least after 2nd order
Connecting to the Value table	Value table	Notes

Value table:

WP selected	WP detected	Y =
WP1	WP1	1
WP1	WPX	2
WP1	WP1usd	3

5.4 Test Project development

The Test Project MUST be submitted using the templates provided by WSE. Use the Word template for text documents and DWG template for drawings. Please contact jordy.degroot@worldskillseurope.org for guidance.

If the Test Project is designed by an Independent Test Project designer, then the Test Project must be designed in accordance with the WSE Independent Test Project Guide v1.1.

If your Skill wishes to have an Independent Test Project designer, you must ensure that WorldSkills Europe is made aware of this, so that it can be assured that there is proper funding in place, or that the Independent Test Project designer is aware that he/she will do this task free of charge.

5.4.1 Who develops the Test Projects or modules

The Test Project / modules are developed under the supervision of:

• Chief Expert, ITPD

5.4.2 How and where is the Test Projects or modules developed

The Test Project or modules are developed in the following manner:

• Other, to be specified here:
  ◦ The Test Projects tasks are developed in close cooperation with the R&D and Product Management of FESTO, the ITPD, Chief Expert

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At the previous Competition	Not applicable
6 months prior to the Competition	• Concept of the TP finished until 6 months before the current Competition • Development of used Equipment finished at main sponsor and order process starts • Test of developed Equipment • Concept check by Test Project Designer, main sponsor and CE
3 months prior to the Competition	2nd Test with Equipment delivery at main sponsor
2 months prior to the Competition	Draft Task CIS-Template and Task description ready to check with the Skill Advisor
1 month prior to the Competition	Tasks ready for the Skill Competition
At the Competition	Not applicable.

5.5 Test Project validation

It will be demonstrated that the Test Project/modules can be completed within the material, equipment, knowledge and time constraints. The assembly and testing of the Test project will be done before the Competition.

5.6 Test Project selection

• Other:
  ◦ The tasks are closely associated to the hardware used – so no significant changes can be made shortly before the competition. Tasks for troubleshooting and optimizing can be defined at the competition and represent 30% of the total score.

5.7 Test Project circulation

Please note that if a Test Project is known by the Chief- and/or Deputy Chief Experts, and/or any of the other Experts, it must be shared via the forums before the start of the Competition. This also means that this Test Project is subject to a 30% change before the start of the Competition.

The Test Project is circulated via the website as follows:

- Other:
  - 6 months before the competition 1 station from 2 or 3 stations of the Test Project will be announced via the discussion forum. The tasks in Skills Competition Mechatronics are closely associated to the hardware used – so no significant changes can be made shortly before the competition. Tasks for troubleshooting and optimizing can be defined at the competition and represent 30% of the total score.

5.8 Test Project coordination (preparation for competition)

Coordination of the Test Project will be undertaken by:

- Chief Expert

5.9 Test Project change at the competition

Not applicable

5.10 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitors to complete the Test Project will be supplied by the Host Organization and are available via the forums. 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.

PLC, HMI and distributed I/O specifications and quantity are to be posted on the Discussion Forum at least 6 months before the Competition by the Chief Expert.

5.11 Software specifications

6 Skill management and communication

6.1 Discussion forum

Prior to the EuroSkills Competition, all discussion, communication, collaboration, and decision making regarding the Skill Competition must take place on the skill specific Discussion Forum, which can be reached via www.worldskillseurope.org. Skill related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be the moderator for this Forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

6.2 Competitor information

All information for registered Competitors is available from the WorldSkills Europe website www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

The information includes:

- Competition Rules
- Technical Descriptions
- Test Projects
- Infrastructure List
- EuroSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

6.3 Test Projects and Marking Schemes

Circulated Test Projects will be available at the WorldSkills Europe website from www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

6.4 Day-To-Day management

The day-to-day management of the Skill Competition during the EuroSkills Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed at www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

7 Skill specific safety requirements

7.1 Requirements

Refer to Host Country/Region Health and Safety documentation for Host Country/Region regulations. This document will be shared via the forums. One overall Health and Safety document will be published, as well as Skill specific safety requirements.

8 Materials and equipment

8.1 Infrastructure List

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

The Infrastructure Lists will be available at the WorldSkills Europe website from www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

The Infrastructure List specifies the items and quantities requested by the Experts for the next Competition. The Host Organization will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items.

At each Competition, the Experts must advise the Competition Manager 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.

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

WorldSkills Europe aims to minimize the sending of toolboxes as much as possible. We therefor ask you to keep this in mind when writing the section below. Please be advised that competitors should bring as little as possible and what they do bring **MUST** be true hand tools. Only items are allowed that would significantly affect their ability to perform the task and deliver the Test Project to a high standard.

The total exterior volume of the shipping box / container / suitcase, containing the toolboxes must not exceed 1.3m³.

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

Exampl: Euro palett by 1,2 m x 0,8 m and total hight by 1,35 m.

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

8.3 Materials, equipment and tools supplied by Competitors in their toolbox

- Any commercially available tools may be used. This is subject to approval by the Expert team from a safety perspective.
- Competitors must supply their own tools.
- Recommended tools to work with the tasks:
- Steel rule or measuring tape, at least 200 mm long
- Open-jawed spanners size 6 - 19 mm
- Adjustable spanner
- Socket set, 4 - 13 mm
- Side cutter
- Insulation-stripping tool
- Cable outer isolation remover tool

- Long nosed pliers
- Standard pliers
- Wire end sleeve crimper
- Allen screwdriver, 0.9, 1.3, 1.5 - 8
- Screwdriver, cross-head or Philips: PZ0, PZ1, PZ2, PH0, PH1
- Screwdriver, flat, 2.5; 4.0; 6.5; 1.2 - 1.6
- Tubing cutter, opening only 8 mm for safety reasons
- Fiber-optic cable cutter
- Small bench vice with G-Clamp
- Junior hacksaw
- Deburring tool
- Metal file
- Multimeter
- Dustpan and brush
- Vacuum cleaner

When some special tools are needed, then this will be announced in the forum.

Competitors must bring at least 2 PLCs or one master PLC and distributed I/O system. It will be announced by the Chief Expert in the forum (at least 6 months before the competition). The distributed I/O must be placed in/on separate stations. All PLCs need to have at least 16 digital inputs and 16 digital outputs and IO-Link Master with 4 ports. Each PLC (distributed I/O module) must have min. of 2 analogue inputs and 1 analogue output. SysLink and D-sub cables (reference Festo Didactic) are used to connect the PLC's to digital and analogue terminals. The I/O cables specification will be announced by the Chief Expert in the forum (at least 6 months before the competition).

- The minimum number of PLCs (exact specification) required for the competition will be announced by the chief expert in the forum before the competition.
- Competitors must bring one HMI device (screen size approx. 5-7" and with at least 16 color) in a frame that must be assembled on the front or on top of the profile plate (examples can be provided in the forum). When HMI device is not required, then this will be announced in the Discussion Forum at least six months before the competition
- The PLCs need a network/bus system for communication between PLCs, HMI device and system hardware. Therefore, competitors have to bring with them network/bus system components.
- Wireless communication PC to PLC and PLC to PLC is not allowed.
- Competitors must supply computer(s) and PLC, HMI device programming software.
- Competitors can bring a printed copy of the Professional Judgement document. Last version will be announced in the forum 1 month before the competition.
- The team is responsible for the provision of connectors, adaptors, plugs, and interfaces suitable for the host country and for the PLC to any station.
- Competitors can bring consumables. A list of allowed consumables will be annouced on C-6M via tha WorldSkills Europe Forum.
- 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 the Familiarization Day.

8.4 Materials, equipment and tools supplied by the Experts

- Stop watch.
- Experts can bring a printed copy of the Professional Judgement document. Last version will be announced in the forum 1 month before the competition.
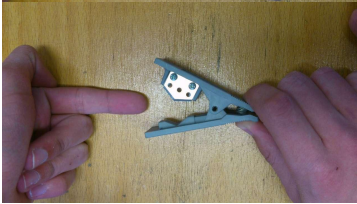
• When the experts have to bring something else with them, then this will be announced in the forum at least 1 month before the competition.

8.5 Materials, equipment and tools prohibited in the Skill area

• Competitors may not supply components as spare parts.
• Please find a list of prohibited items below. Please note that this list also identifies which items are allowable in some cases:

Knives

Pos	Comment	Allowed	Forbidden
K1	Unprofessionelle selbst erstellte Werkzeuge Unprofessional selfmade tools		
K2	Kabelentmantler cable insulation		
K3	Abmantelmesser mit Hakenklinge „Secura" cable insulation with hook blade		
K4	Klappmesser NO Jackknife / knives / open blades		

Pos				
K5	Teppichmesser mit arretierbarem Schieber Carpet knife with lockable slider			
K6	Werkzeug zum Lichtleiter kürzen Shorten tool for fiber optic			Weites öffnen über die Zuführlöcher Wide open on the supply holes
K7	Arbeitsschere mit max 10 cm Klingenlänge Scissors with max 10 cm blade length			
K8	Schlauch- / Kunststoff-Schere Mit Begrenzung auf 8 mm Öffnung erlaubt Hose / plastic scissors Allowed limit of 8 mm opening			

Pliers

Pos	Comment	Allowed	Forbidden
P1	automatische Abisolierzange automatic Wire Stripper		

P2	Seitenschneider side Cutter		
P3	Kabelschneider cable Cutters		
P4	Grimp Zange Grimp pliers		

Appendix

A proposal for modifications for the ZRS pipe cutters (K8) see pictures 1.

For the pipe cutter the opening of the blades is limited by a steel pin to apply

Picture 1

Picture 2

For the pipe cutter below the opening is limited by a steel pin to apply inside the spring.

Picture 3

The results of the applied steel pins for both pipe cutters:

With a small modification it is safer work.

Picture 4

Picture 5

8.6 Workshop Layout

Workshop layouts from previous competitions are available by contacting the Competition and IT Coordinator at: jordy.degroot@worldskillseurope.org. New Workshop Layouts will be communicated via the forums when completed.

Please be advised that you will have the opportunity to discuss your Workshop Layout proposal with the Host Organization during the Skills Development Workshop (SDW) and the Competition Preparation Meetings (CPM).

For workshop layout development, please refer to the forums.

9 Skill-specific rules

9.1 Introduction

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 Personal laptops – USB – memory sticks – mobile phones

- 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 or to the Deputy Chief Expert at the end of each day for safe keeping. These are returned at the beginning of each competition day.

9.3 Personal photo cameras – video taking devices

- Experts 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 C3. This rule is valid for C-3 until C3.
- Chief Expert, and Deputy Chief Expert are allowed to use personal laptops, tablets, electronic translators, and mobile phones anywhere in the workshop for the purpose of competition management.

9.4 Communication between compatriot experts and competitors

- Filming or photographing at workstations during the Competition Day is strictly prohibited for all persons in the workshop. The CE can nominate an independent person to do that in agreement with the Chair and Vice of the Competitions Committee or Director of Skills Competitions. The pictures/film will be provided to the Experts after the competition

9.5 **Other**

Task distribution and Q&A

Via a Skill Mechatronics internal WiFi Network, Competitors will get connection to an Competitor Communication System (CCS). Questions about the Task can be placed there and will be answered by a specific Expert group. All Questions and answers are visible for all participant.

The Task will be distributed in paper with only one set per Team. Furthermore the Task Description, pictures, drawings, data sheats, circuit diagramms, device software, will be available via the CCS.

10 Visitor and media engagement

10.1 Engagement

Following is a list of possible ways to maximize visitor and media engagement, within the remit of the Competition Rules:

- 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 Member. Those students could explain the way to become a Mechatronics 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 competitions in different countries and presenting awards at the Competition.

11 Sustainability

11.1 Sustainability

This Skill Competition will focus on the sustainable practices below:

- Recycling
- Use of 'green' materials
- Use of completed Test Projects after Competition
- Reduced allowed Consumables bringing by Competitors
- Availability of the Test Project digitally for the Competitor's computer immediately before starting the task.
- No invest for Host in Tools, Programming and Controller Equipment that already exist and will be used by participant for training and Skill Competitions
- No Test Project printing (max. 1 Set per Team)
- Use of local W-Lan with server function (used and piloted during WSE 2023).