Technical Description

Industrial Control

Manufacturing and Engineering Technology

worldskills

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:

Effective 22.08.18

Stefan Praschl
Chair of the Competitions Committee

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Vice Chair of the Competitions Committee

1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

Industrial Control

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

Industrial Control contains elements of both electrical installations and automation installations, with greater emphasis on automation installation. The industrial control practitioner requires a wide range of technical skills, such as installing conduits, cables, instruments, I/O devices and Programmable Logic Controllers. The industrial control practitioner also designs electrical circuits, programs Programmable Logic Controllers, parametrizes bus systems and configures Human Machine Interfaces.

The working environment is likely to be one that is potentially very dangerous and hazardous. The industrial control practitioner proactively promotes best practices in health and safety and rigorously adheres to health and safety legislation.

Trouble-shooting is an important skill of the industrial control practitioner and includes identifying problems during equipment installations in a new plant or remedying problems within an existing plant.

The industrial control practitioner has a wide range of industrial settings in which to work. They may be employed in one particular plant and install and maintain production equipment; or they may be employed by a sub-contractor and work in a number of industrial settings.

Delays in production as a result of reliability issues on the production line can have business implications not only financially but also for the company's reputation. Therefore, the industrial control practitioner needs to work efficiently and effectively to meet time constraints, while also providing expert advice and guidance to management on both technical production issues and on innovative and cost-effective solutions to production problems and requirements. A key skill of the practitioner is troubleshooting, identifying problems during installation, or remedying problems with an established plant.

1.1.3 Number of Competitors per team

Industrial Control is a single Competitor skill competition.

1.1.4 Age limit of Competitors

The Competitors must not be older than 22 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 – Competition Rules
- WSI – WorldSkills Standards Specification framework
- WSI – WorldSkills Assessment Strategy
- WSI Online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations

2 THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

2.1 GENERAL NOTES ON THE WSSS

The WSSS specifies the knowledge, understanding and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSSS).

The skill competition is intended to reflect international best practice as described by the WSSS, and to the extent that it is able to. The Standards Specification 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 Standards Specification 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 Specification. This is often referred to as the "weighting". 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 Standards Specification. They will reflect the Standards Specification 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 Standards Specification to the extent practically possible. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Standards Specification.

2.2 WORLDSKILLS STANDARDS SPECIFICATION

SECTION		RELATIVE IMPORTANCE (%)
1	**Work organization and management**	**10**
	The individual needs to know and understand: • Health and safety regulations and best practice, especially in relation to hazardous working environments and the variety of locations and industrial settings where the work may be conducted • Safety requirements relating to plant and equipment • SIL levels of safety and the application to relevant industries • The importance of site safety inductions • The range of safety equipment used to protect self and others and the application relating to various industries • The types of hazards that may be encountered in industrial settings • The importance of effective communications and interpersonal skills	
	The individual shall be able to: • Consistently promote and comply with health and safety regulations and industry best practices in all working environments • Correctly use all safety equipment and personal protection equipment (PPE), lock off systems, and warning indicators • Recognize hazards and potentially hazardous situations and take appropriate actions to minimize risk to self and others • Work effectively as part of a team • Communicate effectively with other professionals including work-shop supervisors and other staff where installations are being carried out • Explain complex mechanical and engineering projects to colleagues who may not have specialist knowledge • Provide expert advice and guidance regarding on-going use, care, and maintenance of equipment • Think logically and work systematically	
2	**Circuit design and modification**	**10**
	The individual needs to know and understand: • Principles of technical specification diagrams • Special technical terms and symbols • Principles and functions of relay/contactor circuits and electro pneumatics	
	The individual shall be able to: • Read and interpret and make additions to technical diagrams in a simulation software according to a function description • Advise on modifications to circuit design • Interpret drawing standard sections (DIN ISO 1219) that are to be used • Design electrical circuits	

3	**Making of the automation control panel/centre**	**15**
	The individual needs to know and understand: • Terminology and symbols used in technical specifications and diagrams • Principles of technical drawing, circuit diagrams, layouts, function descriptions, and terminal drawings • Uses and layout of operation manuals • Electrical and mechanical tools used in panel building activities, such as drilling and cutting • Lean manufacturing processes (wastes etc.) • Responsibility/liability to the customer (extra holes, dirt, damages)	
	The individual shall be able to: • Read, understand, and interpret complex technical drawing, circuit diagrams, layouts, function descriptions, and terminal drawings • Apply information from technical specifications to effective work planning and solutions to engineering and operational problems • Install ducts, terminals, components, and wiring of the control panel according to the drawings and given tolerances • Complete appropriate panel building operations according to specifications • Interpret operations manuals and follow guidelines and instructions	
4	**Field Installation (electrical and automation)**	**25**
	The individual needs to know and understand: • Issues and challenges of the installation of field components • Principles of technical drawings, layouts of installations and control panels, circuit diagrams, and flow charts • Principles and functions of all components used in field installation • Importance of accurate measuring and calculations during field installations	
	The individual shall be able to: • Measure and calculate the correct positions for the components to be installed • Prepare and install wire trays within given tolerances • Install conduits, cables, devices, instruments, and control centre fittings • Install complex cabling systems that combine power and communications • Plan work effectively to meet time schedule requirements • Use all tools effectively and safely without risk to self or others in the workplace • Test and commission installed equipment • Complete all necessary documentation following installation	

5	**Programming**	**30**
	The individual needs to know and understand: • Principles of technical specifications and diagrams • Processes of controlling motors, valves, and other devices used in industrial control • HMI and PC-based HMI/Visualization to communicate with the PLC code • Setting of input limits • Uses of industry accepted equipment such as PLC, HMI, VFD/VSD, and distributed IO • Distributed IO based and industrial Bus Technologies • Industry 4.0 technology ready • IEC sequence-programming methods (IEC 61131-3)	
	The individual shall be able to: • Create programmes according to written specifications and diagrams • Configure the HMI-screens according to written specifications and diagrams • Configure the VSD as required in the function description • Test functions thoroughly and safely • Demonstrate functions to users and provide expert advice and guidance • Conform to IEC sequence programming specifications	
6	**Fault-finding**	**10**
	The individual needs to know and understand: • Safety risks during the fault-finding process • Principles of written specifications, technical drawings, and circuit diagrams • Components and symbols of the relay-based circuit diagrams • Principles of the Relay Control Fault Finding using a multi-meter • Principles and functions of the common Industrial relay/contactor control circuits • Principles and functions of PLC diagnostics • Field Bus Diagnostic principles	
	The individual shall be able to: • Apply all safety precautions • Read, understand, and interpret complex written specifications and diagrams, understanding all technical symbols • Analyse the correct principles of fault finding • Recognize incorrect principles of fault finding • Utilize the correct fault-finding principles • Utilize a range of tools and software to isolate faults	
	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 Specification. The Test Project is the assessment vehicle for the skill competition, and also follows the Standards Specification. 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 Standards Specification and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, in order to demonstrate their quality and conformity with the Standards Specification.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI 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 standards that represent the skill. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards Specification.

By reflecting the weightings in the Standards Specification, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill 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 Specification, if there is no practicable alternative.

The Marking Scheme and Test Project may be developed by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project must be approved by the whole Expert Jury prior to submission for independent quality assurance. The exception to this process is for those skill competitions which use an independent designer for the development of the Marking Scheme and Test Project. Please see the Rules for further details.

Experts and independent designers are required to submit their Marking Schemes and Test Projects for comment and provisional approval well in advance of completion, in order to avoid disappointment or setbacks at a late stage. They are also advised to work with the CIS Team at this intermediate stage, in order to take full advantage of the possibilities of the CIS.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition using the CIS standard spreadsheet or other agreed methods.

4.2 ASSESSMENT CRITERIA

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived in conjunction with the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards Specification; in others they may be totally 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 Specification.

Assessment Criteria are created by the person(s) developing the Marking Scheme, who are free to define 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). It is advisable not to specify either the Assessment Criteria, or the allocation of marks, or the assessment methods, within this Technical Description.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment 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) specified 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, or instructions for how the marks are to be awarded. Aspects are assessed either by measurement or 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 skill in the Standards Specification. 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)

		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, in all circumstances. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (See 4.6.)

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)
- 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, with a fourth to coordinate the marking and acting as a judge to prevent compatriot marking.

4.7 ASSESSMENT AND MARKING USING MEASUREMENT

Three Experts will be used to assess each aspect. 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.

4.8 THE USE OF MEASUREMENT AND JUDGEMENT

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

4.9 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

Evaluation of cables, conductors and terminations

- Cables should be correctly selected for the application;
- There shall be no damage to cables or conductors;
- Excessive conductor should not appear at terminations;
- Conductor insulation should not be damaged by the termination.

Commissioning and marking

- The installation must be in compliance with safety standards, instructions, and specifications before energizing;
- Cable ducts and covers must be securely fixed in place;
- All devices must be identified with labels;
- Competitors must provide a written record of all electrical tests including earth continuity, insulation resistance, voltage levels, and phase rotation;
- The power wires to and out from the VSD and to any power supply must not be connected when the Competitor is making the insulation test.

For Module B

The Competitor is required to produce an I/O address list for the PLC used. The completed I/O list must be handed to the Chief Expert (or their nominee) prior to leaving the skill area on the day the PLC section is to be tested and marked.

4.10 SKILL ASSESSMENT PROCEDURES

The Expert groups will develop the appropriate marking schedules for the section of the marking criteria that they are responsible for. Each measurement of each section will be clear and unambiguous, with appropriate parameters or tolerances specified.

The prepared marking schedule must be checked and approved for use by the Experts, who must sign a set of the complete schedules before they are used.

Procedure for testing PLCs and programming software prior to being used

- Experts must be sure that PLCs are cleared prior to the Competition start and that the programming software is correctly installed;
- Experts must check that no PLC's programme is copied on the Competitor's working PC;
- A seal must be put on the disk drive and the memory slot of the PLC if it has one.

SECTION	CRITERION	TEST END OF DAY	MIN. NUMBER OF TEST GROUPS
A	Circuit design and/or modification	C1	1
B	Fault finding – Hardware	C2	1
C	Measurement	C1/C2	2
D	Installation wall and panel	C3	3
E	Test, commissioning, and safety	C3 or C4	3
F	Hardware Function (Manual operation/wiring)	C4	1
G	Software Function (Automatic operation)	C4	1

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 WSSS.

The purpose of the Test Project is to provide full, balanced and authentic opportunities for assessment and marking across the Standards Specification, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme and Standards Specification 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 Specification, or affect the balance of marks within the Standards Specification other than in the circumstances indicated by Section 2.

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.

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 Specification. Section 2.2 refers.

5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The main Test Project which includes the PLC programming component is designed and assessed in a modular format.

Circuit design and fault finding are standalone modules.

The following table shows the duration and location of the modules.

MODULE	NAME	APPROX. HOURS	PLACE
A	Main project	14	Panel A and B simulation
B	PLC programming and configuring the BUS-system	4	At workbench on computer
C	Circuit design and/or modification	1	At the Booth
D	Fault finding hardware	1	Away from booth
	Total	**20**	

Note: Commissioning is embedded in the main Test Project.

5.3 TEST PROJECT DESIGN REQUIREMENTS

The Test Project must meet the following requirements:

- The Test Project must be modular;
- Be in accordance with the current Technical Description;
- Be a Computer Assisted Drawing (CAD) to ISO-standards supplied in digital format (in AutoCAD .dwg format) and in hard copy;
- Contain a standard legend;
- Be self-explanatory requiring a minimum of translation;
- Include measurements for the installation of materials and equipment from the horizontal and vertical datum (or reference) lines;
- Soft copies of text documents must be provided in Microsoft Word format.

The Test Project may include any of the following sub-modules. Any sub-module must be integrated into the overall function of the installation or module concerned:

- Installation of signal/control/power circuits (heat, motors etc. e.g. pump station, boiler control, and similar industrial applications);
- Testing and commissioning of wiring and relay logic;
- PLC, HMI, and VSD installation and I/O wiring;
- Installation of the Distributed I/O-system and cabling;
- Testing and commissioning of PLC, HMI, and VSD programmes.

The appropriate technical skills are:

- Measuring and marking of installation materials and equipment;
- Measuring and installing equipment and pipes;
- Sawing, drilling, and de-burring;
- Working with and assembling materials made from metal and plastic;
- Wiring and connecting switches, control devices, and consumer appliances.

Module A – Main Project

The main Test Project will consist of four (4) main elements:

1. The installation and wiring element (power and control), which includes:
    - The assembly of and construction of components commonly used in the industry;
    - Installation of control panels and boxes;
    - Installation of wiring systems;
    - Installation of wiring and cabling;
    - Terminations and connections.
2. Testing and commissioning of wiring and relay logic in which the following tests are to be completed:
    - Insulation resistance between phases, phases to neutral, phases to earth, and neutral to earth. The resistance must be equal or more than 1 MΩ when tested at 500V dc. with an insulation resistance tester;
    - Earth continuity resistance – The maximum resistance between the main incoming earth and any point on the installation required to be earthed may not be more than 0.5 Ohm tested with a continuity tester;
    - Individual loads used for Test Projects shall not exceed one kW. The total load shall not exceed two kW;
    - Polarity of socket outlets when viewed from the front (looking at the pins) shall be:
        - Single-phase – clockwise from the earth pin: (L1-N);
        - Three-phase – clockwise from the earth pin: (L1-L2-L3-N);

- Polarity of switches and circuit breakers;
- Voltage tests – correct voltages to be measured between conductors at any point in the circuits;
- Electrical safety;
- Correct wiring to specification;
- Commissioning:
  - Faults identified and corrected;
  - Live testing completed;
  - Function to specification;

3. PLC installation and I/O wiring
   - Mounting and wiring of the PLC;
   - I/O wiring and termination;
   - Segregation of power, analogue and digital inputs and outputs;
4. Testing and commissioning of I/O wiring, PLC program, VSD setup and HMI configuration
   - PLC communication to HMI, VSD and PC;
   - I/O wiring in accordance with I/O addresses;
   - Programme testing and commissioning.

In the event that standard colour codes for wiring cannot be made available by the Competition Organizer, the Experts are to select other colours for use by the Competitors. Sufficient colours must be available as required by the Test Project.

An external electrical supply must be available for testing communication between the PC and PLC prior to commencement of the Competition and for programming during the Competition (if required).

Module B – PLC Programming and HMI Configuration

1. The PLC programme must conform to IEC 1131.3 and be programmed using only the following instructions:
   - Bit level instructions – NO, NC, Transitional, Coils, Jumps, Calls, Sets and Resets;
   - Math instruction – ADD, SUBTRACT, MULTIPLY, DIVIDE;
   - Word level instruction – MOVE, COMPARE, BCD, AND, OR;
   - Basic instruction – TIMERS, COUNTERS, REGISTERS;
   - File control – The Competitor will decide on how they will write the programme and which of the listed PLC instructions he will use.

   No other programming methods are to be used.
2. All information about the requirements of the programme functions must be given equally to all Competitors. Basically, all the information must be at the non-verbal function description.
3. Competitors are not allowed to help each other during the programming module at the working booths.

   - All programming and configuration must satisfy module B specification;
   - The HMI is limited to display and pushbutton controls only;
   - The VSD is limited to basic controls with digital and analogue signals.

Module C – Circuit Design and/or Modification

1. The Competitor is required to design/modify a relay logic, control and/or power circuit diagram in accordance with a specification and/or the functional diagram. The Competitor will design their circuit using

2. The design will be marked on:
   - Functional requirements being met;
   - Economy of design;
   - Accurate use of symbols;
   - Accuracy of design;
   - Provision of a legend;
   - 60% of marks for this section will be awarded for correct functioning.

Module D – Relay Logic Fault Finding – in existing plant (or system)

1. Relay logic fault finding on a given panel
   - The Competitor is required to find five introduced faults within a control and/or power circuit;
   - The Competitor is provided with the circuit diagram and may only see the operational circuit before the fault-finding session is started;
   - Using a multi-meter, the Competitor shall test the panel and identify the faults on the form provided. The form may consist of the circuit diagram, or a function diagram, or a developed form;
   - The Competitor must identify the type of fault and fault location;
   - All faults must be identified on the document(s) provided;
   - A Competitor may return to an earlier fault within the one-hour period;
   - Fault documents completed by the Competitors should indicate: Competitor's name, country/region, and fault test panel number.
2. Design specification for relay logic fault finding
   - Three circuits are to be submitted from different countries/regions to the Chief Expert, who will select one to be constructed by the Competition Organizer for the fault-finding test;
   - The chosen circuit drawings will be circulated at the same time as the main project. So each Competitor must understand the functions of the circuits;
   - The Competition Organizer will construct sufficient identical test panels for the number of Competitors to complete in one day;
   - The Expert group will identify possible faults, two per Expert and the Workshop Manager organizes the lottery on the same morning when the module will start. The Chief Expert will draw the fault number and the Workshop Manager will install that fault. Duplicate faults will count as one;
   - Only one fault at a time is introduced for each test;
   - Faults must be introduced in the same order for all Competitors;
   - Marks are awarded for each fault identified;
   - Bonus marks may be awarded for finding individual faults within a given time;
   - Fault Finding Panels to be built prior to the Competition.

Circuit specifications

The test circuit includes:
- Timers;
- Switches or pushbuttons;
- Relays;
- Contactors with 2xNO and 2xNC auxiliary contacts;
- Simulated loads

3. Types of faults

Faults should be selected from the following list:

- Open circuit;
- Short circuit;
- Only one fault is to be applied per test;

The Experts may allocate marks based on the time taken to find each or all faults by making marking points for finding a fault in less than a given time or times. (Accurate timekeeping is essential, so a stop watch or similar must be provided for this purpose.)

5.4 TEST PROJECT 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 Who develops the Test Project or modules

The Test Project modules are developed by the Skill Competition Manager.

Test Project validation is defined in section 5.5

5.4.2 How and where is the Test Project or modules developed

The Test Project modules are developed independently.

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
Twelve months before the Competition	The Test Project is developed.
Six months before the Competition	The Module A – Main Project is circulated.
At the Competition	The complete Test Project with the change of at least 30% in the Module A – Main project, and all the other modules are presented to the Experts and Competitors.

5.5 TEST PROJECT VALIDATION

It must be demonstrated that the Test Project modules can be completed within the material, equipment, knowledge, and time constraints. This will be demonstrated by written feedback to the Experts at the Competition. Validation is based on circulated Test Project.

5.6 TEST PROJECT SELECTION

The Skill Competition Manager selects the Test Project modules.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The preliminary version of the Test Project is circulated on the website. The Programming and Circuit Design modules are not circulated.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

The Skill Competition Manager develops a Test Project in accordance with the current Technical Description for the next Competition.

They will be responsible for ensuring that:

- The circuit designs are accurate and complete;
- There are no installation requirements that cannot be completed;
- The tasks can be completed in the prescribed time of 22 hours;
- Proper function is achievable;
- The material list is accurate;
- Competitor instructions are kept to a minimum of text. Flow charts or functional diagrams may be used;
- The project is complete in all aspects;
- The Skill Competition Manager will forward the completed Test Project to the Director of Skills Competitions two months before the current Competition;

5.9 TEST PROJECT CHANGE AT THE COMPETITION

The Test Project does not require any change at the Competition because the secret Circuit Design and Programming modules constitute the necessary change.

5.10 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.

The Test Project should be constructed from commercially available materials. When materials in the Host Country are not readily available in other countries/regions, then samples of these materials must be sent to each Competitor six months prior to the commencement of the Competition. The Workshop Manager will confirm if this is necessary.

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 skill specific Discussion Forum (http://forums.worldskills.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 Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Marking Schemes
- Test Projects
- 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

Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manager, 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 in the Expert Centre (www.worldskills.org/expertcentre).

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

- Safety goggles must be worn when using power tools for drilling or cutting materials;
- Protective gloves must be worn when handling materials likely to cause injury;
- The workstation must be maintained in a safe and clean working condition;
- Electrical supply may only be connected to control panels with the permission of the Chief Expert, Deputy Chief Expert, or designated Expert.

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 Experts for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Items supplied by the Competition Organizer are shown in a separate column.

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts 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.

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 COMPETITOR'S TOOLBOX

The maximum allowable external volume of the toolbox is 2.52m^3, including Siemens materials. The box with Siemens equipment should not exceed 0.8m3. This does not include the outside packing used to transport the tool box and material box.

8.3 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

All sponsored automation equipment and software will be provided to the registered Experts or Member for distribution to the Competitors or responsible training organization a minimum nine months before the Competition.

The following materials, equipment, and tools are to be brought to the Competition by the Competitor.

ITEM	SPECIFICATION	PICTURE
01	Combination Pliers VDE Certified Grip 180mm	
02	Nose Side Cutting Pliers VDE Certified Grip 160mm	

ITEM	SPECIFICATION	PICTURE
03	Diagonal Cutting Pliers VDE Certified Grip 180mm	
04	Slip Joint Plier 250mm	
05	Straight Jaw Locking Pliers 225mm	
06	Insulated Screwdriver Parallel Tip 2.5 x 75mm	
07	Insulated Screwdriver Parallel Tip 3.5 x 75mm	
08	Insulated Screwdriver Parallel Tip 4 x 100mm	
09	Insulated Screwdriver Parallel Tip 5.5 x 100mm	
10	Insulated Screwdriver Parallel Tip 6 x 150mm	
11	Insulated Screwdriver Phillips Tip PH1 x 100mm	
12	Insulated Screwdriver Phillips Tip PH2 x 125mm	
13	Insulated Screwdriver Phillips Tip PH3 x 125mm	
14	Insulated Screwdriver Phillips Tip PH4 x 125mm	
15	Retractable Blade Knife	
16	Torpedo level 25 cm	
17	Spirit level 120 cm	
18	Pocket Tape 5m/16ft Width 19 mm Loose	
19	Steel rule 300 mm	
20	Hacksaw Frame 300 mm/12 Inches	

ITEM	SPECIFICATION	PICTURE
21	Measuring tool square	
22	Adjustable Quick Square 170 mm (6.3/4in)	
23	Straight Claw Hammer Leather Grip 560 g	
24	Socket set with 32 pieces	
25	File Set 200mm 5 Piece	
26	Cordless Drill Driver 2 x 5Ah Batteries & Charger	
27	Corded electrical drill	
28	Orbital Action Jigsaw	
29	Compound Slide Mitre Saw	
30	Insulated ferrule crimper	

ITEM	SPECIFICATION	PICTURE
31	Wire striper tool	

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

The Competition Organizer will ensure that Competitor computers/laptops are installed and operating independent to any external network. The PLC, HMI, and VFD programming and configuration software will be installed (in multiple languages) and will be tested for all communications options required by the Competitors to work with the supplied hardware.

The computer/laptop will be of sufficient capacity to run all the programming software simultaneously at an optimal speed. This will require a specification from the software supplier at the time of the competition setup to be met or exceeded.

Computer screen resolution must be 1920 * 1080 and 24" minimum.

8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

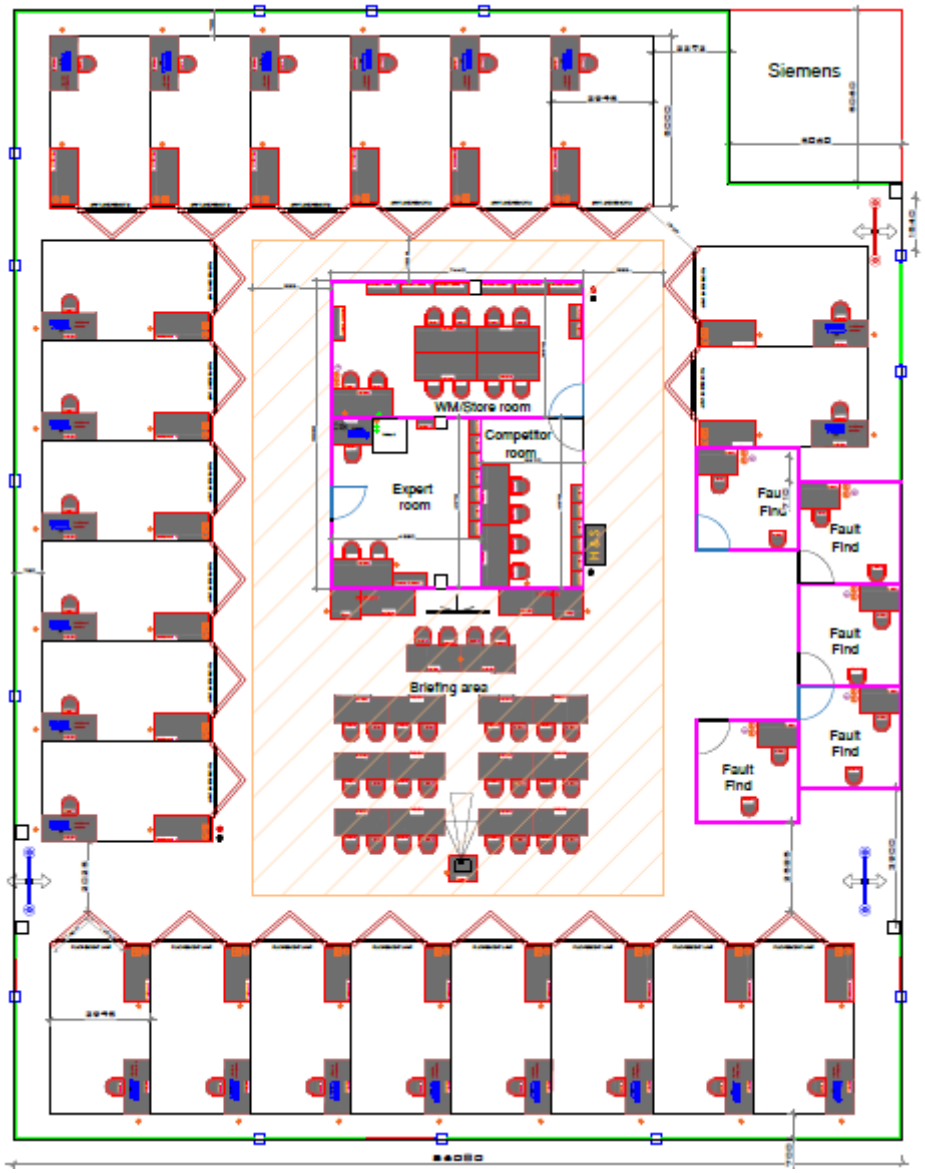
- Preformed templates;
- Mobile phones for Competitors;
- Memory storage devices for PC or PLC programmes;
- Any documentation other than operating manuals (no project instructions or procedures).

8.6 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

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

Example workshop layout:

Instructions for building the electric power supply for each Competitor will be integrated into the workshop layout. Basic rule is that workstation electric supplies will be provided for each Competitor with RCDs (Residual-Current Device).



9 SKILL-SPECIFIC RULES

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 work flow, and documentation management and distribution.

Not applicable.

10 VISITOR AND MEDIA ENGAGEMENT

Following are examples of how this skill could maximize visitor and media engagement:
Build a demonstration stand (Try a Skill)

- The main Test Project will reflect an automated working plant;
- Each Competitor will construct an active visualization image of the automated plant which will be visible to visitors and media;
- All Competitor profiles can be shown on a common screen for visitors and media.

11 SUSTAINABILITY

This skill competition will focus on the sustainable practices below:

- Recycling;
- Use of 'green' materials;
- Use of completed Test Projects after Competition (To find a real customer)
- Smaller toolboxes
- Wires, conduits, consumables etc. are to be used efficiently

12 REFERENCES FOR INDUSTRY CONSULTATION

WorldSkills is committed to ensuring that the WorldSkills Standards Specifications 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 Standards Specification 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.**oneto**nline.org/)

This WSSS (Section 2) appears to relate most closely to *Industrial Engineering Technicians:* https://www.onetonline.org/link/summary/17-3026.00
and/or to *Industrial Engineering Technician*: http://data.europa.eu/esco/occupation/bcc21c63-7eee-4520-8fa7-43eefd389668.

These links also enable adjacent occupations to be reviewed.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Standards Specification in place for WorldSkills Kazan 2019.

ORGANIZATION	CONTACT NAME
GEA Group	Craig Marshall, Team Lead Automation Engineering