Technical Description

Electrical Installations

Construction and Building 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

Electrical Installations

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

An electrician works on commercial, residential, agricultural, and industrial projects. There is a direct relationship between the nature and quality of the product required and the payment made by the customer. Therefore, the electrician has a continuing responsibility to work professionally in order to meet the requirements of the customer and thus maintain and grow the business. Electrical installation is closely associated with other parts of the construction industry and with the many products that support it, normally for commercial purposes.

The electrician works internally or in teams, and the homes of customers and on small and major projects. They will plan and design, select and install, commission, test, report, maintain, fault find, and repair systems to a high standard. Work organization and self-management, communication, and interpersonal skills, problem solving, flexibility and a deep body of knowledge are the universal attributes of the outstanding electrician.

With a constant developing technology an electrician will face new challenges where new systems will be needed and new working methods have to be used.

Whether the electrician is working alone or in a team the individual takes on a high level of personal responsibility and autonomy. From working to provide a safe and reliable electrical installation and maintenance service, in accordance with relevant standards, through to diagnosing malfunctions, programming, and commissioning home and building automation systems, concentration, precision, accuracy, and attention to detail every step in the process matters and mistakes are largely irreversible, costly, and potentially life threatening.

With the international mobility of people, the electrician faces rapidly expanding opportunities and challenges. For the talented electrician there are many commercial and international opportunities; however, these carry with them the need to understand and work with diverse cultures and trends. The diversity of skills associated with electrical installations is therefore likely to expand.

An electrician also has many career opportunities including advancing to leading or managerial positions.

1.1.3 Number of Competitors per team

Electrical Installations 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

ELECTRICAL INSTALLATIONS

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**	5
	The individual needs to know and understand: • Health and safety legislation, obligations, and documentation • The principles of working safely with electricity • The situations when personal protective equipment (PPE) must be used • The purposes, uses, care, maintenance, and storage of all tools and equipment together with their safety implications • The purposes, uses, care, and storage of materials • The importance of keeping a tidy work area • Sustainability measures applying to the use of 'green' materials and recycling • The ways in which working practices can minimize wastage and help to manage costs whilst maintaining quality • The principles of work flow and measurement • The significance of planning, accuracy, checking, and attention to detail in all working practices • Impact of new technology	
	The individual shall be able to: • Develop and follow Health, Safety, and Environment standards, rules, and regulations • Diligently follow electrical safety procedures • Identify and use the appropriate personal protective equipment (PPE) including safety footwear, ear, and eye protection • Select, use, clean, maintain, and store all tools and equipment safely • Select, use, and store all materials safely • Identify and take care of expensive fixtures/fittings • Plan the work area to maximize efficiency and maintain the discipline of regular tidying • Measure accurately • Manage time effectively • Work efficiently and check progress and outcomes regularly • Establish and consistently maintain high quality standards and working processes	
2	**Communication and interpersonal skills**	5
	The individual needs to know and understand: • The significance of establishing and maintaining customer confidence and trust • The importance of maintaining and keeping knowledge base up-to-date • The roles and requirements of related trades • The value of building and maintaining productive working relationships • Techniques of effective teamwork • The importance of swiftly resolving miss-understandings and conflicting demands	

	The individual shall be able to: • Interpret customer requirements and manage customer expectations positively • Provide advice and guidance on products/solutions e.g. technological advancements • Visualize and translate customer wishes making recommendations which meet/improve their design and budgetary requirements • Question customers closely/deeply to fully understand requirements • Provide clear instructions • Introduce related trades to support customer requirements • Produce written reports for customers and the organization • Produce a cost and time estimate for customers • Recognize and adapt to the changing needs of related trades • Work effectively as a member of a team		
3	**Problem solving, innovation, and creativity**		**5**
	The individual needs to know and understand: • The common types of problem which can occur within the work process • Diagnostic approaches to problem solving • Trends and developments in the industry including new technology, standards, and working methods e.g. 'smart house' and energy saving measures • Potential problems with procurement and alternate solutions		
	The individual shall be able to: • Check work regularly to minimize problems at a later stage • Identify problems originating from the work of a related trade e.g. heating pump, ventilation system, etc. • Challenge incorrect information to prevent problems • Recognize and understand problems swiftly and follow a self-managed process for resolving • Recognize opportunities to contribute ideas to improve the solution and overall level of customer satisfaction • Demonstrate a willingness to try new methods and embrace change e.g. ready- made components		
4	**Planning and design**		**10**
	The individual needs to know and understand: • Different types of standards, drawings, installation descriptions, and manuals • Range of materials and installation techniques to be used in different environments		

	The individual shall be able to:
	• Read, interpret, and revise drawings and documentation including:
	  • Layout and circuit drawings;
	  • Follow written instructions;
	  • Plan installation work using drawings and documentation provided		

5	**Installation**	35
	The individual needs to know and understand: • Ducting and wiring systems for commercial, domestic, residential agricultural, and industrial use and when and where to use a specific ducting and/or wiring system • The range of electrical switchboards used for commercial, domestic, residential, agricultural, and industrial uses and when and where to use a specific switchboard system • Types of electric lighting and heating systems for commercial, domestic residential, and industrial use • Control devices and socket outlets used for commercial, domestic, residential, agricultural, and industrial uses • Structured cabling systems including: computer network cabling, fire/burglar alarm (conventional and addressable), evacuation control (audio and optical), control and monitoring, access control ('stand-alone' and 'network supervised'), closed circuit television (cameras, lenses and attachment component, recorders and monitors	
	The individual shall be able to: • Select and install equipment and wire ways as per drawings and documentation provided • Install ducting and cabling systems on different surfaces as per manufacturer's instructions and current industrial standards • Select and install single and double insulated cables inside ducts, conduits, and flexible conduits • Install and securely fix double insulated cables onto cable ladder, cable tray and different surfaces as per manufacturer's instructions and current industrial standards • Install metal and plastic ducting (trunking): accurately measure and cut duct at specified lengths/angles; assemble without distortion to joints and to specified tolerances • Assemble different termination adaptors, including glands onto duct and attach ducts, of different types, securely onto a surface • Install metal and plastic conduits/flexible conduits and attach securely onto surface, maintaining even radius bends, without distortion to conduit • Correct termination adaptors used for entry of conduits into boxes, boards, and ducts • Install and securely attach different types of cable ladder and cable tray to a surface • Install electrical switchboards onto a surface in a secure way and assemble switchboard apparatus in a switchboard as per layout drawings/instructions to include: main switches, RCDs, MCBs, fuses, controlling equipment such as relays and timers and home and building automation devices • Terminate and install wiring inside a switchboard according to circuit drawings • Connect equipment as per instructions provided to include: structured cabling systems as per manufacturer's instructions and current industrial standards and regulations • Install systems such as electrical car chargers, solar panels, energy management systems and other related systems for a sustainable future	

6	Testing, reporting, and commissioning	25
	The individual needs to know and understand: • Industrial regulations and standards applicable to different types of installations • Verification standards, methods, and reports to be used to record verification results • Types of measuring instruments • Tools and software used for parameterization, programming, and commissioning • The correct operation of the electrical installation in accordance with the planned specification and customer requirements	
	The individual shall be able to: • Test installations before energizing to ensure personal and electrical safety to include: insulation resistance and earth continuity tests, correct polarity, and complete a visual inspection • Test installations when energized by checking complete function on all equipment installed to ensure correct operation of new installation as per instructions, for example, correct voltage, phase rotation and correct functioning of protection devices • Set-up equipment to include: selecting and using the appropriate software for programming programmable relays, bus-system; creating necessary settings on devices such as timers and overload relays; programming programmable relays: downloading and importing applications required and programming bus-systems, for example KNX, DALI, Modbus, and IP or IT based systems • Set the installation to fully functioning and ensure customer can operate	
7	Maintenance, fault finding, and repair	15
	The individual needs to know and understand: • Different types of installations for specific environments • Different generations of installations • The purpose of a specific installation • The customers' needs for various functions	
	The individual shall be able to: • Adapt to changing circumstances • Troubleshoot electrical installations and identify faults including: short and open circuits, incorrect polarity, insulation resistance and earth continuity faults, incorrect settings on equipment, and incorrect program on programmable devices • Diagnose electrical installations and identify problems including: bad connections, incorrect wiring, high loop impedance, and equipment failure • Verify that an existing electrical installation still meets current standards • Use, test and calibrate measuring equipment including: insulation resistance, continuity and installation testers, multi, clamp and network cable testers • Repair and replace faulty components in electrical installations • Rewire and or repair faulty installations	
	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 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

The Test Project assessment will be based on the following criterions:
A. Personal safety during work and electrical safety on the completed installations on all modules;
B. Testing, reporting, and commissioning from every module will be assessed as described in the instructions for the various modules;
C. Circuit design will be assessed on the functionality of the circuit and the cable selection. Both for safety and cost efficiency;
D. Measurements and level/plumb will be assessed comparing drawings with the actual installations.

Definitions
- Level: Positioned horizontally to the device being checked;
- Plumb: Positioned vertically to the device being checked;
- All dimensions must be from specific reference lines (datum/centre lines);
- Cable and conduit measurements are to the centre of the cable/conduit;
- Duct and equipment measurements are to the centre or edge of the duct/equipment as shown on drawings.

TOLERANCES	
Level/plumb	Bubble on or between lines on level, not outside
Measurement	+/- 2 mm

E. Installation of equipment and wire-ways may be checked as but not limited to:
- Materials and wire-ways secured;
- Secure definition;
- PVC and metal conduit;
- At least one saddle must be placed between:
- Termination point and bend;
- Bend to bend;
- Termination point to termination point;
- If the distance between any bend or termination point exceeds one metre then additional saddles must be placed for every metre added;
- Flexible Conduit: If flexible conduit is to be fixed, at least one saddle must be placed every 300mm;
- No damage on materials, cables, conduits, etc.;
- Correct materials and wire-ways installed as per drawings;
- Materials and wire-ways assembled and installed as per manufacturers specification;
- No extra materials required during the competition;
- Installation is clean and tidy.

F. Wiring and terminations may focus on but not limited to:

- No copper visible when looking at the connection from a 90-degree position;
- No nicks or cuts in the copper conductors;
- No plastic insulation inside the termination;
- Terminations done correctly (no loose terminations, good electrical and mechanical connection) If ferrules are required the Competition Organizer must provide all equipment and materials to install;
- Neatness of wiring and looming in distribution boards;

G. Installation testing will be assessed as faults found or not found;

H. Programming will be assessed as functions completed or not completed.

4.10 SKILL ASSESSMENT PROCEDURES

The Chief Expert and the Deputy Chief Expert divide the Experts into marking teams. Each team must include at least one Expert who is experienced. Cultures and languages are also considered to ensure there is a range in each marking team.

Where possible all Experts will assess a similar percentage of marks.

No live testing or commissioning will take place without the attendance of two Experts.

5 THE TEST PROJECT

5.1 GENERAL NOTES

Sections 3 and 0 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 Test Project will consist of two modules:
Module one – Domestic and Commercial installation, and programming
Module two – Fault-finding, testing, and reporting

5.3 TEST PROJECT DESIGN REQUIREMENTS

General requirements
- Test Project to be designed by industry partners to reflect current and upcoming technologies;
- All technical terms and descriptions used in the Test Project must be in accordance with internationally recognized standards;
- Cable and conduit measurements are to the centre of the cable/conduit;
- Duct and equipment measurements are to the centre or edge of the duct/equipment;
- All dimensions must be from specific reference lines (datum/centre lines);
- Different cable types must be used. For example:

    - Plastic sheath cable,
    - Flexible cable,
    - Steel wire armour;

- Different cable support systems must be used. For example:

    - Metal conduit,
    - PVC conduit,
    - Metal cable tray,
    - PVC trunking.

The Test Project will consist of the following modules

Module one – Domestic and Commercial installation and programming
- This module will run for a maximum of 17 hours over C1, C2, C3 and C4
- The Competition Organizer must supply all the materials for this module
- Measurement marks will be measured progressively each day as indicated by the; mark summary form
- Module one will be installed on three walls and the ceiling of the Competitors cubicle;
- Module one will include home and building automation and a small smart relay device; as well as conventional wiring systems
- Competitors are to be provided with descriptions, other necessary documentations and associated product files (product data base);
- The Infrastructure List must state the languages that the software, software version and databases will be available in;
- Programming exercise is to be completed in front of the general public;
- Final function tasks decided upon at the Competition;
- Programming will be limited to the control of lighting, HVAC and blinds;
- Competitors will be forbidden to have electronic storage devices in their work station during this module.

Module two – Fault finding, testing and reporting
- A maximum of one hour for this module;
- The testing board for this module to be built by the Competition Organizer;
- This module to be completed by the end of C2;
- Test commissioning will be part of this module

General instructions for all modules

The Test Projects must reflect the IEC standards and not one specific continent. Once all the Test Projects have been completed they must reflect aspects of electrical installations throughout the world.

Test specifications:
- Earth continuity resistance – The maximum resistance between the main incoming earth terminal and any point on the installation required to be earthed may not be more than 0.5 Ω;
- Insulation resistance – The minimum resistance between any current carrying conductors and any other conductors to earth may not be less than one MΩ, tested at a voltage of 500 V DC with an insulation resistance tester;
- Polarity of socket outlets as per Host Country standard.

Requirements for module one – Domestic and Commercial installation and commissioning
- This module must include lighting circuits, power outlet circuits;
- This module must include a design task for the Competitor;
- Installation of distribution boards and protection equipment must be included;
- Installation of programmable devices must be included;
- Installation of home and building automation devices must be included;
- This module may include fixed appliance circuits, Structured Cabling Systems, environment control or access equipment;
- Inspection and testing will be carried out and the test results documented before commissioning;
- Function testing may be carried out with the installation live at standard mains voltage of the Host Country.

Requirements for module two – Fault finding, testing, and reporting

- This module can consist of an installation with two sections. Section one may be supplied with an extra low voltage supply which can be tested live. Section two will receive no power.
- The test circuit designs must include the following circuits:
- A lighting circuit;
- A socket outlet circuit;
- A power circuit (such as a heater or a cooker);
- A control circuit (such as a pump control);
- A total of 10 faults must be installed;
- Installation testing faults must include as a minimum:
- One high earth resistance fault;
- One low insulation resistance fault;
- One incorrect polarity fault;
- One incorrect visual fault.
- Types of faults that may also be used are:
- Incorrect timer settings;
- Incorrect overload settings;
- Short circuit faults;
- Open circuit faults;
- High resistance joints;
- Interconnection;
- Competitors are required to bring their own test instruments to the Competition in order to be able to carry out the requirements of this module. They must meet the Host Country's/Region's health and safety requirements;
- All installation faults must be determined in accordance with "General Instructions for all modules, Test Specifications";
- Using the symbols shown below the Competitor should clearly indicate on the supplied circuit diagram the location of any fault located

short circuit

Open Circuit

Low Insulation Resistance

S   Incorrect setting (timer/overload)

V   Value (incorrect component)

Polarity / Phase Sequence

High Resistance

¶   *Figure 11*

Competition Organizer requirements

- Ensure a power supply of 230/400 V AC at each workstation;
- Ensure that necessary power supplies are available for testing;
- Will build some installation samples for module one in the Competitors area of the competition floor.

Panel layout

The layout of the work cubicle shown below is just for reference purposes.
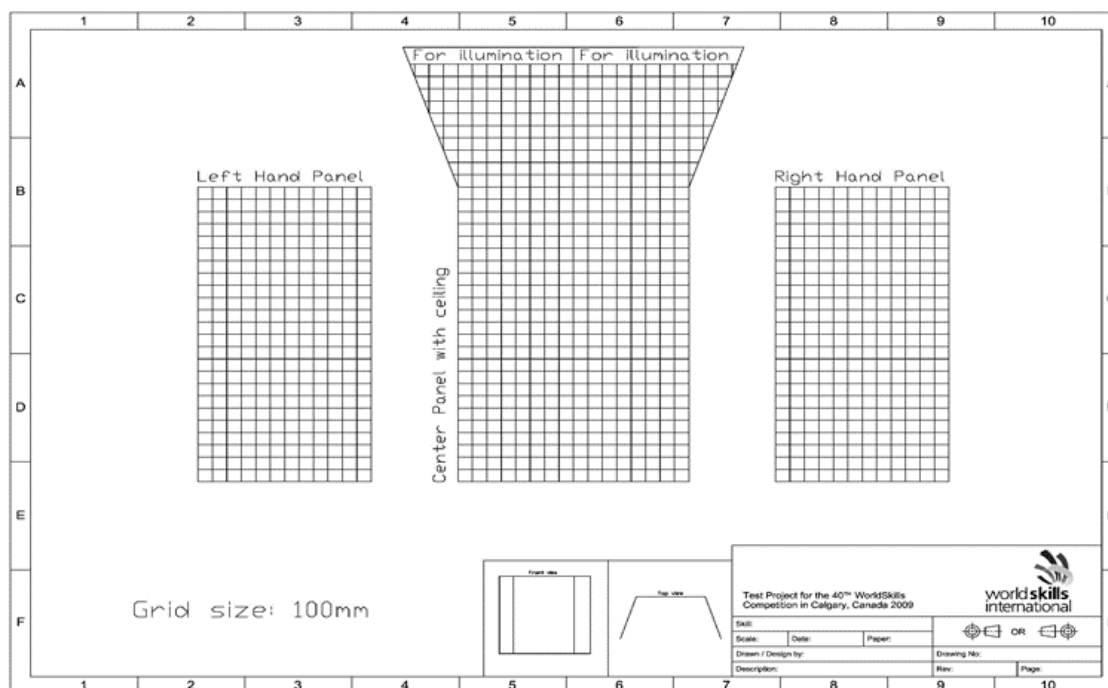
5.4 TEST PROJECT DEVELOPMENT

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 designed by an industry partner team to reflect current and upcoming technologies.

5.4.2 How and where is the Test Project or modules developed

The Test Projects modules are independently designed by the industry partner and submitted to the Director of Skills Competitions.

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
Three (3) months prior to the competition	The industry partner supplies the completed Test Project to the Director of Skills Competitions.
At the Competition (C-2 Familiarization Day)	The secret items on the Infrastructure List is revealed to the Experts and Competitors.
At the Competition C1.	The Test Project is revealed to the Experts and Competitors.

5.5 TEST PROJECT VALIDATION

The Skill Competition Manager and the Workshop Sector Manager will decide together that it is possible for all modules to be completed. Time, Competitor skill, and materials will be taken into consideration.

5.6 TEST PROJECT SELECTION

The Test Project is selected by the Industry Partner.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The Test Project is not circulated.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

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

5.9 TEST PROJECT CHANGE AT THE COMPETITION

The Test Project is not subject to 30% change at the Competition because it is not circulated.

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.

If specific material or manufacturer specifications are required to allow the Competitor to complete the Test Project, it will be provided along with the Test Project, the Workshop Manager must arrange a demonstration on site during Familiarization Day.

The materials chosen for modules that are to be built by Competitors, except where the materials are to be supplied by the Competitor, should be of a type available from a number of manufacturers and readily obtainable from suppliers in the Competition Organizer.

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 Skill Competition Manager (or an Expert nominated by the Skill Competition Manager) 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

The day-to-day management of the skill during the Competition is defined in the Skill 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.

All marking points regarding Health, Safety, and Environment will be made clear to all Competitors at Familiarization Day.

If the supervising Experts, (at least two) who are watching the Competitors, witness any breach of the Health, Safety, and Environment requirements during the Competition they will:

- On the first occasion: Warn the Competitor and make a note of the breach;
- On the second occasion: A record of the breach will be made and result in a loss of the Health, Safety, and Environment mark;

The Competitor can only receive power from the commissioning Expert's team when:

- All device covers have been installed;
- No exposed or un-terminated conductors or cables are seen;
- Experts will maintain supervision from outside the Competitors marked workstation during the period that the installation is live to ensure safety. The Expert cannot enter the workstation unless the Competitor requests their assistance or if it is deemed that the Competitors' immediate safety is at risk.

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 Competition Manager on behalf of 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 Skill Competition Manager must review, audit, and update the Infrastructure List in partnership with the Technical Observer in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions of any requests for increases in space and/or equipment.

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.

Some details on the Infrastructure list will be kept secret and will not be provided prior to the competition except for:

- Electronic programmable devices such as KNX, smart relays, etc.
- Tools provided by the Competition Organizer

8.2 COMPETITOR'S TOOLBOX

The toolbox the Competitors bring should only include the tools listed in 8.3, therefore the toolbox should be the absolute minimum size.

The overall packing size (crate/delivery size) of the toolbox size will be limited to 1m³; (Example: Euro pallet and two standard frames of max .5m).

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

Competitors must bring their own hand tools including a manual mitre saw.

The following battery powered/mains powered tools are allowed unless they are provided by the Competition Organizer:

ITEM	DESCRIPTION	PICTURE
1	Hand held jig saw;	
2	Vibration (multifunctional) tool;	
3	Laser with two lines (one horizontal and one vertical);	
4	Two battery powered drills;	
5	Heat gun;	
6	Vacuum cleaner;	

Note: All levelling and measuring tools, except for the above laser and special tools such as bending equipment, must be provided by the Competition Organizer.

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Not applicable.

8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

Materials and tools according to the Host Country Health, Safety, and Environment regulations are not allowed.
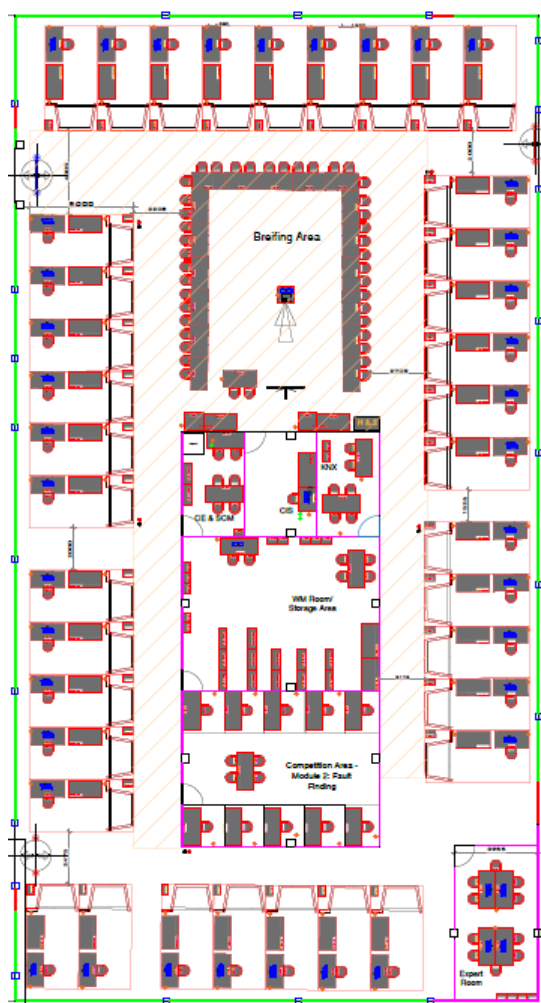
Competitors are forbidden to bring the following tools to the competition:
- Bending tools, formers and jigs of any type;
- Drop saws;
- Any electrical tools provided by the Competition Organizer.

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

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.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – USB, memory sticks	• Competitors are only allowed to use memory sticks provided by the Competition Organizer. No other memory sticks are to be inserted into the Competitor computers. • Memory sticks or any other portable memory devices 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 and must not be taken out of the workshop. • Note: spy software may be used on computers
Use of technology – personal laptops, tablets and mobile phones	• Competitors are not allowed to bring personal laptops, tablets or mobile phones into the workshop. • Experts and Interpreters are allowed to use personal laptops, tablets and mobile phones in the Expert room only. Laptops and tablets can be taken out of the workshop at night.
Use of technology – personal photo and video taking devices	• Competitors, Experts, and Interpreters are allowed to use personal photo and video taking devices in the workshop, however no photos can be taken on details of the Test Project or any marking forms.
Drawings, recording information	• Competitors may make drawings, document instructions or take notes whilst in the workshop however they cannot be taken out of the workshop at any time.
Equipment failure	• If there is a clear evidence that Competitors have caused damage to equipment themselves, they will not be given a substitute and will not be given any additional time.
Health, Safety and Environment	• Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.
Infrastructure	• Superglue, silicone, latex or similar adhesive or filling agent is not allowed in the workshop.
Supervision of Competitors	• Competitors must be supervised at all time during their work. Experts on supervising duties must ensure another Expert is replacing them if they have to leave. • Experts are not allowed to supervise their compatriot Competitor. • Experts and Interpreters are only allowed to enter a workstation if approved by the Chief or Deputy Chief Expert. The only exception to this rule is if it's necessary to stop a Competitor for Health, Safety, and Environment reasons.

10 VISITOR AND MEDIA ENGAGEMENT

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

- Try a trade;
- An area next to the competition site, supervised by local apprentices, where young people can try some of the things an electrician work with on a daily basis;
- Display screens;
- Test Project descriptions;
- Drawings and Test Projects/parts of Test Projects may be displayed next to the "try a trade" area.
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Competitor profiles may be displayed on screens close to the competition site. Useful information is:
  - Name;
  - Age;
  - Country of origin;
  - Type of education;
  - Type of actual career;
  - Information about the Competitors' choice of apprenticeship;
- Career opportunities;
- Information may consist of:
  - Brochures;
  - Flyers;
  - Informers (young apprentices);
- Daily reporting of competition status;

Daily reporting may be used if all Competitors working on the same module on the same day.

11 **SUSTAINABILITY**

This skill competition will focus on the sustainable practices below:

- Recycling;
- Spare materials are to be offered to local schools to be used in education for training purposes;
- Use of 'green' materials;
- During designing of Test Projects and liaising with the current Workshop Manager, the uses of "green" materials are to be considered. Materials that meet the following requirements are to be used as far as possible:
  - Halogen free;
  - Recyclable;
  - Free from toxic substances.

- Use of completed Test Projects after Competition;
- Materials that can be reused, are to be offered to local schools to be used in education for training purpose. Materials that cannot be reused are to be sorted as per Host Country regulations or, if meeting higher requirements, WorldSkills regulations;
- Experts and Competitors must take special consideration when designing and packing their tool box for the competition. They must ensure they only pack the minimum number of tools needed to complete the competition;
- The industry partner designing the Test Project must carefully consider sustainability as a key issue;
- All paperwork prepared at the previous competition must be electronically copied by the new Chief and Deputy Chief Expert.

ELECTRICAL INSTALLATIONS

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.onetonline.org/)

This WSSS (Section 2) appears most closely to relate to *Electrician*:

https://www.onetonline.org/link/summary/47-2111.00

or *Domestic Electrician*: http://data.europa.eu/esco/occupation/5dbb9cf0-b226-402c-a295-2f42ef05ff8b

These links can also be used to review adjacent occupations.

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
IEK Group, Northern Europe and Eurasia	Peter Nekrasov, Head of Direction
Fluke Networks, China	Yin Gang, BD/Technique manager, China
Elektroplan Buchs & Grossen AG, Switzerland and Germany	Samuel Schenk, Project Leader
KNX Association, Belgium	Christian Stahn, Marketing
Voestalpine AG	Sebastian Buschek, Senior Engineer