TECHNICAL DESCRIPTION

ELECTRONICS

MANUFACTURING AND ENGINEERING TECHNOLOGY

TD16 v5.0 — WSC2015

WorldSkills International, by a resolution of the Technical 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 12.08.14

Stefan Praschl
Chair Technical Committee

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Vice Chair Technical Committee

1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

Electronics

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

The electronics industry is very diverse and has evolved into several specialisms. Some technicians/engineers will work across many aspects of electronics, but increasing specialization and technical developments means that specialist technician/engineers are widely employed. The key areas of specialism which can be seen as careers in their own right include the assembly and wiring of electronic products; the designing of prototype circuits to specifications; the installation and commissioning of equipment including the provision of customer support; service and maintenance which include a service both in situ and remotely; and monitoring and testing to specifications sub-assemblies or systems and approving fit-for-purpose and simulating outcomes on computers.

Electronics specialists need to work in a wide range of industries by supporting highly technical specialist equipment. These industries include:

- Aerospace/aeronautics
- The military
- Robotics
- Audio/TV/entertainment
- Laboratories and hospitals
- Higher education research laboratories
- Communications and telecommunications
- Power
- Transport
- Security
- Manufacturing including instrumentation

Electronics technicians/engineers must work with a high degree of accuracy and precision, conforming to detailed specifications and international quality standards and demonstrating extensive technical ability. Due to the constant developments in technology, the electronics technician/engineer needs to be proactive in ensuring that his/her skills and knowledge are up-to-date and meet industry standards and expectations. The technician/engineer may work directly with clients and will therefore need to demonstrate excellent customer service and communication skills and work effectively to time schedules. When working with clients, the technician/engineer may have to explain elements of complex electronics principles to assist the client to use equipment correctly. Often the nature of the establishment in which the electronics expert works will require him/her to respect confidentiality with respect to highly commercially sensitive information and to demonstrate integrity, honesty and a strong ethical sense.

The electronics specialist will work with a wide range of tools, specialist hi-tech equipment and materials. Increasingly, computers and specialist software for communications technology is embedded into the work. In addition, tasks will also require the use of specialist hand tools for the assembly and maintenance of circuits and surface mounted technology.

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 (when available)
- WSI – Online resources as indicated in this document
- Host Country – Health and Safety 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 not be separate tests of knowledge and understanding.

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. 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**	**15**

	The individual needs to know and understand:
	• The importance of:
	  • Creativity
	  • Critical thinking
	  • Honesty and integrity
	  • Self-motivation
	  • Problem-solving
	  • Effective working under pressure
	• Health and safety legislation and best practice in relation to the skill
	• Various electronics specialisms within specific industries
	• Different international languages and symbols and the interpretation of expressions between English and international languages, electronic symbols and units of measurement
	• The importance of continuous personal development
	• Business environment of the client
	• The company culture and procedures and potential variations dependent on national practice
	• The application of electronic principles	

	The individual shall be able to:
	• Conduct the work in an environmentally professional manner, respecting others' work space
	• Work effectively with colleagues and teams both in the local environment and remotely
	• Present ideas to teams and clients
	• Exercise appropriate care in the workplace for personal and other's safety
	• Take appropriate preventative action to minimize accidents and their impact
	• Use materials and tools of the electronics industry in ordinary servicing, installation and repair tasks (hand tools, different soldering and de-soldering tools)
	• Use computers as a tool to effectively complete tasks for example;
	  • Creating networks
	  • Interconnection between computers and other devices
	• Keep up to date with changes in technology
	• Proactively engage in continuous professional development
	• Develop a culture of effective record keeping to facilitate traceability for future development and maintenance and to comply with international standards
	• Read blueprints, wiring diagrams, schematic drawings, technical manuals and engineering instructions
	• Interpret and recognize international symbols, diagrams and languages used by other International Standards Institutes (e.g. DIN, BS, ISO, MIL,UL)
	• Source and purchase components and test equipment to meet specifications and be cost effective
	• Write reports and record data about testing techniques, laboratory equipment and specifications to assist engineers
	• Install equipment, a component, a unit, an upgrade or refurbishment into plant etc.
	• Communicate effectively with the customer
	• Train on the use of the installation
	• Act professionally on clients' premises
	• Initiate records for on-going maintenance policy
	• Establish maintenance contract where appropriate
	• Use computers as a tool to design test strategies, programme test routines and collect test data	

2	Application of Electronics Principles in Practice	10

	The individual needs to know and understand:
	• Electronic Circuit Component Specifications
	  • Analogue and digital logic circuit and sensor circuit
	  • AC and DC technology
	  • Power
	  • Wire and cables
	  • Connectors
	  • Displays
	• Circuit Design
	  • Analysis, of electrical circuits, electronic circuits, digital logic circuit and sensor circuit
	  • Basics of AC and DC technology
	  • Two part LRC network, resistive networks with up to three meshes
	  • RC oscillators
	• Multistage and special amplifier circuits
	  • Basic amplifier circuits (AC, DC and power amplifiers)
	  • Differential amplifiers/operational amplifiers
	  • Ideal operational amplifier: (infinite input resistance, zero output resistance and infinite open loop gain)
	  • Basic circuits with operational amplifier, analogue adder and sub-tractor, differentiator, comparator, impedance transducer
	  • Real operational amplifier: offset voltage and offset current, compensation, common mode gain and rejection, temperature drift, frequency response
	• Generators and pulse shapers
	  • Generators for sine wave voltage: RC, quartz, LC oscillators, Wien bridge generator, phase generator
	  • Pulse shaper: Schmitt trigger, differentiator and integrator
	• Digital electronics
	  • Level switching function, function table, pulse, diagram, circuit symbols
	  • Properties of basic gates AND, OR, NOT, NAND, NOR, EXCLUSIVE OR EXCLUSIVE NOR
	  • Substituting basic NAND or NOR gates for basic gates
	  • Creating switching functions from given circuits and vice versa
	  • Simplifying switching networks using Karnaugh diagram or mathematical techniques
	  • Flip-flops, RS flip-flop, D flip-flop, JK Master slave flip-flop (especially counter circuits, shift register and frequency divider)	

	The individual shall be able to: • Identify and analyse the appropriate principle for the task • Apply cognitive skills as appropriate to the task	

3	**Hardware Design**	**20**
	The individual needs to know and understand: • The application of electronic principles • Specialist (PCB design) software • Design fit for purpose • Process of converting a design into actuality	
	The individual shall be able to: • Design small modifications to electronic basic electronics blocks • Discuss professionally and interpret a briefs and specifications • Draw a developed schematic circuit using E-CAD programme • Design a Printed Circuit Board layout using E-CAD programme • Design a 3D Printed Circuit Board layout using E-CAD programme • Communicate design and data using appropriate files and format to the manufacturer ensuring accuracy for manufacturing equipment and processes • Assemble components and Printed Circuit Board to IPC-A-610 issue E standard • Test the prototype • Use computer simulation as part of the design and testing process • Conduct circuit simulation using SPICE software	
4	**Embedded Systems Programming**	**20**
	The individual needs to know and understand: • Circuit boards, processors, PIC chips, electronic equipment and computer hardware and software • Programming of embedded systems by using C-language and Integrated Development Environments (ex MPLAB) • The application of electronic principles	
	The individual shall be able to: • Programme embedded systems by using C-language and Integrated Development Environments (ex MPLAB) • Set up hardware and software applications • Compile a 'C' programme loaded into a PIC controller for test purposes • Locate, correct and re-compile syntax errors • Modify 'C' programmes such that the demonstration board performs different activities • Calculate and demonstrate an understanding of C expressions and loop codes	
5	**Fault Finding, Testing, Repair and Measuring**	**15**
	The individual needs to know and understand: • The application of electronic principles • Contexts in which the function of fault finding, testing, repair and measurement takes place • The limitations and applications of test equipment • Implications of unreliable equipment on a business and preventative maintenance	

	The individual shall be able to: • Take measures on electronic circuits (with DVM, scope, data collection equipment etc.) • Determine causes of operating errors and the required action • Adjust and replace defective or improperly functioning circuitry and electronics components, using hand tools and soldering iron • Test electronics units, using standard test equipment, and analyse results to evaluate performance and determine need for adjustment • Locate, test and replace faulty electronic components in a printed circuit board, surface mounted board or mixed technology • Use conventional measuring and testing equipment to test, set, adjust and measure electronic components, modules and equipment that are based in DC, AC, digital and analogue electronics. • Record and analyse measured results and data • Collect and analyse the evidence both manually and remotely • Use specialist equipment effectively to measure, diagnose and repair faults • Communicate effectively, especially with non-technical people • Support the development of preventative maintenance schedules • Perform preventative maintenance and calibration of equipment and systems • Use automatic test equipment • Effectively use digital documentation of measuring results • Measure specific electrical parameters with precision or plotting variations over time to ascertain circuit • Test device operations by validating input, output and processing	
6	**Assembly**	**20**
	The individual needs to know and understand: • Different international quality standards • The importance of keeping up to date about changing standards and technologies • Implications of International Standard for Quality of Design IPC-A-610 issue E • The application of electronic principles • The various components used	
	The individual shall be able to: • Assemble and utilize mechanical parts such as DC Motor, AC Motor, Stepper motor Solenoid, sensors etc. • Connect assemble mechanical parts to form a working unit • Wire and form cables • Assemble and use various types of parts and surface mounted devise parts • Assemble parts to standard determined by IPC-A-610 • Work to correct sequences and tolerances • Accurately solder components using lead free solder to comply with industry standards	

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 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 judgment. These are referred to as **objective** and **subjective**, respectively. 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 external designer for the development of the Marking Scheme and Test Project.

In addition, Experts are encouraged 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 the complete and approved 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 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).

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 of assessment 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) has a specified day on which it will be marked.

Each marking form (Sub Criterion) contains either objective or subjective Aspects to be marked. Some Sub Criteria have both objective and subjective aspects, in which case there is a marking form for each.

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 objectively or subjectively and appear on the appropriate marking form.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it and a reference to the section of the skill as set out in the Standards Specification.

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)

STANDARD SPECIFICATION SECTIONS	CRITERIA									TOTAL MARKS PER SECTION
TOTAL MARKS PER CRITERION										100

4.5 SUBJECTIVE MARKING

Subjective marking uses the 10 point scale below. To apply the scale with rigour and consistency, subjective marking should be conducted using:

- benchmarks (criteria) to guide judgment against each Aspect
- the scale to indicate:
  - 0: non attempt;
  - 1-4: below industry standard;
  - 5-8: at or above industry standard;
  - 9-10: excellence.

4.6 OBJECTIVE MARKING

A minimum of three experts will be used to judge each aspect. Unless otherwise stated only the maximum mark or zero will be awarded. Where they are used, partial marks will be clearly defined within the Aspect.

4.7 THE USE OF OBJECTIVE AND SUBJECTIVE ASSESSMENT

The final deployment of objective or subjective assessment will be agreed when the Marking Scheme and Test Project are finalized. The table below is advisory only for the development of the Test Project and Marking Scheme.

SECTION	CRITERION	MARKS		
		Subjective	Objective	Total
A	Hardware design	0	30	30
B	Embedded systems programming	0	25	25
C	Fault finding, repair and measuring	0	25	25
D	Assembly module	0	20	20
Total		**0**	**100**	**100**

4.8 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

A. Hardware design module - 30 marks
A1. Development of given basic circuit - 12 marks;
A2. Design of PCB-board layout - 10 marks;
A3. Functionality of proto unit - 8 marks

B. Embedded Systems Programming - 25 marks
B1. Software functionality - 25 marks

C. Measuring, fault finding and repair module - 25 marks
C1.Finding faulty spots and evidence - 12 marks;
C2. Repairing (IPC-A-610-D) – 3 marks;
C3. Validity of measuring results – 8 marks;
C4. Documentation of measuring method – 2 marks

D. Assembly module - 20 marks
D1. Operating condition OK - 5 marks;
D2. Assembled quality according ICP-A-610 D - 15 marks

4.9 SKILL ASSESSMENT PROCEDURES

Each Expert joins the Competition with a formerly allocated Test Project. The Test Project that will be used at the Competition is selected three days before the first Competition day.

The process of selecting Test Projects is as follows:

The Expert who prepared a Test Project explains it to all Experts.

All Experts vote to decide the Test Projects.

Each Test Project is to be made based on section three The Test Project, however the con-tents in the prepared project can differ according to the project provider's intention.

The assessment procedure and detailed marking standard can be determined as below:

- Forming assessment group for each project;
- Chief Expert allocates four to five Experts for each project;
- Chief Expert nominates the assessment team leader;
- The project provider proposes the outline of marking standard to the project marking group;
- All the Experts in each group confirm the final marking standard referring to the initial outline;
- Each assessment group is responsible for the progress of the pertaining Test Project.

Experts start marking after the end of each module. Each Expert marking group can organize the marking schedule after consultation with the Chief Expert.

Assessment is completed each day. All assessments are done when the last module's assessment is completed.

Only the Expert marking group for a specific module assesses the module. All other Experts can leave the Competition site. Modules are assessment in the Expert room

5 THE TEST PROJECT

5.1 GENERAL NOTES

Sections three and four 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 and balanced 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.

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 0 refers.

5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The format of the Test Project is a series of standalone modules.

5.3 TEST PROJECT DESIGN REQUIREMENTS

Experts design modules for evaluation at the Competition according to the following requirements.

Assembly module

Experts may bring any modules they desire but the modules should include assembly of PC boards that include conventional and surface mount components. Wiring and mechanical assembly may also be required.

It is recommended that:

- 50% of the marks for assembly should be based on components;
- 25 % be based on wiring;
- 25 % based on mechanical assembly.

All surface mount components to have no more than 20 pins and no less than 0.65mm of pin pitch. And all surface mounted passive devices shall not be smaller than 0805 foot-print.

The Experts have to supply replacement components for this module. All electronic parts brought to the Competition should be in antistatic bags.

Fault Finding, Repair and Measuring

The boards may be conventional (standard), surface mount technology or mixed technology boards. All surface mount components to have no more than 20 pins and no less than 0.65mm of pin pitch. And all surface mounted passive devices shall not be smaller than 0803 footprint.

The Expert is expected to bring one working module demonstration board plus boards for all the Competitors as well as two spare boards, circuit diagrams, component over-lays and data.

The Experts are expected to supply replacement components for this module. All boards must be pre-built before the Competition. Each board must have at least three faults. All Experts will bring one working project demonstration board, for the Competitors plus two spare boards; electronic circuit diagrams component overlays and data sheets. All electronic parts brought to the Competition should be in antistatic bags. Integrated Circuits to be brought in antistatic boxes inserted in antistatic foam.

Hardware design module

The final solution to this must include circuit design or modifications to pre-built, or partially built board(s) and include test points as part of their design. Maximum amount of components are 70.

Competition time for this module is seven hours, phase one 2.5h, phase two 2.5h, phase three 2h.

In this module the Competitor needs to create a solution defined in the assignment to meet the properties in a given environment in hardware using a breadboard to prove the design which they must bring with them.

The Experts responsible will supply a complete set of circuit specifications, schematic diagrams, and a list of suggested components. The Experts will also bring materials from which PC boards may be constructed.

Once the design has been proven, each Competitor will have to design a PCB. Circuit design is separate and PBC-design starts from original and right version, same for all. Six months before the Competition add Design Rules document to the Technical Description as an appendix or give a link to the attachment on the Discussion Forum. This document will explain exactly what data is needed at the end of PCB Design Module.

Two months before the Competition explain exactly what data is needed at the end of the PCB Design module (data to include component packing).

This will then be manufactured at the Competition by the Competition Organizer for the afternoon of day three (C3).

This module shall include assembly skills that are hand assembled not using computer assembly programming. The Software Development Plan and Hardware Development Plan boards can contain analogue, digital and embedded components, or a mixture of such components.

Each Expert to bring one working module demonstration board for the Competitors plus two spare boards, circuit diagrams, component overlays as well as data sheets. All electronic parts brought to the Competition should be in antistatic bags. Integrated Circuits to be brought in antistatic boxes inserted in antistatic foam.

Embedded systems programming module

A four hour programming module where the Chief Expert in conjunction with the Com-petition Organizer will confirm any final software arrangements six months before the Competition start date. This is a Software Design; the 18FXX2 processor family shall be used. The 18F4520 device is to be used (details available at http://www.microchip.com).

The program will be in C only. The C compiler must be brought by the Competitor and the one recommended is the one supplied by Microchip.

The C Programming marking system functionality will include the following:

- Use of Interrupts: Interrupt Subroutines (ISR) are allowed. Use of priority is allowed;
- In Line Assembly: This is NOT allowed, the only exception being as follows:
    - The use of commented sections of code that are not editable, that is the Competitor does not need to change any assembly code. The comments should be adequate to understand the function of the code without knowing the detail of the mnemonics.

In task card is allowed only "normal" (need definition of normal) component and if more advanced component is used driver functions have to be delivery same time as datasheet.

Time allowed 19 hours

MODULE	TIME ALLOWED	SUGGESTED DAY
Hardware design	7 hours (2,5+2,5+2)	C1 and C3
Embedded systems programming	4 hours	C2 or C3
Fault finding, repair and measuring	4 hours	C4
Assembly module	4 hours	C2 or C3

General notes on proposed modules

Each proposal must:

- Meet the Test Project design requirements;
- Have a minimum number of words;
- Be able to be translated quickly into the chosen language of the Competitor;
- Have a small project brief;
- Have a parts list;
- Have a circuit diagram;
- Have a data sheet pack.

Project documentation must be brought to the Competition on CD/DVD or memory stick in Microsoft Word. When preparing the project no more than 200 words should be used in any one module. All words are to be double spaced underneath to allow for translation into the chosen language of the Competitors. Each Expert should also allow 25% space on each sheet for drawing.

Modifications. Where Experts have used drawing software, Experts should bring along the version of the drawing software used. Paper copies should also be presented and where possible in three official

Languages. Where possible, circuit diagrams, photographs, line drawings, etc. will be used for all modules and project wording should be as brief as possible.

Specifications for Test Project modules

All Test Project modules must be according to the following specifications (possible data lines and voltages, 5V, 12V).

- There is no DIN connector;
- Voltages are ±12V.

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 for the 2015 Competition by Experts and out-standing company according to the table below:

COUNTRY	ASSEMBLY MODULE	HARDWARE DESIGN MODULE	EMBEDDED SYSTEMS PROGRAMMING MODULE	FAULT FINDING, REPAIR AND MEASURING MODULE
External company, Brazil				X
Brazil			X	No
Canada	X			No
Finland			X	No
Germany		X		No
Japan			X	No
Korea		X		No
Portugal	X			No
UK			X	No
Morocco		X		No
Iran		X		No
Singapore			X	No
Switzerland	X			No
Chinese Taipei			X	No
Vietnam	X			No
DO		X		No
IS		X		No
Columbia		X		No
India		X		No
MY	X			No
AE			X	No
ID	X			
Total				

Experts entering for the first time must contact the Chief Expert at least three months prior to the Competition to discuss which modules they must bring to the Competition. One project/country.

5.4.2 How and where is the Test Project or modules developed

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
At the previous Competition	Experts decide on the modules for the next Competition then they select which modules they would like to develop. This process is controlled by the Chief Expert
Six (6) months before the Competition	New Experts contact the Chief Expert for allocation of module proposals
Two (2) months before the Competition	Experts send all library references and other support material to Chief Expert for circulation to all competing countries/regions
At the Competition	Modules are selected by voting process described in the Competition Rules
At the Competition	A random ballot selection is used to determine the allocation of workbenches to Competitors

5.5 TEST PROJECT VALIDATION

Experts will validate the Test Project together at the Competition. An agreement will be made that the following criteria is met. Test project should meet the description of 5.3 Test Project design requirements.

Time limit – time for each module is open depending on the total time of the Competition.

- Hardware Design Project seven hours;
- Embedded Systems Programming four hours ;
- Fault Finding, repair and measuring four hours;
- Assembly Project four hours.

5.6 TEST PROJECT SELECTION

The Test Project is selected by vote of Experts at the current Competition using the voting process described below.

Voting process

- A first vote will be used when there are more than two projects in a category;
- A second vote will be used to choose between the two projects which have the highest total points in the first vote;
- The project with the highest vote will be selected. If, in final testing, before the project is distributed to the Competitors, a technical problem with the project is discovered, the project will be discarded and the project that got the second highest score will be used.

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 Chief Expert.

5.9 TEST PROJECT CHANGE AT THE COMPETITION

If, in final testing, before the project is distributed to the Competitors, a technical problem with the project is discovered, the project will be discarded and the project that got the second highest score will be used.

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.

Material and manufacturer specifications for Test Projects set by each Expert should be updated on the Industrial Electronics forum by one month prior to the Competition. The information can be provided by uploading the full datasheet of main materials (IC, special parts, etc.). The Expert who prepared the Embedded Systems Programming module should present a newly written library or special function.

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
- Health and Safety documentation
- 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 Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to Host Country/Region Health and Safety documentation for Host Country/Region regulations.

- All Competitors and Experts must have Electro Static Awareness (ESD).

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 Technical Director 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 MATERIALS, EQUIPMENT AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

All equipment for competition is delivery by Competition Organizer and it's not allow to Competitors to bring any equipment and laptops from own country!

Laptops supplied by Competition Organizer, operating system Windows 8, English language!!!

It is not allowed to use any own language package in operating systems and CAD or programming software. Only English language versions are allowed

8.3 MATERIALS, EQUIPMENT AND TOOLS SUPPLIED BY EXPERTS

- Laptop computers, USB ports;
- Hand tools and soldering stations;
- Experts may also bring all their own equipment including step transformers.

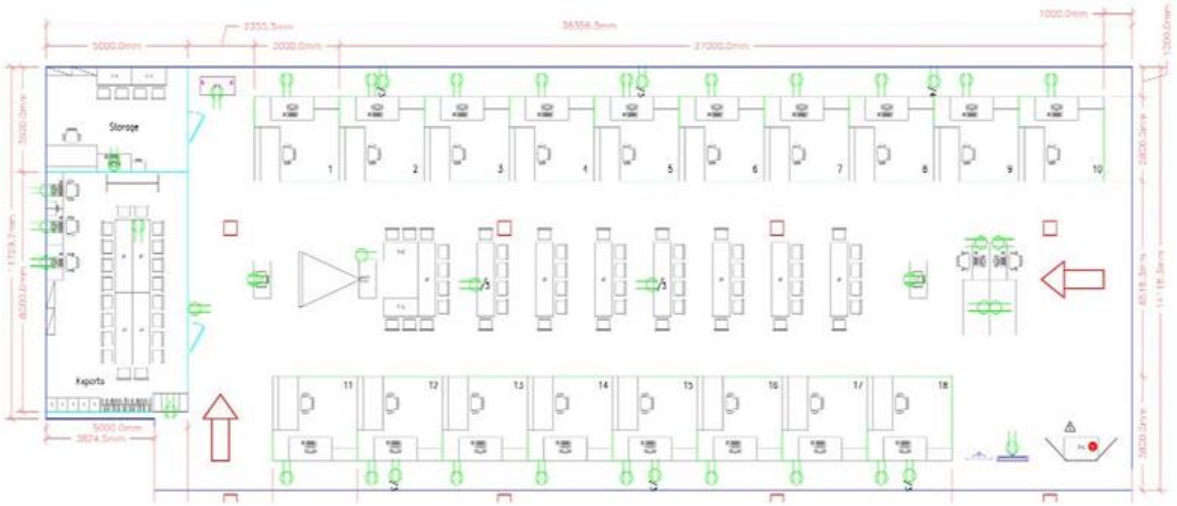
8.4 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

Not applicable.

8.5 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

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

Example workshop layout:



9 VISITOR AND MEDIA ENGAGEMENT

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

- Try a trade;
- Display screens;
- Test Project descriptions;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of Competition status.

10 SUSTAINABILITY

- Recycling;
- Use of ‘green’ materials – Lead-free solder is used for soldering.