

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:

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Liam Corcoran

Technical Committee Chair

1. **INTRODUCTION**

1.1 **Name and description of skill**

1.1.1 The name of the skill is [Electronics](#).

1.1.2 Description of skill

This skill involves manufacturing, testing and troubleshooting electronic equipment. Skilled technicians are able to build equipment and systems for electronics and other special applications. They use the required hand tools, solders and measuring devices and computers. Since the manufacturing processes of modern mass-produced electronics are highly automated, technicians build prototypes before production, and maintain and repair systems.

Computers and embedded systems (computers for which a fixed programming environment is embedded in the processor) play a central role in this skill area since electronic devices are mainly built with the aid of programmed systems.

1.2 **Scope of application**

1.2.1 Every Expert and Competitor must know this Technical Description.

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

1.3 **Associated documents**

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

- WSI - Competition Rules
- WSI - Competition Manual
- WSI - Online resources as indicated in this document
- Host Country - Health and Safety regulations

2. **COMPETENCY AND SCOPE OF WORK**

The Competition is a demonstration and assessment of the competencies associated with this skill. The Test Project consists of practical work only.

2.1 **Competency specification**

[Describe the competencies that are required.](#)
(Use a list with bullet points).

- [Example bullet point](#)
 - [Example sub bullet](#)

2.2 **Theoretical knowledge**

2.2.1 Theoretical knowledge is required but not tested explicitly.
[The Competitors' Theoretical knowledge should cover:](#)

Fundamental electronics principles

- Basics of AC and DC technology
- Two ports LRC network, resistive networks with up to three meshes
- RC oscillators

Components in electronics

Properties, behaviour, characteristics and application (elementary circuits) of mechanically, electrically and physically adjustable components i.e. capacitors, resistors, Coils, transformers and Diodes: rectifying diodes, switch diodes, zener diodes, capacitive diodes, PIN diodes Trigger components, diac, triac, thyristor and Uni. -junction transistors.

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

- Basic logic gates:
- Level switching function, function table, pulse, diagram, circuit symbols (table in appendix)
- 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.
- Making function table from circuit diagrams and switching functions
- 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).

2.2.2 Knowledge of rules and regulations is not examined.

2.3 Practical work

Assembly module

The Competitors will be asked to assemble a project from a kit of parts. The standard to be reached is determined by IPC-A-610 issue D (International acceptability of electronic assemblies).

Measuring and testing module

The Competitors are expected to work with 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. They are further expected to record and analyse measured results. Boards must be pre-built before the competition.

Fault finding and repair module

The Competitor is expected to locate, test and replace faulty electronic components on a printed circuit board, surface mount board or mixed technology board. All surface mount components to have no more than 20 pins. The Competitor should be able to document fault finding method/procedure with results.

Hardware design module

Each Competitor will have to design a PCB. It is recommended that the Altium Software will be used.

This project will be completed in modules over the 4 days of the competition. Parts of the project may be in progress on days 1, 3 or 4.

Embedded systems programming module

Three hour programming module using Microchip 18F4520 (details available from <http://www.microchip.com>).

3. THE TEST PROJECT

3.1 Format / structure of the Test Project

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

3.2 Test Project design requirements

Experts design modules for evaluation at the Competition

Assembly module

Experts may bring any projects they desire but the projects should include Assembly of PC boards that include conventional and surface mount Components. Wiring and mechanical assembly may also be required. Surface mount components should have no more than 20 pins. One or two projects may be selected.

The Experts have to supply replacement components for this project. All electronic parts brought to the competition should be in anti static bags.

Measuring and testing module

The boards may be conventional (standard), surface mount technology or mixed technology boards. SMT components may have a maximum of 20 pins.

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

Fault finding and repair module

The Experts are expected to supply replacement components for this project. 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 anti static bags. Integrated Circuits to be brought in anti static boxes inserted in anti static 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.

In this project 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 as been proven, each Competitor will have to design a PCB. It is recommended that the Altium Software will be used. (*The Chief Expert will circulate six months prior to the competition start date what standard will be used*) This will then be manufactured on the competition stand by the host country for the afternoon of day three of the event.

This project shall include assembly skills, that are hand assembly skills not 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 project 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 anti static bags. Integrated Circuits to be brought in anti static boxes inserted in anti static foam.

Embedded systems programming module

A Three hour programming module where the chief Expert in conjunction with the host country 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.

Time allowed for each module

Module	Time allowed	Suggested Day
Hardware design	6 hours	C1 and C4
Embedded systems programming	4 hours	C2
Fault finding and repair	4 hours	C2 and C3
Measuring and testing	4 hours	C2 and C3
Assembly project	4 hours	C4

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 mother tongue 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 3.5" floppy disc format, CD Rom or Memory Stick in Microsoft Word. When preparing the project no more than 200 words should be used in any one project. All words are to be double spaced underneath to allow for translation into the mother tongue 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 program software that they 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.

3.3 Test Project development

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

3.3.1 Who develops the Test Project / modules

The Test Project / modules are developed by:

The Test Project/modules are developed for the 2009 Competition by Experts according to the table below:

Country	Assembly module	Fault finding and repair module	Measuring and testing module	Embedded systems programming module	Hardware design module
Brazil		X			X
Canada			X		
Finland		X		X	
Germany					X
Japan		X		X	
Korea	X				X
Ireland		X			
Indonesia	X		X		
Morocco		X			X
Iran		X			
Singapore		X			X
Switzerland			X		
Taiwan		X		X	
Tunisia			X		X
Vietnam		X		X	
United Kingdom	X				

Experts entering for the first time must contact the Chief Expert to discuss what projects they must bring at least three months before the Competition.

All modules must use a 12 volt plus or minus supply that will be supplied by the host country.

3.3.2 How and where is the Test Project / modules developed

The Test Project/modules are developed **independently**.

3.3.3 When is the Test Project developed

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

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.
6 months before the Competition	New Experts contact the Chief Expert for allocation of module proposals.
2 months before the Competition	Experts send all proposals to Chief Expert for circulation to all competing countries/regions. This includes all library references and other support material. Only proposals that comply with the Competition Rules and the Technical Description will be circulated.
At the Competition	Modules are selected by voting process described in section 2.9
At the Competition	A random ballot selection is used to determine the allocation of workbenches to Competitors.

3.4 Test Project marking scheme

Each Test Project must be accompanied by a marking scheme proposal based on the assessment criteria defined in Section 5.

3.4.1 The marking scheme proposal is developed by the person(s) developing the Test Project. The detailed and final marking scheme is developed and agreed by all Experts at the Competition.

3.4.2 Marking schemes should be entered into the CIS prior to the Competition.

3.5 Test Project validation

Please describe how Test Project validation will be conducted as required by the Competition Rules.

3.6 Test Project selection

The Test Project is selected as follows:

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

Voting process

- First, vote for the project most appropriate for the skill description. Rank and give them a point.
- Second, vote for projects considering their level of difficulty and freshness of idea. Choose two projects you consider the best and the second in one vote.
- Then rank and give them a point
- The two projects which have the highest and the second highest total points in votes 1 and 2 will be selected

Rank Point	Vote 1	Vote 2	Vote 3
1 st			
2 nd			
3 rd			
4 th			
5 th			
Others			

3.7 Test Project circulation

The Test Project is not circulated

3.8 Test Project coordination (preparation for Competition)

Coordination of the Test Project will be undertaken by the Chief Expert.

3.9 Test Project change at the Competition

Not applicable.

3.10 Material or manufacturer specifications

If specific material or manufacturer specifications are required to allow the Competitor to complete the Test Project then please state how, when and by whom this information will be provided. If this does not apply then write "Not applicable".

4. SKILL MANAGEMENT AND COMMUNICATION

4.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration and decision making regarding the skill must take place on the skill-specific Discussion Forum (<http://www.worldskills.org/forums>). All 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 moderator for this forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

4.2 Competitor information

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

This information includes:

- Competition Rules
- Technical Descriptions
- Test Projects
- Other Competition-related information

4.3 Test Projects

Circulated Test Projects will be available from [worldskills.org](http://www.worldskills.org) (<http://www.worldskills.org/testprojects>) and the Competitor Centre (<http://www.worldskills.org/competitorcentre>).

4.4 Day-to-day management

The day-to-day management 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 finalised at the Competition (agreed by Experts and submitted to the Chair/Vice Chair of the Technical Committee). The Chief Expert is to regularly share updates of the Skill Management Plan via the Forum.

5. ASSESSMENT

This section describes how the Experts will assess the Test Project / modules. It also specifies the assessment specifications and procedures and requirements for marking.

5.1 Assessment criteria

This section defines the assessment criteria and the number of marks (subjective and objective) awarded. The total number of marks for all assessment criteria must be 100.

Section	Criterion	Marks		
		Subjective (if applicable)	Objective	Total
A	Hardware design		25	25
B	Embedded systems programming		20	20
C	Fault finding and repair		20	20
D	Measuring and testing		15	15
E	Assembly project		20	20
Total =		XX	XX	100

5.2 Subjective marking

[Not applicable.](#)

5.3 Skill assessment specification

[Please enter assessment specification here.](#)

5.4 Skill assessment procedures

[Please enter assessment procedures here.](#)

6. **SKILL-SPECIFIC SAFETY REQUIREMENTS**

Refer to Host Country Health & Safety documentation for Host Country regulations.

Skill-specific safety requirements:

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

7. **MATERIALS & EQUIPMENT**

7.1 **Infrastructure List**

The Infrastructure List lists all equipment, materials and facilities provided by the Host Country.

The Infrastructure List is online (<http://www.worldskills.org/infrastructure/>).

The Infrastructure List specifies the items & quantities requested by the Experts for the next Competition. The Host Country will progressively update the Infrastructure List specifying the actual quantity, type, brand/model of the items. Host Country supplied items 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 Secretary General 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.

7.2 **Materials, equipment and tools supplied by Competitors in their toolbox**

Laptop Computers with English Language, USB Ports, Embedded System kit with a standard interface. Hand tools and soldering stations are required, however they may bring all their own equipment plus step transformers.

7.3 **Materials, equipment and tools supplied by Experts**

Not applicable

7.4 **Materials & equipment prohibited in the skill area**

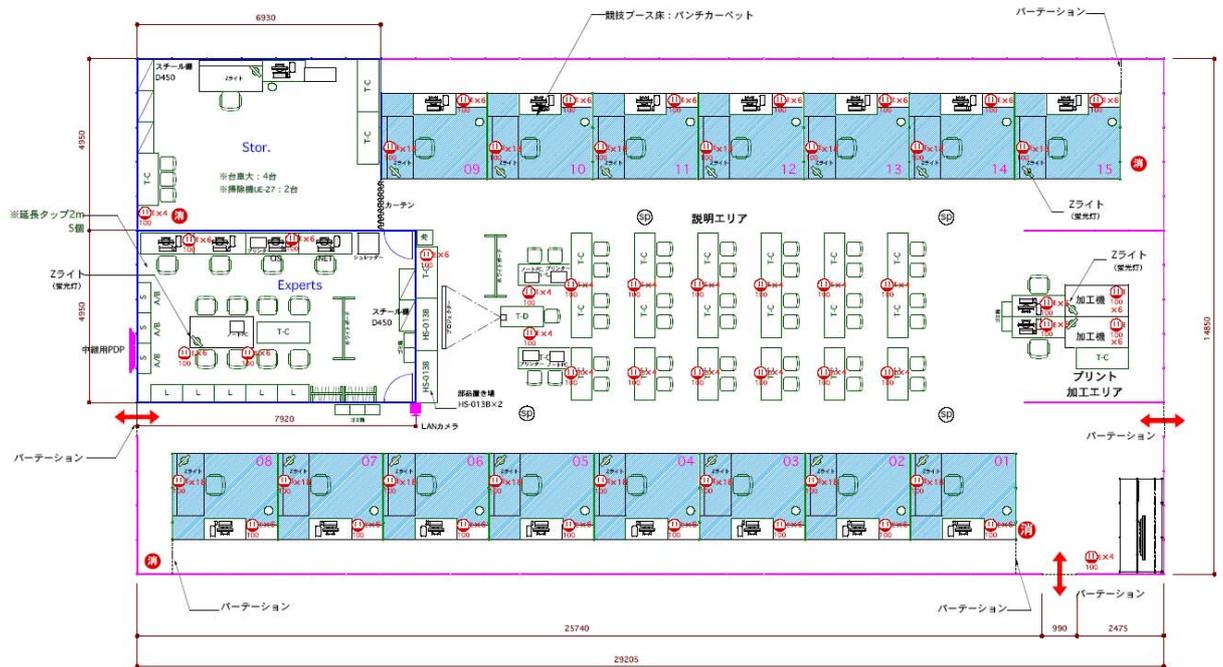
Not applicable

7.5 **Sample workshop and workstation layouts**

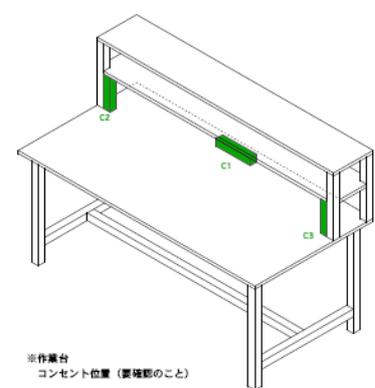
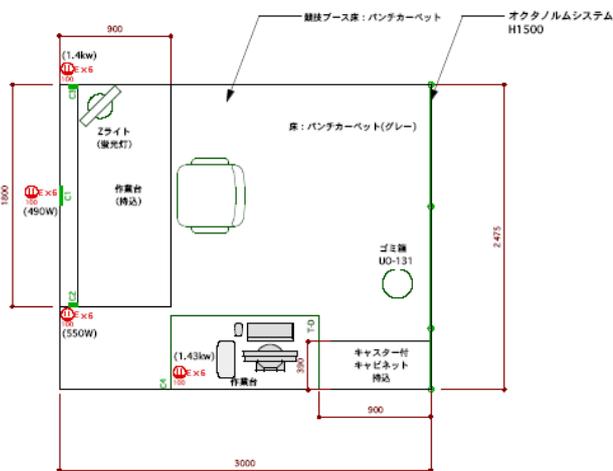
Workshop and workstation layouts from Shizuoka are available at:

http://www.worldskills.org/index.php?option=com_halls&Itemid=318

Workshop layout from previous Competition:



Workstation layout from previous Competition:



※作業台
コンセント位置 (要確認のこと)

記号	
①	単相100V コンセント
②	単相100Vアース付 コンセント
③	単相200V コンセント
④	三相200V コンセント
⑤	三相200V アース付コンセント
ⓐ	エアバルブ
ⓑ	給排水口
Ⓒ	分電盤

①	Single-Phase 100V Outlet
②	Single-Phase 100V Outlet with Ground Terminal
③	Single-Phase 200V Outlet
④	Three-Phase 200V Outlet
⑤	Three-Phase 200V Outlet with Ground Terminal
ⓐ	Air Valve
ⓑ	Water Supply and Drainage
Ⓒ	Distribution Panel

8. MARKETING THE SKILL TO VISITORS AND MEDIA

8.1 Maximising visitor and media engagement

Please list the ways you intend to maximise visitor and media engagement for this skill. For example:

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

8.2 Sustainability

- Recycling
- Use of 'green' materials
- Use of completed Test Projects after Competition