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INDUSTRIAL ELECTRONICS

V1.0 - 10 May 2006

technical description



INTRODUCTION

WorldSkills, 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:

- Section 1 – Technical/Competition Description (TD)
- Section 2 – Project Design Criteria (PD)
- Section 3 – Skill Management Procedures (SM)
- Section 4 – Workshop Setup (WS)
- Section 5 – Infrastructure List (IL)
- Section 6 – Appendices

Effective 10.05.06



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10.05.06

1. SECTION 1 - TECHNICAL/COMPETITION DESCRIPTION (TD)

1.1 Name and description of skill

- 1.1.1 The name of the skill is Industrial Electronics
- 1.1.2 Every expert and competitor must know this Technical Description.
- 1.1.3 In the event of any conflict within the Technical Descriptions, the English version will take precedence.
- 1.1.4 Words implying male gender shall automatically imply female gender also.

1.2 Scope of work at WorldSkills Competitions

- 1.2.1 Assembly project.
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). Each project must fit the Euro card standard using DIN 41612 F64 or F32 connectors that fit a standard back plane connector, power and data bus points. See section 4:7.
- 1.2.2 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 will also be required. It is recommended that
 - 50% of the marks for assembly should be based on components
 - 25 % be based on wiring and
 - 25 % based on mechanical assembly.Surface mount components should have no more than 20 pins.
- 1.2.3 A competitor must be able to complete the project in three hours. One or two projects may be selected.
- 1.2.4 All electronic parts brought to the competition should be in anti static bags. Integrated Circuits are to be brought in anti static boxes inserted in anti static foam.

1.3 Measuring and testing project.

- 1.3.1 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.
- 1.3.2 The boards may be conventional (standard), surface mount technology or mixed technology boards. SMT components may have a maximum of 20 pins.
- 1.3.3 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. Pin configurations and power supply will be as stated in 4:7.

1.4 Fault Finding and Repair project.

- 1.4.1 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 will be able to document fault finding method/procedure with results.
- 1.4.2 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. Pin configurations and power supply will be as 4:7.

1.5 Hardware Design Project

- 1.5.1 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 as described below.
- 1.5.2 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.
- 1.5.3 The final solution to this must include circuit design or modifications to a pre-built, and partially built board(s).
- 1.5.4 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.
- 1.5.5 Once the design as been proven each competitor will have to design a PCB that will be manufactured by the host country for the afternoon of day three of the event. The prototype boards will have to be connected to standard I/O-Bus and will have to be built and proven.
- 1.5.6 This project shall include assembly skills, that is 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.
- 1.5.7 The host county will provide - Resistors E24 series, 0.25 watt to be available, a range of capacitors, 3 of LM and 74 Series ICS and a selection of 1N series diodes. Competitors will be expected to design and build a project from a combination of the above components plus whatever extra the expert may bring.
- 1.5.8 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. Competitors may bring their own measurement instruments which should be calibrated. See equipment lists below.

1.6 Embedded Systems Programming

- 1.6.1 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. The software written will be used to drive the hardware mentioned above.
- 1.6.2 This is a Software and hardware Design, the following **processor family** 18FXX2 shall be used. The **particular device**, 18F452 is the device that is to be used. The family is described in the document 379464B at www.microchip.com. The particular device, the 18F452 is also available at www.microchip.com.
- 1.6.3 Suggested Guidelines for Training see appendix
- 1.6.4 The program will be in C only (Not C++). The C compiler recommended is the one supplied by Microchip and the IDE (Integrated Design Environment) shall be the Microchip one. This is available at www.microchip.com. The IDE and compiler version numbers shall be the ones that are current at Jan 1st 2007. Changes to the C compiler specifications may be made subject to approval of the Chief Expert.
- 1.6.5 C Programming marking system : We will adopt a fill in the blanks programming marking method.
- 1.6.6 Use of Interrupts : Interrupt Subroutines (ISR) are allowed. Use of priority is allowed.
- 1.6.7 In Line Assembly : This is NOT allowed, the only exception being as follows: -
 - (i) 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.
- 1.6.8 Two recommended text books are
 - Predko Myke "Programming and Interfacing the PIC Microcontroller"
 - Peatmann John "*Programming the 18F552 @ at www.picbook.com* It is recommended that the hardware demonstration board used in this book are used as a basis for project boards.

1.7 Building Blocks allowed in both the Hardware Design and the Software Design Projects

- 1.7.1 Building Blocks :
 - Analogue Multiplexers
 - Hall Effect Switches
 - V/F and F/V Converters
 - A/D and D/A converters
 - Digital Pots
 - LCD Displays
 - Simple DC to DC building blocks
 - Standard battery charger circuits (Lilon, NiMH and NiCAD)
 - RMS to DC converters
 - Analogue Multipliers
 - FIFO memory
 - Flash memory
 - EPROMS
 - Simple PLDs (must specify in advance)
 - DC Motors

- DC Servomotors, and Stepper Motors as building blocks for embedded systems
- TRIAC/SCR Power Control
- H Bridges
- Instrumentation Amplifiers
- Bargraph Display drivers
- 7, 16 and 18 segment display drivers
- Function generator ICs
- LCD displays (must specify in advance if details necessary)
- Relays and Solenoids and driving circuits
- Capacitance Proximity Switches
- Humidity Detectors
- Real Time Clocks with and without digital ID signatures
- Ph Sensor ICs
- Voice Recorder ICs

1.8 Theoretical Knowledge Statement

This competition covers Assembly, Faulting Finding, Test and Measurement as well as design. To support this competition Electronics Technicians have to have a good theory knowledge that covers: -

1.8.1 Fundamental electronics principles

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

1.8.2 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.

1.8.3 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.

1.8.4 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.

1.8.5 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).

1.8.6 All countries are expected to bring two theory questions, one digital and one analog.

1.9 Practical work

1.9.1 Incorporated into Subsection 1.2.

1.10 Materials

1.10.1 Refer Section 4.

1.11 Workshop installations

1.11.1 Refer Section 4 and Section 5.

1.12 Test Project marking

1.12.1 All documentation used must be available in digital form.

1.12.2 There is to be a majority agreement (minimum = 50 % + 1) from experts on the accepted Competition marking scale.

1.12.3 Selection of appropriate project/s is based on paragraph 1.7.2. The expert team may make modifications to the proposed project.

1.12.4 The experts will decide together on the Test Project, the marking criteria and the dimensional tolerances on Forms 5, 5A and 6, and they will prepare the material list.

1.12.5 Rating

	Time	Objective	Points
Design Printed Circuit Board	2 Hours	Yes	10
Design Hardware	5 Hours	Yes	21
Design Software	3 Hours	Yes	15
Fault Finding	4 Hours	Yes	18
Measurement	4 Hours	Yes	18
Assembly Project	4 Hours	Yes	18

1.12.6 Points awarded

- Perfect = 10 points
- Very good = 9 points
- Good = 8 points
- Fairly good = 7 points
- Sufficient = 6 points

- Average = 5 points
- Poor = 4 points
- Unsatisfactory = 3 points
- Very bad = 2 points
- Nothing = 1 point

1.12.7 If a country submits a project and his/her competitor gains a large score and all the other competitors have a low score, then the average of all the low scores will be awarded to the competitor from the country that submitted the project.

1.12.8 Conversion from the 0 – 100 scale to the 400 - 600 scale will be performed by the WorldSkills Competition Information System (CIS).

2. SECTION 2 - PROJECT DESIGN CRITERIA (PD)

2.1 General requirements

2.1.1 Overall, the Test Project must:

- Be modular
- Be in accordance with the current Technical Description
- Comply with WorldSkills requirements and numbering standard
- Be accompanied by a marking scale that will be finalised at the competition in accordance with Subsection 1.7.
- Be accompanied by proof of function/ proof of construction/ completion in the set time etc – as appropriate to this skill category. – For example, a photograph of a project done according to the Test Project within material, equipment, knowledge and time constraints.

2.2 Design requirements

2.2.1 Refer subsection 1.5 for the time and points per project.

2.3 Project development and implementation procedure

2.3.1 Experts, Technical Delegates, Jury Presidents, Shopmasters and other associated or invited people will use the WorldSkills Discussion Forums to communicate, collaborate and co-ordinate the development of the Test Project and the overall development of this skill category for the WorldSkills Competition. The address for the forum for this skill category is http://www.worldskills.org/members/forums/forum_16/index.php. The Chief Expert (or an expert nominated by the Chief Expert) will be moderator for this forum.

2.3.2 The following countries will provide the following at the 2007 Competition. Any country entering for the first time must contact the Chief Expert to discuss what projects they must bring.

Country	Assembly Project	Fault Finding	Software Design	Hardware Design	Measuring and Testing	PCB Design
Brazil			X	X		
Canada					X	
Finland	X		X			
Germany		X		x		
Japan		X		X		
Korea	x			X		
Macao		x			x	
Ireland			X		X	
Iran			X			
Portugal		X		X		
Singapore	X		X			
Switzerland	X				X	
Taiwan		X	X			
Tunisia			X		X	
United Kingdom	X			X		

2.4 Project selection guidelines

- 2.4.1 All competition presentations will be made in English. Before any project is presented for selection it must be checked that it conforms to the current rules of World Skills and the current Trade 16 Technical Description. If the rules are not followed the project will not be considered for selection. All documentation must adhere to the World Skills rules or it will not be selected. The experts will form a project group with experts from other countries who have brought similar projects. The group will be chaired by an expert who has attended two or more events. The project group will then select either one or a number of projects for the competition. The chair of the group will then present the selections to the rest of the experts. Following everyone's approval the experts will then agree a marking scheme for the project(s). When the competition begins, these experts manage and mark that aspect of the competition under guidance from the Chief Expert.
- 2.4.2 All projects will
- Meet the trade description criteria
 - Have a minimum number of words
 - 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
- 2.4.3 Voting Process
- First, vote for the project most appropriate for the trade 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			

- 2.4.4 Project documentation
- 2.4.5 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.
- 2.4.6 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

2.5 First time countries

- 2.5.1 Any Countries attending the competition for the first time **should** contact the Chief Expert via world skills who will then if possible forward previous competition documentation and agree their project in advance for them to prepare for the competition

2.6 Ballot Selection of Competitors Work Areas, Competition Notes and Timetable

- 2.6.1 For a total random selection procedure, the country codes should be placed in one bin and workbench numbers in another. Alphabetically the country competitors will select one piece of paper from each, and this is then the start bench for that country.

3. SECTION 3 - SKILL MANAGEMENT PROCEDURES (SM)

3.1 Documents required

- 3.1.1 The Chief Expert will have available a current copy of all documents associated with this skill for the Competition.
- 3.1.2 The documents required are:
- Technical Description – Skill 16 Industrial Electronics
 - (WorldSkills) Competition Rules
 - Health and Safety documents
 - QAMS – all documents
 - Any other documents referred to in the documents listed above.
- 3.1.3 While it is understood that the Chief Expert will have a copy of these documents in his/her own language, there shall also be a complete set in the language identified as that taking precedence.
- 3.1.4 The Chief Expert is expected to have a sound knowledge of the requirements and procedures specified in the documentation.
- 3.1.5 The Jury President is expected to have a thorough knowledge and understanding of the requirements and procedures specified in the documentation.

3.2 Pre-Competition responsibilities

- 3.2.1 In the period between one Worldskills Competition and the next, the elected Chief Expert is responsible to ensure that the requirements of Section 2 – Project Design Criteria are complied with.

3.3 Skill Management procedures for the Chief Experts prior to and during the Competition

- 3.3.1 The procedures specified below must be adhered to.
- 3.3.2 On arrival at the Competition site for the first time, the Chief Expert must:
- Welcome the experts and ensure introductions are made
 - Inform them of their duties and responsibilities in terms of the Competition Rules and Standing Orders
 - Ensure that the project is endorsed by all the experts and that a copy is signed by all the experts
- 3.3.3 The Chief Expert will then divide the experts into teams for the following activities:
- Verify that the material on site is appropriate and sufficient
 - Verify again that the quantities of material as specified on the material list is accurate
 - Develop a program for the competitors to complete the modules
 - Develop timetables for activities
 - Set up equipment
 - Confirm that the layout, work areas and equipment are in accordance with the workshop setup requirements

- Confirm that all machinery/equipment is in a safe working order
 - Confirm that all workstations/machinery/equipment are in accordance with the plan, and that they are numbered
 - Confirm that there is sufficient illumination
 - Confirm that there is sufficient space for the competitors to work efficiently
 - Confirm that the barriers are far enough removed from the competitors to ensure that there will be no interference, and if they are not, set up a roster among the experts to police the area during the Competition
 - If necessary, set up duty rosters for activities during the Competition – e.g. keeping watch during lunch, preventing access of unauthorised persons, etc
- 3.3.4 The Chief Expert will then divide the experts into teams for purpose of marking and setting up marking schedules in accordance with the requirements of Subsection 1.7.
- 3.3.5 Suggestions and comments for the revision and improvement of the Technical Description are to be provided to the Deputy Chief Expert in writing. The Deputy Chief Expert will reduce the information to a single typed document ready for discussion by all experts. Prior to leaving the Competition site, the Chief Expert, the Deputy Chief Expert and the Jury President will facilitate the discussion and revision of the Technical Description. Also refer paragraph 3.3.12.
- 3.3.6 At any time that a unanimous decision is not achieved within a reasonable time, the Chief Expert will put the matter under discussion to the vote. A majority will be 50% of the experts present plus one. This decision will be final. In the event that an expert is absent at the time that the vote takes place, he/she has the right to be informed of the decision but the matter will not be raised again or voted upon again. The exception to this majority rule will be in the case of approval of the changes to the Technical Description, where the majority of 80% is required.
- 3.3.7 In the event that an extension of time is requested for the Competition to exceed 22 hours, the matter must be discussed with the Jury President. All possible alternative solutions must be investigated before approval of an extension of time is requested, or will be approved.
- 3.3.8 Prior to the end of the Competition, the Jury President will facilitate the selection of the Chief Expert and Deputy Chief Expert for the next WorldSkills Competition.
- 3.3.9 Experts are eligible for selection as a Chief Expert if they:
- Can speak English
 - Have attended the WorldSkills Competition at least twice before (if less than 4 experts have been to the WorldSkills Competition before, this criteria may be relaxed at the discretion of the Jury President)
 - Demonstrate a high degree of expertise in the skill
 - Demonstrate leadership qualities.
 - Are competent using a computer and the Internet – specifically to facilitate the Discussion Forum for their skill category.
- 3.3.10 The process by which selection will take place is by secret ballot and is as follows:
- Each expert present will list their choice of three experts in order of preference
 - The Jury President will allocate a score of three (3) points to each experts first preference, two (2) points to the second preference and one (1) point to the third preference
 - The Jury President will then calculate total scores and announce the three highest scoring experts
 - The expert with the highest score will be appointed Chief Expert for the next WorldSkills Competition

- If the first choice cannot attend, then the second choice will be Chief Expert
- If the first and second choice cannot attend, then the third choice will attend
- If none of the choices can attend, then the jury president will appoint, or facilitate the appointment of a Chief Expert
- The names of the selected experts will be entered into the provided documentation and signed by the Jury President and returned to the WorldSkills Secretariat.

- 3.3.11 Changes to the method of Competition design or suggestions offered for the next Competition design process or tasks must be written down and signed by 80% of the experts and included in Subsection 2.3.
- 3.3.12 The Deputy Chief Expert's primary role is to ensure that the Technical Description is updated to reflect the technological advances of the skill category and include overall improvements for the preparation and running of the Competition. He/she will ensure that all changes to the Technical Description are entered, that all experts sign it, and that it is delivered to the WorldSkills Secretariat as a hard copy and digitally.
- 3.3.13 The Deputy Chief Expert also assists in the distribution and collection of the QAMS Audit Questionnaires and assists the Chief Expert where necessary.

3.4 Competition procedures

- 3.4.1 The project will be worked on over all four days of the Competition (project organised by tasks, sections or modules).
- 3.4.2 Each module/task/section will be completed on the assigned day so that progressive marking can take place. Progressive results are to be available each day via a PowerPoint presentation or similar.
- 3.4.3 Prior to the start of the Competition, each competitor will receive a detailed timetable reflecting the timing for completion of the project tasks or modules.
- 3.4.4 Competitors will have a maximum of X hours (TBC) to become familiar with material, equipment and processes. Where processes are particularly difficult, a subject matter expert will be available to demonstrate the process and the competitors will be given the opportunity to practice.
- 3.4.5 The competitors will be given all Competition documents including the marking criteria X hours (TBC) prior to the commencement of the Competition so that they may study the requirements.
- 3.4.6 At no time during the Competition may the expert from the same country of origin as the competitor be involved in any discussion without another expert present or without permission from the Chief Expert.
- 3.4.7 Experts and competitors who continually fail to abide by the Technical Description and Competition Rules may be temporarily or permanently removed from the Competition.
- 3.4.8 Ballot selection of competitor work areas, competition notes and timetable
For a fair selection procedure, the country codes should be placed in one bin and workstation numbers in another. Alphabetically the country competitors will select one piece of paper from each, and this is then the workstation for that country.

3.5 Competition safety requirements

- 3.5.1 Policies and procedures specified within the following documentation will be adhered to or followed at all times.
- Health and Safety Policy – General Requirements
 - Health and Safety Policy – Skill Specific
 - Procedure for Safety Training
 - Safety Training Development Flowchart
 - Host Country Health and Safety Requirements
 - Medical Assistance Request Procedure
 - Accident Report Form
- 3.5.2 After having received training and briefing, the Chief Expert will provide the experts, competitors and personnel for whom he has responsibility with the information and training required to ensure a safe Competition in accordance with the requirements of the documentation specified in paragraph 3.5.1 above, and taking into account any of the specified requirements identified in Subsection 3.6 below.
- 3.5.3 The Chief Expert will ensure that all experts, competitors and personnel for whom he has responsibility complete and sign the Confirmation of Receipt of Training Form (refer Appendices) on completion of the training session.
- 3.5.4 The Chief Expert will countersign these forms, and keep them secure until the end of the Competition at which time they will be returned to the Quality Auditor for the Competition.
- 3.5.5 The Chief Expert will additionally task the experts with the responsibility of ensuring that all experts, competitors, and other personnel comply with the safety requirements for the skill category and Competition site.
- 3.5.6 The Chief Expert will receive nominations and appoint a safety officer whose responsibility will be to carry out the tasks specified in the Safety Checklist (refer Appendices).
- 3.5.7 Work clothes must comply with relevant codes. If the host country has any specific codes that are to be in place during the Competition, then these must be made known to the competitors at least 6 months prior.
- 3.5.8 All machinery and/or equipment must comply with the safety requirements of the host country.
- 3.5.9 Competitors must keep their work area clear of obstacles and their floor area clean of any material, equipment or items likely to cause someone to trip, slip or fall.
- 3.5.10 Failure by the competitor to comply with safety directions or instructions may incur loss of marks for safety. Continuous unsafe practice may result in competitors being temporarily or permanently removed from the Competition.

3.6 Skill specific safety requirements

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

3.7 Judging procedural requirements

- 3.7.1 The experts that attend the Competition will be divided into marking groups to deal with each section of the marking criteria.
- 3.7.2 Every completed module/task/section will be marked on the same day in which it was completed.
- 3.7.3 To ensure transparency, each competitor is provided the same evaluation sheet as used by the experts.
- 3.7.4 The experts agree that a majority vote is needed to:
 - Change scoring system (within limits specified in the Technical Description)
 - Change Competition sequence or content
 - Agree on a solution for disputes concerning points awarded etc.

3.8 Honesty, fairness and transparency

- 3.8.1 The competitors that attend the Worldskills Competition have the right to expect fair and honest treatment during the Competition in terms of the following:
 - Instructions that are clear and unambiguous
 - Marking schedules that provide no advantage to an opposing competitor
 - All necessary equipment and material specified within the skill documentation that are required to complete the Competition
 - The assistance necessary from judges and officials to ensure that he is able to complete the project. (The assistance deemed necessary will be provided equally and at the same time to all competitors present)
 - No undue interference by officials or spectators that may hinder them in the completion of their project
- 3.8.2 Every competitor has the right to expect and demand that no opposing competitors will receive undue or unfair assistance or intervention that may provide that opposing competitor with an unfair advantage.
- 3.8.3 All officials and judges present on the Competition site are expected to ensure that paragraphs 3.8.1 and 3.8.2 above are complied with and maintained.
- 3.8.4 It is the responsibility of the Chief Expert or his Deputy to ensure that all competitors, interpreters, officials and judges comply with and maintain the integrity of the Competition, and additionally ensure that all necessary steps are taken to ensure that:
 - Translations and any interpretation to a particular competitor does not advantage that competitor
 - Outside influences do not unduly improve or decrease competitors' abilities to provide a worthy performance.
- 3.8.5 A briefing will be provided to all experts and competitors on the requirements for integrity during the Competition.
- 3.8.6 Additionally, the Chief Expert is expected to identify these and any other factors that may exist on the Competition site that may result in the contravention of paragraphs 3.8.1 and 3.8.2 above, and reduce them to a checklist for continuous reference.

- 3.8.7 In the event that any competitor, judge, official, observer or competitor compatriot is found to be attempting to gain or provide assistance in any form that may result in an unfair advantage, the Chief Expert is to immediately refer the matter to the Jury President.
- 3.8.8 The Chief Expert will receive nominations and appoint a Security Officer whose responsibility it will be to ensure that these requirements are carried out.
- 3.8.9 It will be explained to all experts and competitors that nothing is to come in or out of the site unless specified by the Chief Expert as being allowed after being briefed on this topic.
- 3.8.10 Security checks will be carried out each day on experts and competitors (by experts and competitors) upon entry and exit to the site.

3.9 Information policy

- 3.9.1 TBC

4. **SECTION 4 - WORKSHOP SETUP (WS)**

4.1 **Materials**

4.1.1 The working area should provide enough space for the competitors, expert's (jury), measurement and repair area, material cupboards and wardrobes.

4.2 **Measuring Instruments and Testers**

4.2.1 The host country will provide the following equipment for the workstations and a spare set of the above for experts.

- Universal DVM
- Function generator 1-5 MHz, sine, square, triangle.
- 2 x Bi-polar power supplies triggering, AC/DC. For > 40 MHz (with accessories).
- Various connection cables (3-30V adjustable) per competitor
- Oscilloscope with (if necessary, coax cable with BNC plugs).
- Lamp.
- Electrostatic workstation.
- Calculator, scientific one may be used but a programmable calculator or PDA computing device is unacceptable.

4.3 **Materials (Components)**

4.3.1 The workshop master must ensure that the materials provided are completed, packed in bags and checked also for the power supply project, and range of E24, 0.25w resistors from 10 ohm to 1 megohms is supplied.

4.4 **Other Materials**

- solder 60/40 type (By 2009 all solder will be lead free)
- Approx. 1 m bare wire (0.5-mm diameter) per competitor.
- Approx. 2 m each has insulated wire (or standard wire) in two different colours for each competitor.
- Binding /insulation tape.
- Lacing string /Tie raps/heat shrink sleeving Hot-air fan for heat-shrink tubing.
- Magnifier for expert x3 or x5.
- Printer
- Computer for experts

Lockable cupboards must be provided for the safe keeping of the materials and the examination papers under the responsibility of the chief expert

4.5 **Tools**

4.5.1 Competitors must bring all their own assembly tools,

- a Laptop.

- A 2005 Pentium XP standard computer with at least 1G RAM and 250GB Hard Disk is recommended.
- At least four USB 2.0 ports are needed.
- They may also bring one multimeter and oscilloscope only to use.
- All other assembly and measurement instruments be supplied by the host country and will be used by all competitors at the event.

4.6 Clothing

4.6.1 Work clothes must comply with relevant safety standards. Safety standards require a minimum of safety glasses and covered footwear.

4.7 Making of PCBs for Hardware Design

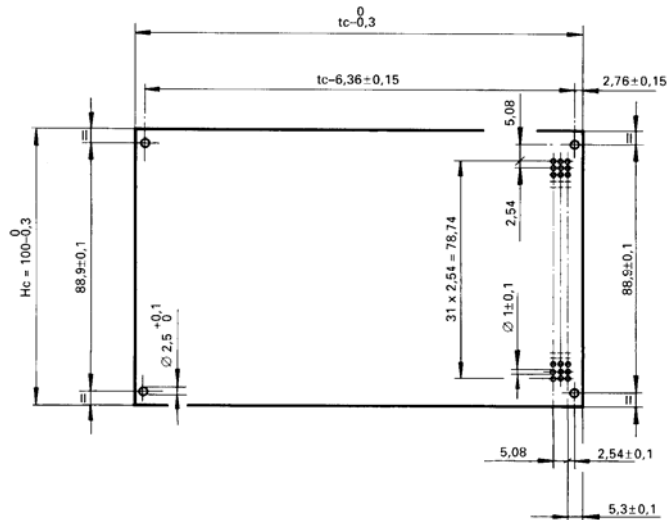
4.7.1 The host country will make arrangements for the manufacture of the competitors PCB Designs from day 1 to be ready for the afternoon of day three. All PCB will have to follow the standard the voltage rails detailed below, but not the data bus.

4.7.2 The host country in conjunction with the Chief Expert will inform the Technical Delegates of each country twelve months in advance what software and issue number will be required to design the PCBs

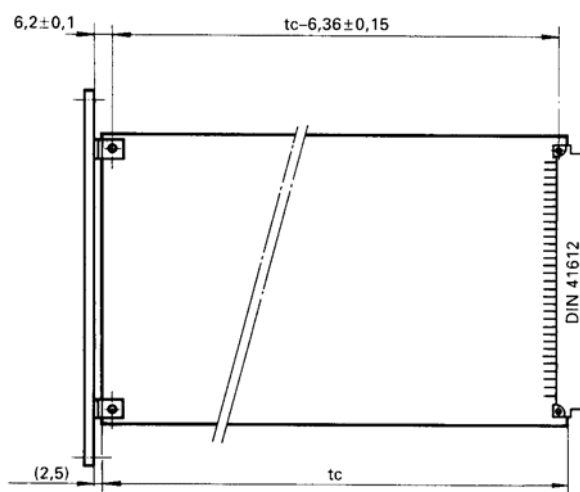
4.8 Specifications for PC Boards

A1	C1	+5v Digital
A3	C3	Digital Ground
A4	C4	Data Bus
A5	C5	Data Bus
A6	C6	Data Bus
A7	C7	Data Bus
A8	C8	Data Bus
A9	C9	Data Bus
A10	C10	Data Bus
A11	C11	Data Bus
A12	C12	Data Bus
A13	C13	+5v Analog
A15	C15	+12v Analog
A16	C16	Analog ground
A17	A17	-5v Analog
A18	C18	-12v Analog
A23	C23	Data Bus
A24	C24	Data Bus
A25	C25	Data Bus
A26	C26	Data Bus
A27	C27	Data Bus
A28	C28	Data Bus
A29	C29	Data Bus
A30	C30	Data Bus
A31	C31	Digital Ground
A32	C32	+5v Digital

- Mechanical specifications: The Europe format for PCB card is specified as follow (PCB only):



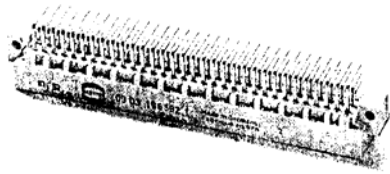
- All dimensions are in millimetres. TCP = 160 mm
- The Europe format for PCB card with a front plate is specified as follows (with front plate and DIN41612 connector):



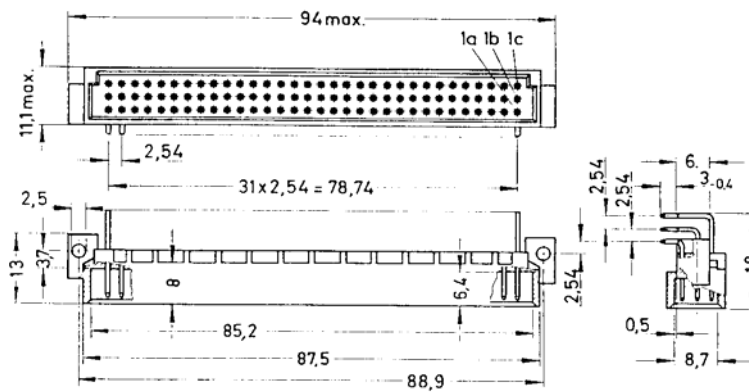
- All dimensions are in millimetres. TCP = 160 mm
- Front plate dimensions (if needed): 40,64 mm x 128,7 mm x 2,5 mm

4.9 PCB connector:

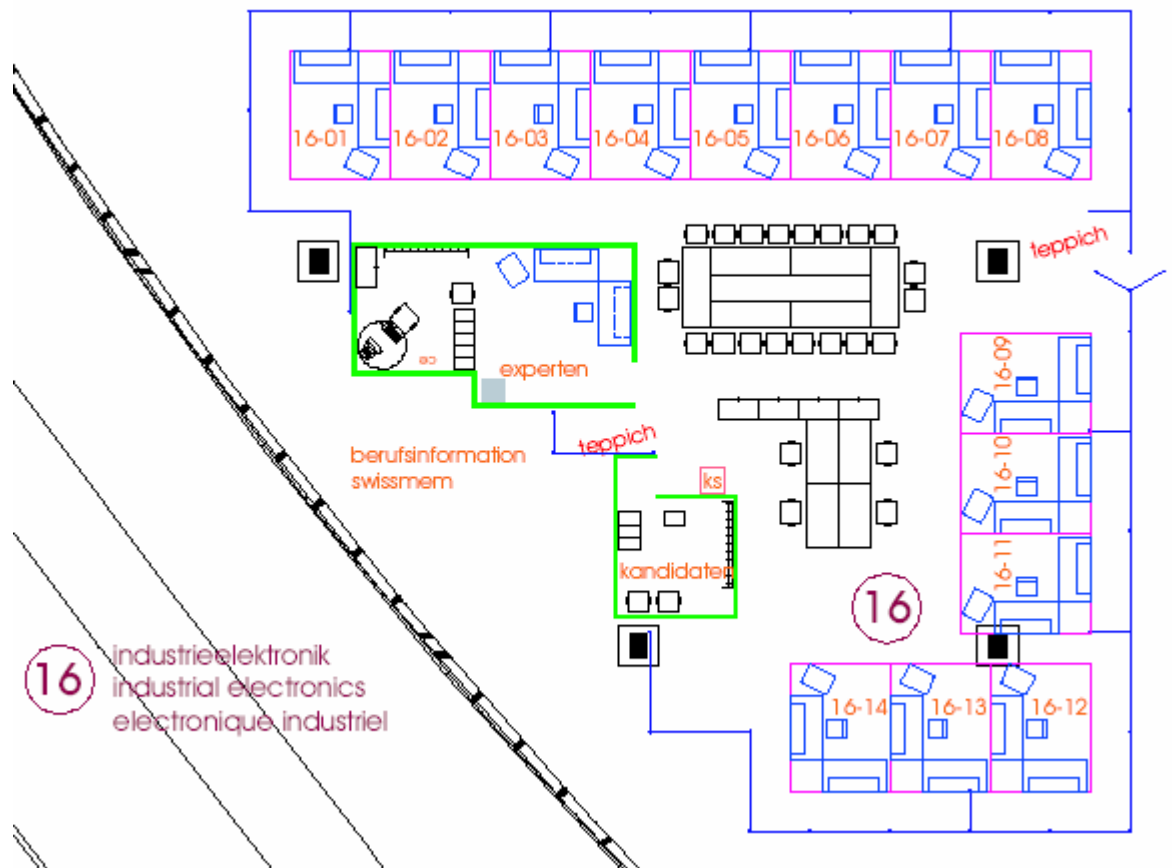
- Each card must be designed with a DIN41612 male 64 pins a + c (C form) connector for PCB. The reference from HARTING is: 0903.164.6921.



- Mechanical dimensions of the connector



4.10 Sample layout



Layout at the 37th WorldSkills Competition, St Gallen, Switzerland 2003.

5. SECTION 5 – INFRASTRUCTURE LIST (IL)

Item	Number Required
Fuses, sets Sets, 1A/3A/2A/100 mA/200 mA/500 mA, 250V	20 of each
Resistors Complete Set E24/0,25 W (10W 10	1 Box
Soldering tin 60/40	8 Bobbins
Bare wire, approx5000, Ø 0.5	8 Bobbins
Insulated wire5000, 0.4 mm ² different colours	8 Bobbins
Red wire insulated	
Insulating tape / adhesive tape different colours	2 Boxes
Highlighters	40
Cable ties	2 Boxes
Staplers	4
Pencils	40
Note pans	20
ESD Mats and Safety (bench Matts)	20
Function generator	20
Screwdrivers, set, sizes 1-5	20
Combination pliers	20
Universal +/- 12 V DC Power Supply 2amps	20
Universal digital voltmeter 1 Flukes	20
Scope Meter Scope Meter Scope Meter 1 Fluke 196C	20
Calibration of scope meter Fluke 196C	20
Stabilized power supply r 1 2x 0 ... 2.5A, 1x 3 ... 6VDC/2A	20
Six Foot Cupboards (Locking away projects)	3
Personnel Lockers for experts and competitors	40
Measuring cables	60
Coaxial with BNC plugs cables	40
Calculator not programmable non programmable	20
Hot-air guns (230V)	4
Shrink on sleeve boxes	4
Refrigerator	1
Coffee machine	1

PCB cleaning/ De-fluxing facility	1
PCB cleaning machine signs	4
Hand washing facilities (signs)	1
Signs for hand washing station	1
Floor concrete	N/A
Sockets on work benches 8 off	N/A
Workstation ESD-protected work station (Plus 2 for trainers)	20
ESD signs	2
Desoldering stations	5
Connections:	
Electricity sockets individually protected for stations	18
Electricity sockets individually protected experts	8
Tables for experts	10
Chairs for experts	18
Set office material:	
Phone Telephone Land Line	1
Computers for trainers	2
Printer b / w	2
Working table 1600 x 800	18
Chairs	18
Photocopier	1
File shredder	1
First Aid Kit	1
Flipchart	1
Solder Fume Extraction (2 for experts)	20
PCB Making Facility	1
Toolbox:	18
tweezers	18
side cutters	18
pliers	18
craft knife	18
tape measure	18
scissors	18
mechanical strippers	18

PCB manufacturing facility, Japan experts aware of request

6. SECTION 6 – APPENDICES

6.1 Health and Safety Check List

List each item A to C

'A' = Good

'B' = Unsatisfactory but rectified immediately

'C' = Poor needs action

1	Are all exits from the area free of obstruction?	
2	Are all gangways within the area free from obstruction?	
3	Is all fire fighting appliances at their designated locations, and access to them not obstructed?	
4	Do Experts / Competitors in the area know? a) Means of escape in emergency b) The location of fire equipment and alarm points. c) What action to take if the evacuation alarm sounds. d) The action to take if a person is seriously ill / injured	
5	Is the floor surface safe?	
6	Are items of furniture in a sound condition? e.g. lockers, tables, chairs, benches etc	
7	Are cables and extension leads on electrical equipment protected and checked?	
8	Are electrical wall sockets secure and in good condition?	
9	Are the emergency stop buttons on equipment assessable and clearly marked?	
10	Are the following satisfactory? a) Lighting b) Ventilation c) Temperature d) Noise level e) Extraction	
11	Are "fittings" in a safe state, e.g. lights, service supplies etc?	
12	Are all items of handling equipment in a safe condition, e.g. trolleys?	
13	If competitors or others are working in the area, are they under full supervision?	
14	Is safety information for chemicals or substances used available and known to the use?	
15	Are all filing cabinet drawers functioning correctly, and are drawers prevented from coming out by limit stops. ?	
16	Are metal cabinets free from sharp edges?	
17	Are the tops of units free from unsuitable objects?	
18	Is there suitable storage provided (and used) for cabinet drawer locking bars, when not in use. ?	
19	If applicable, are paper guillotines properly guarded?	
20	Does the area demonstrate a satisfactory level of good house keeping?	
21	Are tools in good condition?	
22	Are heavy items stored on low level racks?	
23	Are there other items of safety equipment available for use?	
24	Are all personnel trained to use appropriate equipment in this area? (See	

	supervision).	
25	Are there necessary restrictions being enforced e.g. entry of unauthorised persons. ?	
26	Are flammable liquids and chemicals stored in appropriate environment?	
27	Are all raw materials or equipment safely positioned?	
28	Are the edges of areas marked with a hazard stripe?	
29	Is all equipment that requires guarding, fitted with secure and serviceable guards?	
30	Is eye protection being worn in appropriate areas?	
31	Are waste materials correctly disposed of?	

Chief Expert (Signature).....

TRADE 16/2 EXPERTS FAIRNESS AGREEMENT

World Skills requires each competition to have guidelines for competition fairness to which the experts must adhere. The guidelines for Trade 16, Industrial Electronics, are listed below.

It is understood that the experts, before the competition begins, have developed strategies regarding

- Competition relationships and communication
- Competition management
- Competitor management

Competition relationships and communication

The experts

- Respect and trust each other.
- Communicate honestly, accurately and completely and without anger, frustration, etc.
- Listen actively
- Reach agreements quickly
- Value the contribution of other experts
- Keep an open mind regarding all issues

Competition Management

The experts agree that

- No visitors will be allowed in the competition area.
- No means of electronic communication, such as cell phones, wireless computer communications, etc. will be used in the competition area.
- No competition information (hard or soft copies) will be given to the participants before it is appropriate to do so.

The experts will

- Manage time effectively
- Set reasonable, attainable goals
- Have contingency plans in place
- Create a vision for future competitions
- Recognize possible issues of conflict and move to prevent disagreements
- Will reach consensus on issues and then convey the decisions made to the participants.
- Will present a common front to the participants

The experts agree that when the competitors arrive

- They will not talk to the competitor or visitor from their country without the presence of at least one other expert
- They will not leave the competition area when the competitor from their country is away from the competition area unless they are in the presence of another expert
- No forms of electronic communication devices such as mobile phones, wireless computing devices, etc. are permitted in the competition area.

Competition Guidelines

World Skills requires each competition to have guidelines for competition fairness to which the competitors must adhere. The guidelines for Trade 16, Industrial Electronics, are listed below.

Competition Rules for Competitors while working on their Projects

The competitors agree that they

- will not talk to the expert from their country unless there is another expert present.
- will not talk to any people outside the competition area while working on a project.
- Will ensure that no forms of electronic communication (mobile phones, wireless computing device, sneaker net) devices are permitted in the competition area.
- They will not leave the competition area without an escort except at scheduled times for lunch and visits to other areas.
- will not leave their workstation without permission, except to obtain wire etc from centre bench.
- They will raise their hand if they have a question or feel ill
- They will not touch any project other than their own.
- They will not touch any other competitors equipment.
- They will, if they finish early, completely leave the competition area

SUGGESTED COMPETITION TIMETABLE/4

Programme of Activity

For Japan 2007

Day 1

Step	Activity	Start time	Finish time
1	Introduction by Chief Judge	9:00	09:15
2	Hardware Design Introduction	9:15	09:45
3	Hardware Design	10:00	13:00
4	Lunch	13:00	14:00
5	Time round competition	14:00	15:00
6	Design PCB Board	15:00	17:00

Total competition time - 5.00

Day 2

Step	Activity	Start time	Finish time
1	Assembly Introduction	09:00	09:30
2	Assembly 1	09:30	12:30
3	Lunch	12:30	13:30
4	Measurement Board 1 Introduction	13:30	14:00
5	Measurement Board	14:00	17:00

Total competition time - 6.00

Day 3

Step	Activity	Start time	Finish time
1	Demonstration of Fault Finding	09:00	09:30
2	Start of Fault Finding	09:30	12:30
3	Lunch	12:30	13:30
4	Build and Test Prototype Project from Day 1	13:30	15.30
5	Time round competition	15.30	17:00

Total competition time - 5.00

Day 4

Step	Activity	Start time	Finish time
1	Software Design Introduction	09:00	09:30
2	Software Design I	09:30	12:30
3	Lunch	12:30	13:30
4	Test and Measurement 2 Introduction	13:30	14:00
5	Test and Measurement II	14:00	17:00

Note

The above programme is only an example competition

Facility infrastructure

Same as Finland but added extras

PCB manufacturing facility, Japan experts aware of request

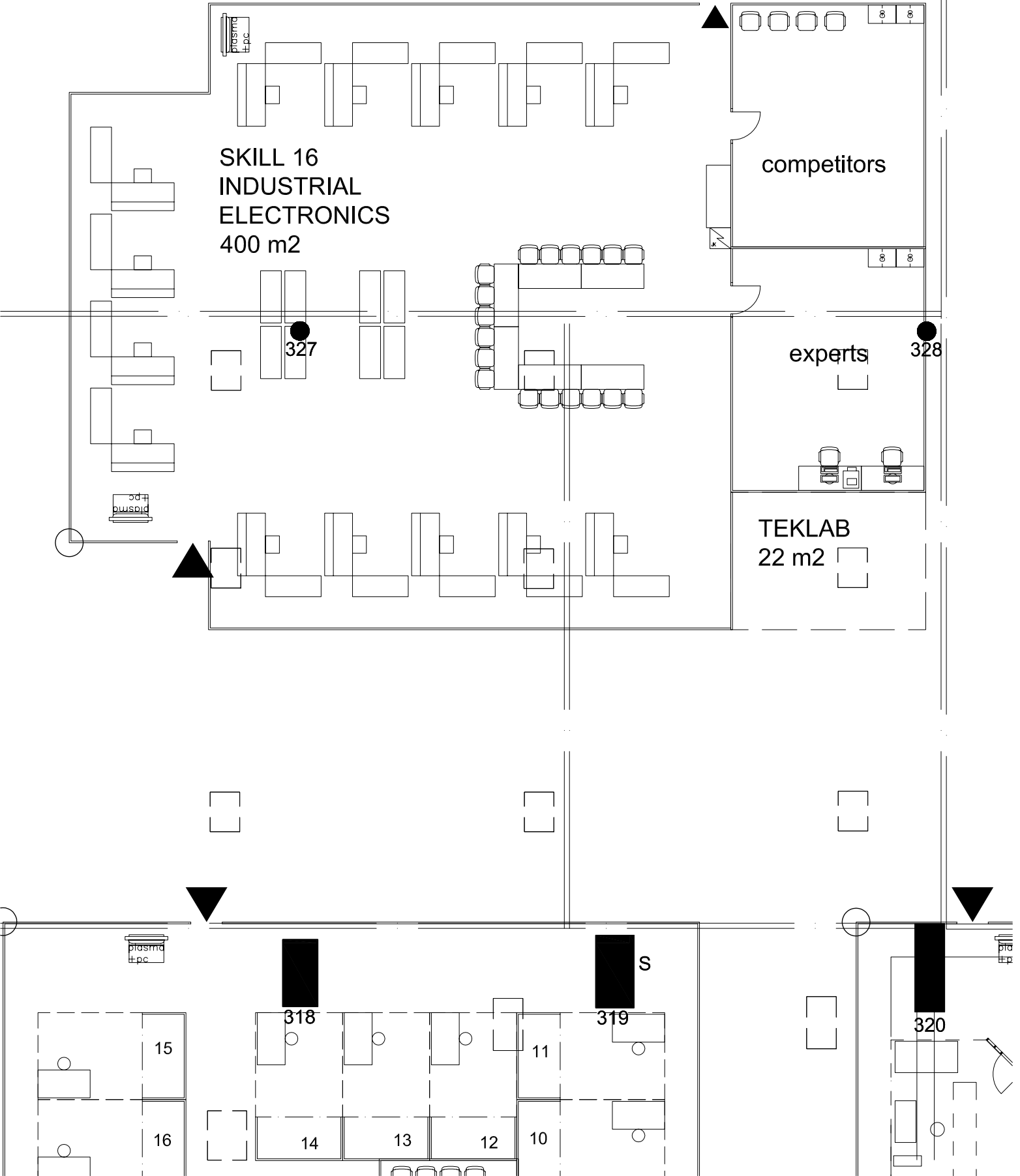
Camping mat and sleeping bag for Chief Expert!

SKILLS 2005



Skill 16
1:100
2.5.2005

Note: This drawing is not to scale. Please contact WorldSkills Secretariat for original AutoCAD file.



5. INFRASTRUCTURE LIST
16
Industrial Electronics
**Electronique
industrielle**
Industrieelektronik

Description (EN)	Description (FR)	Beschrieb (DE)	TD Qty JP OC Qty	Type Type Typ	Measures mm Mesures mm Masse mm	Partner	Comments
General installations	Installations générales	Allgemeine Einrichtung				Partner	
Tables	Tables	Tische	8				
Chairs	Sièges	Stühle	19	grün			
Set office material	Jeu matériel de l'office	Büromaterial-Set	1				
Phone	Telephone	Telefon	0				
Computer	Ordinateur	Computer	1				
Printer b / w	Imprimante b / n	Drucker s/w	1				
Working table	bureau	Schreibtisch	1		1600 x 800		
Chair	Siège	Stuhl	1	grün			
Photocopier	Photocopieuse	Fotokopierer Halle 9.1.2					
file shredder		Aktenvernichter Halle 9.1.2					
Flipchart / Writer	Flipchart / Stylo-feutre	Flipchart / Schreiber	2				
First Aid Kit	Caisse de premier secours	Erste Hilfe Koffer	1				
Fire extinguisher	Extincteur	Feuerlöscher	1				
Box Competitors	Caisse pour cadidats	Garderoben Kandidaten	1x16		300 x 500 x 380		
Box Experts	Caisse pour experts	Garderoben Experten	1x12, 1x8		300 x 500 x 380		
Cloakroom	Vestiaire	Garderobe	1				
Cupboard lockable	Armoire fermer à clé	Schrank abschliessbar	1	C 12			
Clock	Pendule	Wanduhr	1				

Refrigerator	Réfrigérateur	Kühlschrank	1		150 l
Coffee machine	Cafetière électrique	Kaffeemaschine	1		
Cleaning Set	Set de ménage	Reinigungsmaterial-Set	1		
Washroom	Lavabos	Waschgelegenheit	X		
Floor concrete	Plancher du béton	Bodenbelag Beton	X		
Installation of workstations	Installation postes de travail	Einrichtung pro Arbeitsplatz		Einrichtung pro Arbeitsplatz	
+ expert	+ experte	+ Experten	1		
Workstation	Plage utile	Arbeitsbereich	1		3200 x 2500
ESD-protected workstation	poste de travail antistatique	ESD-Arbeitsplatz			
Connections:	Raccordements :	Aschlüsse:			
Electricity	électrique	Elektrizität			230 V
10 sockets	10 prises	10 Steckdosen	1		
individually protected with FI	postes protégés par fusible à action instantanée	pro Arbeitsplatz mit FI und abgesichert Absicherung nicht mehr als 4 Teilnehmer zusammen			6 A
Workbench, without ESD protection	Table de travail, non antistatique	Arbeitsstisch ohne ESD	1	63.568	1600 x 800
without earth	sans prise de terre	höhenverstellbar mit Klinke ohne Erdung			
		Abdeckplatte Kunstharz	1	63.382	1600 x 800
		Tischaufbau	1	39.846	1255 x 350
with energy tunnel	avec conduit de câbles	mit Energiekanal ohne FI	1	39.872	1255
		mit 4 Steckdosen			
Workstation lamp	éclairage du poste de travail	Arbeitsplatzlampe	1	39.885	
Worktable, with ESD protection	Table de travail, antistatique	Arbeitsstisch mit ESD	1	95.914	1600 x 800

with earth	avec prise de terre	höhenverstellbar mit Klinke	1		
		mit Erdung	1	63.229	1600 x 800
		Abdeckplatte Kunstharz	1	95.922	1255 x 350
		Tischaufbau	2	95.936	1255 x 350
with energy tunnel	avec conduit de câbles	Tablare	1	95.947	1255
		mit Energiekanal ohne FI	1	95.852	
		Handgelenkband	1	95.858	
		mit Spiralkabel	1	95.625	
Workstation lamp	éclairage du poste de travail	Erdungsbaustein	1	39.884	
		Erdungsschraubenset	1		
		Arbeitsplatzlampe	1		
		Schubladenboy S 403 F	1	95.005	
Office chair	Siège de bureau	auf Rollen	3	95.024	100
		Schubladen	2	95.025	150
		Schubladen	4	95.008	
		Rollen	1		
isolating transformer	transformateur isoler	Trenntransformator	1	Rotima	230V / 50 Hz 350 VA
Electronic racks: frame for pcbs, incl. cylinder-head, bolts, hex nuts, packing, cylinder-head bolts, hex nuts, packing washers and spacers, contact pins, etc.	Racks pour électroniciens : Bac à cartes pour circuits imprimés avec vis à tête cylindrique, écrous, hexagonaux, rondelles et rondelle bagues d'écartement, fiches de contact, etc.	Elektroniker-Racks: Rahmen für Leiterplatten, inkl. Zylinderkopfschrauben, Sechskant muttern Beilagscheiben und Distanz- rollen, Kontaktstiften etc	1		19" 160 x 100
power supply	bloc d'alimentation	Netzteil	1	PUP 110-40	+/- 5V DC

					+/- 12 V DC
Universal digital voltmeter	Voltmètre numérique universel	Universal-Digitalvoltmeter	1	Fluke 187	
Scope Meter	Scope Meter	Scope Meter	1	Fluke 196C	
Stabilised power supply adjustable	Alimentation stabilisée réglable	Stabilisierter Netzteil regelbar	1	EA-PS 2332-25	2x 0 ... 32V DC 2x 0 ... 2.5A 1x 3 ... 6VDC/2A
Function generator sine, triangle, rectangle	Générateur de fonctions sinusoidales, carrées, triangulaires	Funktionsgenerator Sinus, Rechteck, Dreieck	1	Hameg HM 8130	1-20MHz
Various measuring cables, if necessary coaxial with BNC plugs	Divers câbles de mesure le cas échéant câble coaxial avec connecteurs coaxiaux	Messkabel diverse ggf Koaxialkabel mit BNC-Steckern	je 1		
Calculator not programmable	ordinateur non programmable	Rechner nicht programmierbar	21		
Workshop installations	Equipement d'atelier	Werkstatteinrichtung			
Hot-air fan to shrink on sleeves	appareil à air chaud pour distendre des gaines	Heissluftgebläse zum Aufschrupfen von Hüllen Anschluss:	4	Hot Jet S	
EDS tester	appareil de contrôle, antistatique (avec mise à la terre)	Prüfgerät ESD (mit Erdung)	1		
Battery-powered screwdriver	visseuse électrique sur batterie	Akkuschrauber	1		
Bit set	jeu de lames	Bit-Set			
Drill set	jeu de forets	Bohrersatz			
Overhead projector	rétroprojecteur en lumière du jour	Hellraum-Projektor	1		
Silver screen	écran de projection	Leinwand	1		
Flipchart with pencil	flipchart avec crayons	Flipchart mit Schreiber	1		
Tables	tables	Tische	4		

For judges	Poste de contrôle pour experts	Prüfplatz für Experten			
controlling station, measuring devices like c.s	Poste de contrôle, instruments de mesure comme participants	Prüfplatz, Messgeräte wie Teilnehmer	1		
power supply	bloc d'alimentation	Netzteil	4	PUP 110-40	+/- 5V DC +/- 12V DC
Universal digital voltmeter	Voltmètre numérique universel	Universal-Digitalvoltmeter	9	Fluke 187	
Scope Meter	Scope Meter	Scope Meter	4	Fluke 196C	
Stabilised power supply adjustable	Alimentation stabilisée réglable	Stabilisierter Netzteil regelbar	4	EA-PS 2332-25	2x 0 ... 32V DC 2x 0 ... 2.5A 1x 3 ... 6VDC/2A
Function generator sine, triangle, rectangle	Générateur de fonctions sinusoidales, carrées, triangulaires	Funktionsgenerator Sinus, Rechteck, Dreieck	2	Hameg HM 8130	1-20MHz
Screwdrivers, set, sizes	jeu de tournevis taille de	Schraubenzieher Set, Grösse	1		1-5
Combination pliers	Pince universelle	Kombizange			
Universal cutter	Outil de découpe multiusage	Allzweckschneider			
Pair of pointed tweezers	Pincette à pointes	Pinzette spitz			
Magnifying glasses, 3- to 5-fold	loupes, grossissement	Vergößerungsglas	je 2		3-5 x
Soldering stations	poste de brasage	Lötstationen	2	1 x SMD	
Torches	lampe de poche	Taschenlampe	2		
isolating transformer	transformateur isoler	Trenntransformator	1	Rotima	230 V / 50 Hz 350 VA
Lockers	armoire fermant à clé	abschliessbare Schränke C 12	4	20.002	
calculator not programmable	ordinateur non programmable	Rechner nicht programmierbar	4		

Materials	Consommables	Verbrauchsmaterialien			
Fuses, sets	Jeux de fusibles de protection	Sicherungen, Sets			
				1A/3A/2A/100 mA/200 mA/500 mA, 250V	
Resistances Series	Résistances série	Widerstände Serie			
				E24/0,25 W (10W 10 MW)	
Graph paper	Papier millimétré	Millimeterpapier			
				DIN A3	
Soldering tin	Etain à braser	Lötzinn			
				60/40	
Bare wire, approx.	Fil nu, env.	Blankdraht ca.			5000, Ø 0.5
Insulated wire, different colours	Fil isolant en différentes couleurs	Isolierdraht, ca. verschiedene Farben	5		5000, 0.4 mm ²
Insulating tape / adhesive tape	Chatterton / ruban adhésif pour ligatures	Isolier- / Klebeband zum Binden			
Cable ties	Serre-câble	Kabelbinder			
Binding twine as required	Ficelle, selon besoins	Bindegarn nach Bedarf			
Shrink-on sleeves	Gaines rétractables	Schrumpfhüllen			