

NATIONAL SKILLS COMPETITION
Competitions Sub-Committee

The National Skills Competitions Sub-Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, and is subject to change by the National Skills Competition Steering Committee.

1. Name and description of trade

1.1 The name of the trade is:

Industrial Electronics

1.2 The Industrial Electronics Technician works in industrial or commercial environments and works with or studies electronics. This includes:

- Development
- Construction
- Design
- Measuring
- Testing
- Repair

1.3 This technical description must be known to every candidate.

1.4 Words implying masculine gender only shall include the feminine gender

2. Scope of work at Competition

2.1 The practical work will test the competitors ability in any two of the following:

- Assemble, adjust, commission, measure and test electronic equipment
- Carry out and document measurements on analogue and digital circuits
- Locate, document and repair faults in a given circuit
- Design or refine a design of a circuit, and construct using prototype
- Construction techniques

2.2 To solve theoretical tasks using mathematical and graphical methods to a Technician Level

2.3 To redraw a circuit drawing schematic with Computer Aided Design.

- Design, installation, commissioning and maintenance of software driven electrically controlled equipment.

3. Competition Format for Practical Work

3.1 Assembling

Assemble a project that has to be from a kit of parts to the IPC-A-610 issue C international acceptability of electronic assemblies. (Web page WWW.solder.net/main/ipca/htm. Each project should be able to fit a Euro card standard using DIN 41612 F64 or F32 connectors, that will fit a standard back plane connector. Power points will be as follows: -

A1	C1	+5v Digital
A2	C2	Digital Ground
A15		+5v Analog
	C15	+12v Analog
A16	C16	Analog Ground
A17		-5v Analog
	C17	-12v Analog
A31	C31	Digital Ground
A32	C32	+5v Digital

3.2 Measuring and Testing

To work with conventional measuring and testing equipment for AC, DC, digital and analog electronics. To test, set, adjust and measure electronic components, modules and equipment. To record and analyse measured results. Boards **will be pre-built** before the competition.

3.3 Fault Finding and Repair

To test, locate and effect repairs on a printed circuit board, surface mount board or mixed technology board. All surface mount components to have no more than four pins and Fault finding method/procedure with results will be required. All boards will be pre-built before the competition. Each board will have at least three faults. Pin configurations and power supply will be as 3.0.

Competitors may bring their own measuring instruments.

3.4 Prototype Design

To carry out a simple electronic design using given components to meet a given specification. Printed circuit boards should be pre-built. Resistors E24 series, 0.25 watt to be made available. No more than 15 wire wrap connections and no more 15 point to point connections will be required on this module. Pin configurations and power supply will be as 3.0.

Competitors may bring their own measurement instruments.

3.5 The competition is modular and will be marked at the end of every module.

3.6 Time allowed for each module is as follows:

Theory	2 hours
Drawing	2 hours

Prototype	4 hours
Fault Finding	4 hours
Measurement	4 hours
Assembly Project	3 + 3 hours

4. Theoretical Knowledge

4.1 To solve theoretical problems, using mathematical and graphical methods based on the following:

- Fundamental electronic principles:
 1. Basics of AC and DC technology.
 2. Two ports LRC networks, resistive networks with up to three meshes.
 3. RC oscillators

- Components in Electronics:

Properties, behaviour, characteristics and application (elementary circuits) of mechanically, electrically and physically adjustable components i.e.:

- Resistors
 - Capacitors
 - Coils
 - Transformers
 - 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.

1. Ideal operational amplifier: (infinite input resistance, zero output resistance and infinite open loop gain) Basic circuits with operational amplifier, analogue adder and subtractor, differentiator, comparator, impedance transducer.
 2. Real operational amplifier: Offset voltage and offset current, compensation, common mode gain and rejection, temperature drift, frequency response.
- Generators and Pulse shapers:
1. Generators for sine wave voltage: RC, quartz, LC oscillator; Wien bridge generator, phase generator.
 2. Pulse shaper: Schmitt trigger, differentiator, integrator.
- Digital Electronics
1. Basic logic gates.
 2. Level switching function, function table, pulse, diagram, circuit symbols (table in appendix).
 3. Properties of basic gates AND, OR, NOT, NAND, NOR, EXCLUSIVE OR EXCLUSIVE NOR.
 4. Substituting basic NAND or NOR gates for basic gates.
 5. Creating switching functions from given circuits and vice versa.
 6. Making function table from circuit diagrams and switching functions.
 7. Simplifying switching networks using Karnaugh diagram or mathematical techniques.
 8. Flip-flops; RS Flip-flop, D Flip-flop, JK Master slave Flip-flop (especially counter circuits, shift register and frequency divider).
 9. Memory circuits, selection, addressing, and memory decoding volume.
- Software Programming
- Competitors must be able to write programmes to control a PLC machine.

5. Materials

5.1 Components

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 10 megohms is supplied.

5.2 Other materials

- a. Graph paper A3 size
- b. Solder 60/40 type
- c. Approx. 5m bare wire (0.5mm diameter) per competitor
- d. Approx. 5m each of insulated wire (or standard wire) in five different colours for each competitor
- e. Binding/insulation tape
- f. Lacing string /Tie raps/heat shrink sleeving
- g. Hot-air fan for heat-shrink tubing

5.3 Clothing

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

6. Workshop Installations

- 6.1 The working area should provide enough space for the competitors, experts (jury), measurement and repair area, material cupboards and wardrobes.

➤ General Requirements

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

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

The organizers will provide four sets of the following for the experts:

1. 4 x Hot-air fan for heat-shrink tubing
2. 2 x Magnifiers for experts x3 or x5
3. 2 x Computers
4. One Laser printer

6.2 The personal working area for each competitor should be about 3m x 3m, and shall also allow for the equipment and machines specified in Sec. 6.4 below.

6.3 Measuring Instruments and Tester/Tools

The organisers will provide the following for each competitor:

1. 1x universal DVM
2. 1x Function generator 1-50 MHz, sine, square, triangle
3. 1x stabilized power supply (3-30V adjustable)
4. Various connection cables (if necessary, coax cable with BNC plugs)
5. 1x Bench Lamp
6. 1x Electrostatic workstation
7. 1x Calculator, non-programmable

The organizers will also provide a spare set of the above for the experts.

6.5 Competitors must bring all their own tools, including wire-wrapping equipment. Measurement instruments are optional.

7. Test Project Marking

7.1 The experts will decide together on the test projects, the marking criteria and the dimensional tolerances on forms 5, and 6, and they will prepare the marking list.

7.2 Marks:

Perfect	=	10 points
Very good	=	9 points
Good	=	8 points
Rather good	=	7points
Sufficient	=	6 points
Medium	=	5 points
Weak	=	4 points
Insufficient	=	3 points
Very bad	=	2 points
Zero	=	1 point

7.3 Rating

Section	Item	Maximum Points
A	Theory	10
B	Drawing	10
C	Prototype	22
D	Fault Finding	22
E	Measurement	22
F	Assembly Project	15
G	Programming	10
H		

8. Competition Procedure

8.1 The competition will be worked on all two days of the competition. Modules will be completed on each day for all competitors so that progressive marking can take place, and for results to be made available each day.

8.2 Competitors will have time made available to familiarise themselves with material and processes. Where processes are particularly difficult, the judges will provide a subject matter expert to demonstrate the process and the competitors will be given the opportunity to practice.

8.3 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition so that they may study the requirements.

8.4 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for completion of modules.

8.5 Project Design, Selection and Documentation will be carried out as specified.

PCB information is provided in Appendix 6

8.6 The rules and procedures, and timetable specified in Appendix 2, 3 and 4 must be complied with.

9. Judging procedural requirements

9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.

9.2 Every completed module will be marked on the same day in which it was completed.

10. General safety requirements

- 10.1 All competitors must use safety glasses when using any hand, power or machine tools or equipment likely to cause or create chips or fragments that may injure the eyes
- 10.2 All competitors must wear appropriate clothing.
- 10.3 All machinery, equipment and safety clothing must comply with the safety rules of the organising country.
- 10.4 Competitors must keep their workspace clear of obstacles and the floor space clean of material and equipment - any items likely to cause the competitor to trip, slip or fall.
- 10.5 Failure by the competitor to comply with safety directions or instructions may incur penalties for safety.
- 10.6 Judges will wear the appropriate personal safety equipment when inspecting, checking or otherwise working with a competitor's project.
- 10.7 Safety Checklist must be adhered to and is provided in Appendix 5

APPENDIX 1

Project Documentation

Project documentation must be brought to the competition on 3.5" floppy disc format,/CD in Microsoft Word. Where experts have used a drawing software. Experts should bring along the version of the drawing program software that they used. Paper copies should also be presented. Where possible circuit diagrams will be used for all modules and project wording should be as brief as possible. All projects must include the following:-

1. Short project brief
2. Parts list
3. Circuit diagram
4. Data sheet pack
5. Projects will only be accepted with software

APPENDIX 2

Competition Rules for Competitors while working on their Projects

1. If you have a question raise your hand.
2. You must not leave your workstation without permission, except to obtain wire etc from centre bench.
3. If you feel ill or require anything, raise your hand.
4. You may not leave the stand without an escort except at scheduled times for lunch and visits to other stands.
5. You must not touch any project other than your own.
6. You may not touch any other competitors' equipment.
7. If you finish and leave your stand early, you **must** leave the stand.
8. No use of mobile phones is permitted.
9. No talking to any people outside the stand area while you are working on a project.

APPENDIX 3

Suggested Competition Timetable - Trade ___ Industrial Electronics

Day 1

Step	Activity	Start Time	Finish Time
1	Introduction by Chief Judge	09.00	09.15
2	Demonstration of assembly rack and power supplies	09.15	09.45
3	Start assembly	10.00	13.00
4	Lunch	13.00	14.00
5	Continue with assembly of project	14.00	17.00
Total Competition Time			6.00

Day 2

Step	Activity	Start Time	Finish Time
1	Drawing Introduction	09.00	09.30
2	Drawing/C programming	09.30	11.30
3	Tour around venue and lunch	11.30	12.00
4	Theory Introduction	12.45	13.00
5	Theory	13.00	15.00
6	Break	15.00	15.15
7	Demonstration of Fault Finding one project	15.15	15.30
8	Fault Finding One	15.30	17.30
Total Competition Time			6.00

Step	Activity	Start Time	Finish Time
1	Introduction to Design Project	09.00	09.30
2	Design and Prototype	09.30	12.30
3	Lunch	12.30	14.00
4	Demonstration of Fault Finding Project number 2	14.00	14.15
5	Fault Finding	14.15	16.15
6	Tour around Venue	16.15	17.00
Total Competition Time			5.00

Step	Activity	Start Time	Finish Time
1	Demonstration of Measurement and Testing Project	09.00	09.15
2	Measurement Project	09.15	12.15
3	Lunch	12.15	13.30
4	Demonstration of C Programming Project	13.30	14.00
5	C Programming Project	14.00	16.00
Total Competition Time			5.00
Overall Competition Time			22.00

APPENDIX 4

FAIRNESS

As part of the competition, each competitor is required to have a fairness of competition rules for the experts, which are listed below for your comments.

Before the competition starts

1. All experts are to be trusted
2. Experts to believe in each other and their values
3. Effective management of time
4. Communicate both accurate and complete
5. Keep communication with team members user-friendly
6. Be a good listener
7. As a team we value the contributions of its members

Reach early agreement and our goals and have contingency plans

1. Create a vision of success for other competitions to follow
2. We will not make preformed judgements

3. Recognise issues early and open dialogue then explore for common ground
4. If you have a visitor to the stand he/she must not speak to the competitors
5. Be united in our decisions
6. Always show a united front when dealing with the competitors

When the competitors arrive

1. You must not leave the stand when your competitor is away from the stand unless in the presence of another expert
2. No use of mobile phones is permitted.

APPENDIX 5

Health and Safety Check List

List each item A to C

'A' = Satisfactory

'B' = Unsatisfactory but rectified immediately

'C' = Unsatisfactory - remedial action required

Text Boxes

1. Are all exits from the area free of obstruction?
2. Are all gangways within the area free from obstruction?
3. Are all fire fighting appliances at their designated, location, 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 alarms 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, at the plug?
8. Are electrical wall sockets secure and in good condition?
9. Are the following satisfactory?
 - a. Lighting
 - b. Ventilation
 - c. Temperature
 - d. Noise level
 - e. Extraction
10. Are "fittings" in a safe state, e.g. lights, service supplies etc.
11. Are all items of handling equipment in a safe condition, e.g. trolleys etc. and up to date. (In the area)?
12. Are all filing cabinet drawers functioning correctly, and are drawers prevented from coming out by limit stops.
13. Are metal cabinets free from sharp edges?
14. Are the tops of units free from unsuitable objects?
15. Is there suitable storage provided (and used) for cabinet drawer locking bars, when not in use.
16. If applicable, are paper guillotines properly guarded?

17. Does the area demonstrate a satisfactory level of decent housekeeping? e.g. steps, ladders etc. (are they in good condition)?
18. Are heavy items stored on low-level racks?
19. Are all personnel trained to use appropriate equipment in this area (see supervision)?
20. Are there necessary restrictions being enforced e.g. entry of unauthorized persons.
21. Are flammable liquids and chemicals stored in appropriate environment correctly, e.g. gloves, goggles etc?
22. Are the edges of areas marked with a hazard stripe?
23. Are all equipment that require guarding, fitted with secure and serviceable guards?
24. Is eye protection being worn in appropriate areas?
25. Are there other items of safety equipment available for use?
26. Are tools in good condition?
27. Are all raw materials or equipment safely positioned?
28. Is there a list of authorised persons who may use machines or equipment?
29. Are waste materials correctly disposed of?
30. If chemicals or substances are used, are they in suitable containers that are correctly marked?

31. Is safety information for chemicals or substances used available and known to the user?
32. Are the emergency stop buttons on equipment assessable and clearly marked?
33. Are competitors supervised?
34. Are freestanding gas bottles secured?
35. Are all tools in use in good condition?
36. Are free standing gas bottles secure.
37. If applicable, have all system components been subjected to test, is a certificate available?
38. If applicable, is equipment within validation.
39. If applicable, is pipe work adequately secured?
40. Are there written procedures for: -
 - a) Setting up for test.
 - b) Test procedure.
 - c) Making safe after test.
41. Are the necessary restrictions being enforced e.g. entry of unauthorized personnel.
42. Do all personnel know the main isolation controls of the services being used?
43. Are cables and flexible hoses correctly routed to prevent accidents or damage?
44. If flammable liquids or chemicals are being use, are they: -

- a. Of minimal quantity.
- b. In approved containers.
- c. Correctly labelled.

45. Have reasonable safety precautions been taken against any foreseeable occurrence whilst carrying out the test.

46. If applicable, is the equipment correctly bonded / earthed.

47. If competitors or others are working in the area, are they under full supervision.

Chief Expert (Signature).....

APPENDIX 6

Specifications for PCB cards

Mechanical spec.'s

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

All Dimensions are in millimeters. Tc = 160 mm

The Europe format for PCB card with a front plate
Is specified as follow (with front plate and DIN41612 connector):

All Dimensions are in millimeters. Tc = 160 mm

Front Plate dimensions (if needed): 40,64 mm x 128,7 mm x 2,5 mm

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

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1. Name and description of trade

1.1 The name of the trade is:

Mechanical Repairs

1.2 The theoretical and practical training of the mechanical repairs is concerned with the mechanical, hydraulic and pneumatic equipment in a manufacturing or assembly plant.

1.3 The mechanical repairs technician works mainly in manufacturing or assembly plant in the design, installation, commissioning and maintenance of fluid mechanically controlled equipment.

1.4 This technical description must be known to every candidate.

1.5 Words implying masculine gender only shall include the feminine gender

2. Scope of work at Competitions

2.1 The competitor must be able to:

➤ Solve logic problems

- Carry out system design
- Assemble a machine according to documentation
- Connect a machine to its control system
- Commission the machine to carry out its correct function to solve a series
- Of practical operational problems as set by the experts
- Document procedures carried out
- Interpret appropriate forms of technical documentation (e.g. circuits,
- Displacement-step diagram)
- Design hydraulic and pneumatic circuits by hand or by using commercially available software

2.2 There will be two competitors per team. The competition includes team and individual events.

2.3 The total working time for the project will be between 10 and 12 hours.

3. Practical Work

3.1 Design

The project will be designed using the industrial components in accordance with specifications. Optimization may be included in the project.

3.2 Assembly and Connection

The project is to be assembled using the industrial components in accordance with the instructions and documentation, or own design.

- The speed of assembly of known stations will not be a criterion. The assessment of the quality of assembly must reflect industrial standards and professional practice.
- Connections are to be made according to instructions and documentation to ensure correct function of the machine. Any circuit diagrams necessary for successful completion of the project are to be included.

3.3 Commissioning

The machine must be made to function in accordance with the instructions, documentation and professional practices. No deliberate faults are to be introduced.

3.4 Troubleshooting

There may be a series of multiple problem troubleshooting sections, which will draw on a prepared set of faults, preferably with computer-generated random selection immediately prior to their use.

3.5 Information Technology

Tasks must be included to test the competitor's ability to carry out system programming. Documentation produced by competitors and communication may also be included.

4. Theoretical Knowledge

4.1 Mechanical Design

Competitors must be able to understand and design mechanical systems. This must include knowledge of pneumatic and hydraulic systems, their standards and their documentation.

4.2 Circuit Design

Competitors must be able to understand and design pneumatic circuits and hydraulic circuits in machine/controller systems.

4.3 Industrial Controllers

Competitors have an understanding of the configuration of the industrial controller and how a software program relates to a machine action.

4.4 Analytical Techniques

Competitors must be able to demonstrate mastery of master problem-solving techniques.

5. Materials

- 5.1 A general description of the previous test work, including a sample of the competition schedule is to be made available.
- 5.2 Specifications are to be emailed at least 4 months before the competition.
- 5.3 Pre-competition on-site training will be provided and shall be a maximum of 8 hours.

6. Workshop Installations

- Each team of competitors will have a work area should provide enough space to work in teams of two with the usual facilities for experts, material and tool storage as specified in Sec. 6.3 below.
- The layout should be designed for public access and maintain equal exposure of visitors to each competing team.
- The competitor's area must be at least 1.5 metres from the visitor barrier.
- A soundproof conference room for experts must be provided for up to 25 people and have photocopier facilities.
- A Pentium PC with Standard English operating system and printing facilities must be provided for experts as per that provided for each workstation.

6.3 The competitor's work area dimension is to be a minimum of 5 x 3 meters (see layout). In addition to the competitor's work areas and administration section, an equipment store needs to be centrally located (dimensions 3 x 3 m) for each team.

6.4 The following equipment will be made available to each team of competitors at each work station:

- Stand for equipment plus working surface

- A Pentium PC with standard English operating system and printing facilities for each workstation.

6.5 Tools for competitors

- Any commercially available tools may be used. This is subject to approval by the Safety Officer.
- Competitors must supply their own tools.
- Competitors must bring all software required for the PLC they have selected.
- It is the responsibility of their expert to check software compatibility.
- The team is responsible for the provision connectors, adaptors, plugs, and interfaces.

7. Test Project Marking

7.1 All documentation presented must be available in digital form.

- There is to be a majority agreement (minimum = 50 % + 1) on the accepted competition marking scale.

7.2 Selection of appropriate projects is based on 7.1.1. The expert team may make modifications to the proposed project.

7.3 Results may be displayed in the competition area.

7.4 All marking will be subjective in accordance with the marking scale.

- Only Form 6 will be required for the submission of marks.
- Marking is designed to be entered after each section has been completed, and a program has been developed for computer calculation after time and task data has been entered.
- A sample marking scale and instructions for juries from the previous competition are to be attached to the Trade Description

7.5 Experts are to complete a score sheet for each section completed, for each team.

7.6 **Marks:**

Perfect	=	10 points
Very good	=	9 points
Good	=	8 points
Rather good	=	7points
Sufficient	=	6 points
Medium	=	5 points
Weak	=	4 points
Insufficient	=	3 points
Very bad	=	2 points
Zero	=	1 point

7. Rating

Section	Item	Maximum Points
A	Design	5 – 15
B	Assembly	10 – 15
C	Commissioning	15 – 20
D	Troubleshooting	20 – 30
E		
F		
G		

7.8 Conversion to the 400 - 600 scale will be done by computer.

8. **Competition Procedure**

8.1 The competition will be worked on over all two days of the competition. Modules and tasks will be completed in accordance with a prepared schedule each day for all competitors so that progressive marking can take place, and for results to be made available each day.

- 8.2 Competitors will have a maximum of eight (8) hours at their disposal to familiarise themselves 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.
- 8.3 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition so that they may study the requirements
- 8.4 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for completion of modules.

9. Judging procedural requirements

- 9.1 Refer Sec. 7
- 9.2 Every completed module will be marked on the same day in which it was completed.

10. General safety requirements

- 10.1 All competitors must use safety glasses when using any hand, power or machine tools or equipment likely to cause or create chips or fragments that may injure the eyes
- 10.2 Work clothes must comply with relevant codes.
- 10.3 A first aid kit must be available throughout the competition.
- 10.4 All machinery, equipment and safety clothing must comply with the safety rules.
- 10.5 Competitors must keep their workspace clear of obstacles and the floor space clean of material and equipment - any items likely to cause the competitor to trip, slip or fall.

10.6 Failure by the competitor to comply with safety directions or instructions may incur loss of marks for safety.

10.7 Judges will wear the appropriate personal safety equipment when inspecting, checking or otherwise working with a competitor's project.

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1. Name and description of trade

1.1 The name of the trade is:

Refrigeration

1.2 The refrigeration technician deals with the installation, maintenance, fault finding and repair of refrigeration systems which transfer heat by means of the vapour compression refrigeration cycle; e.g. refrigeration systems as applied to coolrooms, freezer rooms, air-conditioning systems, liquid coolers and heat pumps.

Systems must operate on a commonly used HFC and/or HCFC refrigerant.

1.3 This technical description must be known to every competitor.

1.4 Words implying masculine gender only shall include the feminine gender

2. Scope of work at Competitions

2.1 The work at the competition is practical work as described in section 3 below.

2.2 The theoretical knowledge necessary to carry out the practical work as described in section 4 below.

3. Practical Work

3.1 The competitors must be able to carry out the following tasks with his working skills:

- Installation of refrigerant piping.
- Installation and setting of controls and regulating devices.
- Installation and commissioning of complete systems.
- Charging, recovering and transferring refrigerants.
- Draining and refilling compressor lubricant.
- Electrically connecting the components and testing the circuits.
- Troubleshooting and repairing systems.
- Replacing components.
- Measuring and recording system operating parameters.
- Interpreting manufacturers operating manuals, piping diagrams and
- Electrical diagrams.
- Filling in a materials list from system specifications and
- Drawings/diagrams.

4. Theoretical Knowledge

- 4.1 - Identification and utilisation of materials, components and tools.
- All theoretical knowledge required to carry out the practical work.

5. Materials

5.1 Only commercially available components, controls and regulating equipment must be used.

6. Workshop Installations

- 6.1 The workplace for the competition must be suitable for the number of competitors and the layout must be suitable for the projects selected.
- 6.2 Each competitor must be provided with a workstation, which must be suitable for the projects selected.
- 6.3 The competitors must use the following machinery and equipment supplied for the competition:
- Refrigerant recovery machine
 - Vacuum pump
 - Brazing and silver soldering equipment and materials.

Full operating manual, wiring diagrams and specifications of the major equipment will be submitted at least 3 months prior to the competition.

- 6.4 The following machinery and equipment will be supplied for each competitor:
- All equipment, components and accessories required for the installation project must have a cooling capacity of approx. 1 kW at medium temperature for the cabinet and a cooling capacity of approx. 2 kW for the split air conditioner.
 - Brazing and silver soldering equipment and materials.
 - Workbench with vice.
 - Project mounting support or panel, if required.
 - Refrigerant.
 - Pressure-temperature charts for the refrigerants used.
 - A vacuum pump suitable for evacuating down to 50 Pascal absolute (or equivalent pressure), complete with vacuum gauge and spare oil.
 - A regulated supply of dry nitrogen and regulator to supply a minimum pressure of 1000 kPa.
 - All electrical hand tools as required for the projects.
 - A suitable single-phase power supply.
 - Suitable refrigeration oil.
 - A lead light.

- An extension cable.
- An Oilcan
- Cleaning rags
- Emery cloth
- Steel wool

6.5 The competitors must, as a minimum, bring the following tools:

- 1 metal rule 300 mm.
- 1 protractor.
- 1 set square 90°.
- 1 spirit level 300 mm.
- 1 scribe.
- A 5 m steel measuring tape.
- 1 centre punch.
- 1 set screwdrivers 2 - 6 mm.
- 1 set crosshead (Phillips) screwdrivers.
- 2 adjustable spanners (250 and 300 mm).
- 1 set of spanners up to 25 mm and imperial up to 1`AF.
- 1 set of files: flat, half round and round.
- 1 gauge manifold and hoses.
- 1 vacuum gauge suitable for measuring down to 50 Pascal absolute (or equivalent pressure).
- 1 electronic leak detector for HFC and/or HCFC refrigerants.
- 1 small mirror.
- 1 Schrader valve spanner.
- 1 valve ratchet spanner.
- 1 set of tube mechanical benders, up to 5/8", all 180°.
- 1 set of bending springs, up to 5/8".
- 1 pipe reamer.
- 1 pipe cutter, up to 1 1/8".
- 1 pipe expander set, up to 5/8".

- 1 pipe flaring set, up to 5/8".
- 1 set twist drills 1 - 10 mm.
- 1 bull nose pliers.
- 1 long nose pliers.
- 1 pair wire strippers.
- 1 knife.
- 1 hacksaw and blades.
- 1 hammer, approx. 400 gram.
- Personal safety clothing and equipment including long sleeve shirt
- Suitable instrumentation for measuring voltage, current and resistance.
- 1 insulation tester.
- 1 differential digital thermometer with at least 2 sensor probes.
- 1 set of writing implements, including coloured and highlighting pens.
- 1 Allen key set metric or imperial

7. Test Project Marking

7.1 The experts will decide on the project, the marking criteria and the dimensional tolerances on forms 5, 5A and 6.

7.2 Marks:

Perfect	=	10 points
Very good	=	9 points
Good	=	8 points
Rather good	=	7points
Sufficient	=	6 points
Medium	=	5 points
Weak	=	4 points
Insufficient	=	3 points
Very bad	=	2 points

Zero = 1 point

7.3 Rating

Section	Item	Maximum Points
A	Refrigeration Pipework	25
B	Electrical Wiring	10
C	Component & System Installation	10
D	Commissioning & Adjustment	20
E	Fault Finding	10
F	Repair and Part Replacement	10
G	Refrigerant Recovery and Emission Control	10
H	Safety	5

7.4 Conversion to the 400 - 600 scale will be done by computer.

8. Competition Procedure

8.1 Competitors will have time to familiarise themselves with equipment, material and work processes. When particular processes are particularly difficult, relevant demonstrations of the work processes will be arranged for the competitors.

8.2 The competitors will be given all competition documents including the test project questions, summary of marking scheme, detailed time table, equipment manuals one day before the commencement of the competition for study.

8.3 All competitors' work must be covered and must face the judges and visitors while working on the project.

9. Judging Procedural Requirements

9.1 The experts that attend the competition will be divided into expert groups, with a group leader, to deal with and mark the individual questions of test project. The same expert group will mark all competitors for the same question.

9.2 The weighting of marks responsible by the expert groups should be equal as far as possible.



NATIONAL SKILLS COMPETITION Competitions Sub-Committee

The National Skills Competition Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, subject to change by the National Skills Competition Steering Committee.

1. Name and description of trade

1.1 The name of the trade is:

Press Tool Making

1.2 Press Tool Making covers the manufacture of blanking dies, forming dies and bending dies, according to drawings. They will be made of commercial materials, and are to be used for mass production.

1.3 **This technical description must be known to every candidate.**

1.4 In the event of any query or conflict within the technical descriptions, the English copy will take precedence

1.5 Words implying masculine gender only shall include the feminine gender

2. Scope of work at Competitions

2.1 The test project consists only of practical work.

2.2 Technical knowledge is limited to that necessary to carry out the manufacture of the tool.

3. Practical Work

3.1 The competitor has to carry out, independently, the following tasks using the appropriate technical skills:

- Make a cutting die with commercial materials according to drawings
- Manufacture, assemble and test the tools according to drawings

3.1.1 The surface grinding of punches will be on flat and angular faces only.

Competitor must grind at least one (1) punch to finish size.

3.2 The appropriate technical skills are:

- Measuring and marking out of components
- Filing and sawing
- Drilling, countersinking, de-burring, reaming, tapping
- Milling, grinding
- Setting and try-out of tool in press

3.3 Break down of time for the following operations:

Description	Min	Max
Surface Grinding	3	4 hours
Milling	12	14 hours
Filing & Assembly	5	6 hours
Project Total Time	20	24 hours

4. Theoretical Knowledge

4.1 Interpretation and execution of drawings to ISOA and ISOE standards.

4.2 A project must be submitted in three languages and consist of drawing and marking scheme.

4.3 Knowledge of materials and processes.

5. Materials

5.1 The following items will be supplied for the competition by the host country:

5.1.1 Description Finished Size (Ground) Standard ISO

- Dowel pins $\text{Ø} 6\text{mm} \times 35 \text{ mm}$
- Cap screw M6 x 30 mm
- Cap screw M6 x 25 mm
- Base plate – Min 110 x 14 x 96 mm; Max 145 x 23 x 120 mm – 1.1730
- Die Plate – Min 66 x 10 x 110 mm; Max 88 x 12 x 120 mm – 1.2379 –
- X210 Cr12
- Stripper Plate – Min 66 x 14 x 110 mm; Max 88 x 14 x 120 mm – 1.1730
- ST44-2
- Punch Plate – Min 66 x 12 x 110 mm; Max 88 x 18 x 120 mm – 1.1730 –
- ST44-2
- Pressure Plate – Min 66 x 3 x 110 mm; Max 88 x 3 x 120 mm – 1.2162 – X
210 Cr12
- Top Plate – Min 66 x 12 x 110 mm; Max 88 x 14 x 120 mm – 1.1730 – ST44-2
- Shank $\text{Ø} \sim / \text{M}16 \times 1.5$ 1.1730

Note:

- (a) Components not listed such as punches and screws etc. supplied by the host country.
- (b) All punches must be hardened and tempered to $60 \pm 1 \text{ HRC}$

5.2 Any of the following materials may also be used in the project design, and will be supplied by the host country:

Tool steel, free cutting steel, brass strip, screws, dowel pins, structural steel, case-hardened steel.

Note: Any extra material will be the responsibility of the shop master.

6. Workshop Installations

6.1 Each competitor will have a working area. Local conditions will be taken into consideration.

6.2 The general layout of the workshop venue will be as below, with sufficient space for the booth and for the competitors working area as defined in 6.3 below.

6.2.1 General requirements

The following machines will be made available for competitors:

- 2 milling machines for every three (3) competitors with digital readout, automatic feed and coolant. This includes for each grinding machine:
 - 1 vice for each milling machine (150 mm wide x 155 mm opening)
- 1 surface-grinding machine for every two (2) competitors with automatic feed and coolant. This includes for each grinding machine:
 - 1 wheel balancing device
 - 1 sine vice for grinding punches
 - 1 vice for each drilling machine (120 mm)
- 1 drilling machine for every three (3) competitors
- 1 fly-press (32mm shank size) for every four (4) competitors
- 1 pedestal grinding machine for competition
- 1 digital measuring machine
- 1 optical projector – this machine allocation is subject to local conditions

6.3 The personal working area for each competitor should be at least 3m x 3m, and shall also allow for the equipment and machines specified in Sec. 6.4 below.

6.4 The following equipment will be made available to each competitor:

- 1 work bench 1500 x 750 with lighting

- 1 height adjustable vice 145 mm with two soft jaws
- 1 bench
- 1 surface plate 300 x 300 x 75mm
- 1 marking off table 750 mm x 750 mm
- 1 compressed air supplied to each bench

6.4 As a minimum requirement, each competitor must bring the following tools in a toolbox:

- 1 vernier callipers, approximately 150 mm measuring range
- 1 inside callipers, 1/100 mm range
- 1 surface gauge
- 1 feeler gauge set, 0.02 to 0.1 mm
- 2 off each outside micrometers; 0 - 25 mm, and 25 - 50 mm
- 1 protractor
- 1 set of each radius gauge, 1 - 7,5, concave and convex
- Straight edges: 50 mm and 120 mm (1 each)
- Precision squares 900 and adjustable
- 2 precision squares 900, approx. 100 x 70 mm / 50 x 38 mm (1 each)
- 1 vernier height gauge
- Several centre punches
- Twist drills, diameters from 2mm - 10mm (in 1mm steps), 13 14.5 (1 of each)
- Twist drill, diameter 6,5mm, 600 point angle
- Countersinks 900, diameters 10 and 20 mm (1 each)
- De-burring countersinks, diameters 10 and 20 mm, 900 point angle (1 each)
- 1 centre drill A 1.6
- 1 set of taps M 6, M 16 x 1,5
- 1 counter-bore, diameter 6,6 x 11
- 1 tap wrench for taps M 6, M 16 x 1,5
- Taper reamers 1:50, diameters 4 / 5 mm (1 each)
- Machine reamers H 7, diameters 4 / 5 / 6 /8/10mm (1 each)
- Limit plug gauges H 7, diameters 4 / 5 / 6/8/10 mm (1each)
- Several files of cuts 1 and 3, of different sections

- Several handle for files of cuts 1 and 3, of different sections
- Several abrasive stones, coarse and smooth
- 2 parallel jaws vices, approx. 130 mm holding range
- 2 parallel bases, approximately. 25 x 10 x 100 (150) mm
- 1 metal saw box for perforations
- Several saw blades
- Several cut-off tools for perforations
- 1 precision grinding vice
- 1 set of pin punches up to 6 mm diameter
- Drilling vice, holding range at least 100 mm
- Set of protective vice jaws, approx 120 mm wide, soft metal or plastic
- 1 plastic hammer
- 1 Vee block
- 1 magnetic Vee-Block
- 1 set of boring bars
- Milling cutters dia – 3, 4, 5, 8, 10, 12, 15, 20, 25
- Digital vernier calliper
- 1 set of gauge blocks
- 1 fitter's hammer, 500 to 600 gr.
- 1 paint brush
- 1 hand brush
- Protective glasses
- Tolerance specification book / geometrical tolerance table
- Safety shoes

7. Test Project Marking

7.1 The experts will decide together on the test project, the marking criteria and the dimensional tolerances on forms 5, 5A and 6.

Note: Any extra material will be the responsibility of the shop master.

7.2 Marks:

Perfect	=	10 points
Very good	=	9 points
Good	=	8 points
Rather good	=	7 points
Sufficient	=	6 points
Medium	=	5 points
Weak	=	4 points
Insufficient	=	3 points
Very bad	=	2 points
Zero	=	1 point

7.3 Rating

Section	Item	Maximum Points
A	Dimensions of product	30
B	Assembly and function	7
C	Dimensions of components	40
D	Flatness and angularity	5
E	Burr and flatness of product	5
F	Finish of tool	8
G	Material consumption	5
H		

7.4 Conversion to the 400 - 600 scale will be done by computer.

8. Competition Procedure

8.1 The competition will be worked on over all four days of the competition.

- 8.2 Competitors will given time to familiarise themselves with material and processes. Where processes are particularly difficult, the host country will provide a subject matter expert to demonstrate the process and the competitors will be given the opportunity to practice.
- 8.3 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition so that they may study the requirements
- 8.4 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for the four days.

9. Judging procedural requirements

- 9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.
- 9.2 Marking will be blind:
Competitors will be allocated secret numbers, so that no expert will know the number of his candidate.

10. General safety requirements

- 10.1 All competitors must use safety glasses when using any hand, power or machine tools or equipment likely to cause or create chips or fragments that may injure the eyes
- 10.2 All competitors must wear long trousers and regulation safety footwear.
- 10.3 All competitors must wear hearing protection when necessary.

- 10.4 Competitors with long hair shall wear caps or and equivalent means of containment to ensure that their hair does not provide any potential for accidents or injury.
- 10.5 All machinery, equipment and safety clothing must comply with the safety rules of the organising country.
- 10.6 Competitors must keep their workspace clear of obstacles and the floor space clean of material and equipment - any items likely to cause the competitor to trip, slip or fall.
- 10.7 Failure by the competitor to comply with safety directions or instructions will incur loss of marks for safety.
- 10.8 Judges will wear the appropriate personal safety equipment when inspecting, checking or otherwise working with a competitor's project.



NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

The National Skills Competition Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, subject to change by the National Skills Competition Steering Committee.

1. Name and description of trade

1.1 The name of the trade is:

Mechanical Engineering, Drawing and Design – CADD

1.2 Mechanical Engineering Drawing and Design covers the use of Computer Aided Drawing & Design (CADD) technology in the preparation of graphical models, drawings, paperwork and files containing all the information necessary for manufacture and documentation of parts and components typical of solutions to mechanical engineering problems facing workers in industry. Solutions will comply with appropriate industry and national standards.

1.3 **This technical description must be known to every candidate.**

1.4 In the event of any query or conflict within the technical descriptions, the English copy will take precedence

1.5 Words implying masculine gender only shall include the feminine gender

2. Scope of work at the Competitions

- 2.2 The test projects consist only of practical work

- 2.3 The theoretical knowledge is limited to that necessary to carry out the practical work and reflect that of an entry level Mechanical Engineering Drawing and Design technician, CADD.

3. Practical Work

- 3.1 Practical tasks will be given by sketches, drawing and electronic data files, individual physical components and assemblies. Collection of information from these sources will require reading of prints, sketches, drawings, engineering tables, charts, and manuals. Additional information will be obtained from direct measurement of actual parts supplied and/or from scaled drawings. Problems will require solutions in the form of graphical and textual descriptions, sufficient to communicate successfully the information necessary for manufacturing of these components and assemblies in industry.

- 3.2 Competition project categories

The competition will include at least one project from each of the following categories:

3.3.1 Drawings From A Physical Model

Producing drawings from dimensions taken of an actual part. This will be done by measuring aids such as, measuring tape, vernier calipers, micrometers, protractors, depth gauge, radius gauge, thread gauge etc. and transfer of the measuring result to paper sketches and the CADD system. Typically this will be done by providing an actual part that must be measured and then after a specified time, the model will be removed from the competitors and they must continue to complete the required drawings from the information and notes they have recorded.

3.3.2 Assembly Drawings

Preparing an assembly drawing with all the necessary views, sections and general dimensions, based on drafts or notes that contain all information on design, general dimensions, or any other information necessary for assembly.

3.3.3 Detail Drawings

Preparing one or more detail part drawings for manufacturing containing all the necessary information for logical manufacturing processes such as:

- Complete shape description of the component
- General dimensions
- Fundamental dimensions and tolerances
- Geometric tolerance of form and position
- Surface finish symbols
- Machining and assembly instructions
- Heat treatment instruction
- Surface treatment instructions

3.3 Additional project skills tested

All of the following skills will be tested within one or more of the individual projects listed below from Material and Parts list to Kinematics.

3.3.1 Material and Parts list

With data on name and number of components, position number, material, standard components, semi finished stock, foundry pattern number and material stock dimensions.

3.3.2 Engineering Change Orders

Implementation of engineering change orders to modify existing components and assemblies, adapt new parts and fixtures to existing parts and assemblies. This may be

accomplished by issuing an unannounced engineering change to the competition problem part way through the competition time.

3.3.3 3D Modeling

- 3D Models created based on information supplied by actual parts measurement, sketches, drawings and files.
- Analysis of models to determine appropriate engineering data
- Produce color rendered views of 3D models.

3.3.4 Parametric Modeling

- Ability to work effectively with parametric modelling capabilities to solve mechanical engineering problems.
- This includes using parametrics for both 2D and 3D problems and solutions.

3.4.1 Kinematics

Preparation of drawings, schematic of drawings, graphical representations and charts as required to fully articulate the motion study of parts in a mechanical assembly. For example; cams and linkages.

3.4 Output

Solutions will be supplied in the following formats:

3.4.1 Drawings plotted on paper in sizes A1 and smaller.

3.4.2 Charts, tables and documents printed by laser printers on paper sizes A3 and smaller.

3.4.3 Renderings, shaded models and drawings printed by color and mono chrome laser printers and color plotters.

3.4.4 Electronic files of drawings, models, lists, tables, charts and documents in such formats as dwg, dxf, txt, doc, tif, gif, and xls as required by the competition.

3.5 Appropriate related skills

While not measured directly, these skills will be required by all successful competitors and include:

- Taking dimensions by means of measuring aids such as divided scale, measuring tape, vernier calipers, micrometers, protractors, depth gauge, radius gauge, thread gauge, etc. and transfer of the measuring result to paper sketches and the computer.
- Creating freehand sketches to capture design intent, measurement information and other details such that they can be transferred to the working drawings efficiently and accurately.
- Preparation of drawings sheets including borders, title blocks and relevant information.
- Reading and use of technical manuals, tables or standard manuals, software and hardware reference manuals as well as catalogues of semi finished and finished products.
- Working knowledge of computer operating systems sufficient to manipulate and manage computer files and software correctly.
- Good command of technical drawing and mechanical design as well as the practical application of Drawing principles and practices.
- The ability to produce paper drawings, using inkjet plotters and laser printers, after instruction during the familiarization period.

4. Theoretical Knowledge

- 4.1 Interpretation and execution of drawings, sketches and diagrams according to ISO or competitors national standards.
- 4.2 Knowledge of materials and manufacturing processes, reading and interpreting drawings, sketches, tables, and CADD technology.
- 4.3 Working knowledge of standards for conventional dimensioning & tolerancing, and geometric dimensioning & tolerancing appropriate for the country.

5. Materials

- 5.1 The host country shall for practical reasons be responsible for the provision of the major products and support personnel for such items as computers, monitors, digitizers, plotters and furniture.
- 5.2 Additional materials to be supplied include:
 - Sketching paper
 - Sketching pencils
 - Sufficient paper for all printing and plotting equipment.
 - Top quality plotter and plotting paper suitable for A1 size minimum.
Plotter must be capable of at least four (4) line widths.
- 5.3 The competitor must bring the remaining materials and equipment including:
 - Tables and charts for basic mechanical engineering applications.
 - Pocket calculator.
 - Measuring equipment (scales, vernier calliper, micrometers, etc.).
 - NO software or disks other than that provided at the competition will be allowed.

Note: All materials and equipment brought by competitors must be presented to the Technical Experts on request. The judges shall rule out any items brought to the competition that are not considered normal Engineering Drawing and CADD related tools and equipment, that will give any competitor an unfair advantage.

5.4 Competitor Software

5.4.1 Operating system

The computer operating system for Trade 5 will be Microsoft Windows. This will consist of the most recent version of this Operating System (OS). At the time of writing this document this was Windows 98 and Windows NT 4.0.

Note: MS Windows will be the ONLY software environment supported and available. Therefore, ALL software used for the competition must run in Microsoft Windows, latest version on the date of the competition, (currently Windows 98 and Windows NT 4.x).

5.4.2 Network environment

All computers, software and peripherals will also be required to run within a secure network environment.

5.4.3 Office productivity software

For office productivity software, Microsoft Office, latest edition, will be supplied and used.

5.5 CADD software

Each competitor MUST use the Windows based Autodesk CADD software, indicated by the Chief-Expert 6 months in advance of the competition date.

Note to Autodesk CADD software suppliers:

The software vendors that supply Autodesk CADD software at this competition MUST provide all of the following if their software is requested by a competitor.

- One new package of the software.
- Minimum of one technician, capable of installing, configuring and trouble shooting their software package such that:
 - This is all completed within the schedule specified by the host country for Trade 5, and
 - The software is running to the satisfaction of the Trade 5 Chief Expert and the competitor using the Autodesk CADD software.
- Provide full time technical assistance during the contest, and the configuration and support for plotting of the drawings.

6. Workshop Installations

- 6.1 Each competitor will have a work area with enough space to work with the usual facilities for material and equipment as specified in Sec. 6.3 below.
- 6.2 The general layout of the workshop venue will be as below, with sufficient space for the competitors working area as defined in 6.3 below.

6.2.1 General requirements

The following will be made available for competitors:

1. Plotters, two (2) or more
 - Capable of plotting to A1 or larger paper sizes, on high quality drafting paper
 - Capable of at least the following four line thickness: 0.25, 0.35, 0.5 and 0.7 (mm)
2. Color printers, two (2) or more
 - Capable of producing high quality color rendered images in 16-bit color or greater, to A3 or larger paper.
3. Laser Printers
 - Capable of printing to A3 or larger
 - High speed and volume units required as per network printers

6.3 The competitor's work area dimension is to be a minimum of 2.5 x 3 meters (see layout) with following minimum equipment must be provided for each workplace:

- Work station furniture (desk), preferably in "L" shape arrangement
- Ergonomically adjustable chair

6.3.1 Competitor CADD workstation

One CADD workstation to meet at least the minimum specification of AutoDesk.

6.4 Technical Experts workplace

For the Technical Experts, the following minimum equipment is required:

- Four complete CAD Workstations as described above, with internet access
- Measuring rules 300 mm and 1000 mm
- 2 vernier calipers 150 mm
- 2 depth gages 150 mm
- 2 micrometers (0 - 25); (25 - 50)
- 2 protractors 0 – 180
- Sets of Drawing utensils; circle, writing utensil, eraser

6.5 Network and system requirements

- All of the workplaces defined below, including experts and competitors, and all the printers and plotters, must be connected by a NETWORK, and supported by the Network Manager.
- All competitors may bring their own computer KEYBOARD to suit their national language preferences. If so, the competitor must bring the keyboard complete with a plug adapter as required to work with computer specifications as supplied by host country.

7. Test Project Marking

7.1 The experts will decide together on the test project, the marking criteria and the dimensional tolerances on forms 5 and 5A, and they will prepare the material list. A combination of Subjective and Objective marking criteria will be used for each project as per 7.2 below and therefore form 5A will be used.

7.2 **Marks:**

Perfect	=	10 points
Very good	=	9 points
Good	=	8 points
Rather good	=	7points
Sufficient	=	6 points
Medium	=	5 points
Weak	=	4 points
Insufficient	=	3 points
Very bad	=	2 points
Zero	=	1 point

7.3 Rating

Section	Item	Maximum Points
A	Drawing from physical model	25
B	Assembly drawings	25
C	Detail drawings	50
D		
E		
F		
G		
H		

7.4 Conversion to the 400 - 600 scale will be done by computer.

8. Competition Procedure

8.1 The competition will be worked on over all four days of the competition. Where modular projects are used, at least one module will be completed on each day for all competitors so that progressive marking can take place, and for results to be made available each day.

- 8.2 Competitors will have time at their disposal to familiarise themselves with processes and equipment. Where processes are particularly difficult, the host country will provide a subject matter expert to demonstrate the process and the competitors will be given the opportunity to practice.
- 8.3 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition so that they may study the requirements.
- 8.4 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for completion of modules.

9. Judging procedural requirements

- 9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.
- 9.2 Every completed module will be marked on the same day in which it was completed.

10. Safety requirements

- 10.1 Competitors must keep their workspace clear of obstacles and the floor space clean of material and equipment - any items likely to cause the competitor to trip, slip or fall.
- 10.2 The chief expert may identify additional safety requirements that will be communicated to the competitors and judges.
- 10.3 Failure by the competitor to comply with safety directions or instructions will incur loss of marks for safety.



NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

The National Skills Competition Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, subject to change by the National Skills Competition Steering Committee.

1. Name and description of trade

1.1 The name of the trade is:

Welding

1.2 Terms and Definitions:

Standard reference terms and definitions for welding processes, welding positions and weld testing shall be to International Standard Organisation (ISO) and American Welding Society (AWS) standards. Where conflict arises ISO standards shall have precedence. If no ISO standard is applicable than the relevant AWS standard shall be used. The word "SHALL" used throughout this Technical Description means mandatory compliance with that instruction.

1.3 The trade covers the welding of components, structures, plates and tanks.

For welding various processes will be applied depending on the material and it's application.

For instance: -

1. Oxy acetylene welding, OAW (311).
2. Manual metal arc welding, MMAW (111).
3. Metal inert gas welding MIG (131).
4. Metal active gas welding MAG (135)
5. Flux core arc welding (136) and or Metal cored arc welding (136)
6. Tungsten inert gas welding (141)

Materials to be welded are ferritic and austenitic steels as well as non-ferrous metals in the form of plates pipes and rolled steel sections.

1.4 This technical description must be known to every candidate.

1.5 In the event of any query or conflict within the technical descriptions, the English copy will take precedence

1.6 Words implying masculine gender only shall include the feminine gender

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2 Scope of work at WorldSkills Competitions

2.1 The test project consists of practical welding and skill related competency knowledge.

2.1.1 The test project will consist of the following tasks:

- Task 1: Test Plates/Pipes:
- Task 2: Aluminium Structure:
- Task 3: Stainless Steel Structure:
- Task 4: Pressure Vessel:
- Task 5 : Working Correctly to Welding Procedures:
- Task 6 : Competency Interpretation:

For further details please refer to Project Development (PD10)

2.1.2 The total time allocation for the whole project is 22 hours.

2.2 The theoretical knowledge is limited to that necessary to carry out the practical and diagnostic work.

3 Practical Work

3.1 The competitor has to be able to carry out, unaided, the following tasks:

Butt and fillet welding of plates, pipes and rolled sections, in all working positions and with seams of different angles of inclination and rotation. Welding positions

terminology shall be to both ISO 6947/ISO2553 and AWS A3.0/A2.4

3.2 The appropriate minimum technical skills are:

3.2.1 General

- starting and using the welding equipment supplied by the organiser, following the appropriate safety regulations
- checking that the dimensions of the materials are in accordance with the material list and the prints/drawings
- preparing the materials by filing and grinding
- assembling the materials in accordance with the drawings

3.2.2 Oxy Acetylene Welding (311)

- gas welding is limited to the welding of small diameter pipes (range 25mm to 60mm with a wall thickness range 1.6mm to 3mm)
- setting into operation the oxy-acetylene installation according to safety regulations and technical instructions
- selecting the appropriate gas nozzles and filler rods
- adjusting gas pressure
- using the correct lighting up and closing down procedures for welding.

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3.2.3 Manual Metal Arc Welding (111)

- selecting the most suitable size and type of electrode
- adjusting the correct current and polarity for welding.

3.2.4 Gas Metal Arc Welding (131 and 135) ,Flux Cored Arc Welding (136) and Metal Cored Arc Welding (136)

- using the appropriate shielding gas, current type (DC), amperage and voltage
- adjusting gas pressure and rate of flow
- adjusting and welding with different modes of transfer e.g. spray arc, globular arc, short arc (dip), pulsed arc etc.
- selecting the gas nozzles for wire electrodes
- adjusting the wire feed speed, welding with the appropriate contact pipe (tip) distance and electrode-positioning angle.

3.2.5 Tungsten Inert Gas Welding (141)

- using the most suitable welding power unit, electrodes, gas nozzles, gas lenses and purging devices
- adjusting the appropriate polarity.

3.3 Rules concerning the Welding Competition:

3.3.1 Welding Machines, Tools and Equipment Usage

- due to the complexity of modern welding machines, it is a requirement that the host country supplies welding machines which can be used in basic modes of operation
- welding machines may be used to their full technical potential.
- it is a requirement that the host country provides to all attending countries detailed operation manuals eight (8) months prior to the competition
- the welding machines provided shall have the capability to be operated using both standard amperage control and remote amperage control. Remote devices shall be made available and the remote devices include hand button, hand slider and foot controls

3.3.2 Grinding

Grinding is not permitted for the cleaning of the final surfaces of the weld reinforcement and plate surface.

3.3.3 Backing Bars / Plates and Restraining devices

- No copper (Cu) chill plates or ceramic backing tapes/bars are to be used in the competition
- Purging equipment may be used for the Gas Tungsten Arc Welding process
- Restraining devices shall not be used whilst welding the test plates. Such devices include; clamps, jigs, fixtures or steel plates, tack welded to the test plates
- Welding of the test plates is to be carried out without the aid of restraining devices, this is so the experts can access the control of distortion.

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3.3.4 Weld cleaning of TIG projects

The weld faces on the aluminium and stainless steel TIG (GTAW) projects are to be presented in the as welded condition. No cleaning; sanding, grinding, steel wool, wire brushing or chemical cleaning etc.

3.3.5 Tack welds

- Tack welds shall be no longer than 15mm in length
- When assembling the pressure vessel the competitor may use any of the welding processes nominated on that drawing for tack welding

3.3.6 Welding of Test Plates

The test plates shall be welded only once, there will be no flame cutting or grinding of the test pieces to allow for complete re-welding.

3.3.7 Competitors Hand Pieces / Torches

Competitors may use their own TIG, OAW, MIG and MMAW hand pieces/torches provided the competitor does not damage the host country's equipment. The competitor's equipment must comply with safety regulations.

4 Theoretical Knowledge

4.1 The theoretical knowledge is limited to that necessary to carry out the practical work, welding procedures and the competency test.

4.2 Preparation and execution of welding exercises must be to ISO standards and welding instructions.

4.3 Knowledge and compliance of the competition safety regulations.

4.4 Knowledge of the welding properties of materials and consumables.

4.5 Competitors must be able to follow a basic welding procedure and fulfil the specification on that procedure correctly. ISO 9956 (EN 288) shall be the reference standard for the WPS.

4.6 Selecting the correct welding consumables (filler metals) from a selection available to match the material supplied.

5 Materials

5.1 During the competition only materials provided by the organiser may be used.

These include:

Practice Plates for the Competition:

The host country organising committee shall provide 10 practice plates of

each different type of material used in the competition projects. These plates shall be made available to the competitor for practice on the day set aside for testing the installations, before the competition.

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Dimensions of Practice Plates

The practice plates shall be the same width and thickness as the actual project pieces, but they shall be shorter by 20mm in length.

5.2 Basic materials:

Plates

- quality low carbon steel, 2mm to 16mm thick to ISO 10038
- austenitic stainless steel, 1.5mm to 10mm thick e.g. 18/8 types X5CrNi 18 10 (1.4301) UNS S30400 304
- aluminium, 1.5mm to 10mm thick e.g. 1000, 4000 or 5000 series.

Pipes

- quality low carbon steel pipes to ISO 10038, diam. 25mm to 250mm, wall thickness 1.6mm to 10mm

Auxiliary materials

- For Oxy Acetylene Welding
 - o Steel filler rods, diam. 1.5mm to 3.2mm
AWS A5.2 R60 or AWS ER70S-2
- For Manual Metal Arc Welding
 - o Basic coated stick electrodes, diam. 2.5; 3.2, 4.0; and 5.0mm
AWS A5.1 E7016 or E7018 or cellulosic
- For Flux Cored Arc Welding
 - o Rutile-flux cored wire Grade 3 shipping society approvals (e.g.: L.R.S., A.B.S., D.N.V. etc.), diam. 1.2mm.
AWS A5.20 E71T-1/1M and or E81T-1/1M
- For MIG / MAG Welding
 - o Low carbon steel wire electrodes, diam. 0.8mm, 0.9mm and 1.0mm
AWS A5.18 ER70S-6 or E70C-6.

- o Stainless steel wire electrodes, diam. 0.8mm, 0.9mm and 1.0mm

AWS A5.9 ER308LSi or ER316LSi

- o Aluminium wire electrodes, diam. 1.2mm

AWS A5.10 ER5356 or ER5183 or E4043

- For Tungsten Inert Gas Welding

- Filler rods, diam. 1.6 , 2.4 and 3.2mm (3.2 for aluminium only)

- o AWS A5.18 R70S-2 or R70S-4.

- o AWS A5.10 R5356 or R4043 or R5183.

- o AWS A5.9 R308L or R316L.

5.3 The consumables used shall match and be suitable for the welding of the base materials supplied.

5.4 Welding and shielding gases

- Acetylene C₂H₂

- Oxygen O₂

- Pure Argon Ar (99.9%)

- Carbon dioxide CO₂

- Gas mixtures as required for MAGS welding.

5.5 Notification of welding consumables & gases

Welding Consumables (filler metals) and Shielding Gas combinations, chemical compositions/classifications must be provided to the competing countries eight (8) months prior to competition.

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6 Workshop Installations

6.1 Each competitor will have a workstation. Local conditions will be taken into consideration. Size of the welding booth: 3m x 3,5m

6.2 The general layout of the workshop venue will be as below, with sufficient space for the booth and for the competitors working area as defined in 6.3 below.

Please note that this is an example of the layout, and is not definitive. The minimum area requirements will be available.

6.2.1 The host country shall make the following machines and equipment available for the workshop area:

- 2 large electrode furnaces, 0 to 350 deg.C
- hand files of different forms and sizes
- wire brushes and emery cloth
- magnetic or simple clamps
- 1 set of pliers
- 5 weld seam measuring gauges
- 5 steel measuring ruler (300mm)
- 5 bevel square
- 1 centre square
- 1 dividers
- 3 work benches with vice and 110v or 220v power
- 2 upright grinding machines with 300 mm diameter grinding wheels
- 2 electrode grinders bench mounted (150mm)for tungsten electrodes

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- water for cleaning and cooling the work pieces
- electrical connections for work bench, hand grinders and radiographic viewers
- an oxygen and acetylene gas apparatus for pre-heating the pieces in process will be available for every 5 to 6 competitors
- 1 oxygen and acetylene flame plate cutter
- 1 pressure test pump (80 bar) to be automated
- 1 radiographic viewer
- 4 lamps for visual inspection
- 1 local X-ray laboratory facilities
- 1 bend test machine, hydraulic type
- 1 Equipment to accurately remove and prepare the test plate bends specimens with in a 24-hour period. (40mm wide specimens)

6.3 The personal working area for each competitor shall be at least 2.5m x 2.5m with a layout similar to that shown in Sec 6.2 above, and shall also allow for the equipment and machines specified in Sec. 6.4 below.

6.4 The host country shall make the following machines and equipment available for

each competitor:

- 1 ea. welding bench (900mm x 800mm x 10mm) with adjustable arm (with clamping device) which can be raised, lowered, turned and locked
- holder for prints
- 1 chair or stool for each competitor suitable for a welding environment.
- non-flammable curtains for screening off the welding station
- all gas up-takes must have a welding regulator and a backfire safety device
- gas hoses at least 5 m long
- 1 ea. welding torch with grip, inserts of different sizes
- 1 ea. AC and DC power unit, current intensity 250 A, for MMAW (SMAW), with welding accessories
- 1 ea. AC and DC power unit, water or air cooled, current intensity 300 A, for TIG/GTAW welding, with welding torch , foot control or hand remote control, pulse facilities and accessories
- 1 ea. DC power unit, current intensity 350 A, for MIG/MAG and FCAW complete with accessories
- 1 ea. electrode heated storage container for the welding cubical, 0 to 150 deg.C
- 1 ea. Fume extraction device for removing welding fumes (in each bay)
- 2 ea. 110v or 220v power outlets in each bay for hand power tools
- 2 ea. local power (e.g.: 110v) plugs and adapters.

6.5 Notification of workshop installations

It is a requirement of the host country to supply a detailed equipment and accessories list no later than eight (8) months period to the IVTC meeting.

6.6 The competitor may bring the remaining tools and equipment in a toolbox and other new tools and helping devices that are being used in today_s industry are encouraged:

- welding safety glasses
- safety goggles
- welders helmet

- spare glasses for goggles and shields
- leather gloves and welding jacket
- leather apron and leggings
- safety shoes or boots
- chipping hammer (slag hammer)

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- inter-weld run cleaning, blade scrapers
- chisels
- scriber
- files
- prick punches
- wire brushes
- engineers hammer
- weld seam gauge (fillet gauge)
- steel measuring ruler
- plate square
- chalk
- dividers
- G-clamps and quick gripping devices
- oxy-acetylene welding torches
- TIG accessories (gas lenses, etc.)
- purging apparatus for TIG
- MMAW, MIG and TIG hand pieces/torches
- 100mm (4inch) angle grinder
- wire brush wheels to suit grinder
- power transformer and extension leads
- volt-ampere meter
- their own foot control, hand held control, to suit the supplied welding machines
- Other personal hand tools
- Working clothes and all tools must comply with safety regulations.

6.7 Where possible every assistance shall be given to a competitor to adjust/modify working heights to suit the individual.

7 Test Project Marking

7.1 Each expert will provide workable marking criteria that are compatible with the presented projects and shall be on forms 5, 5A and 6.

7.2 Objective Marking (form 5):

Score 1 or 10

Does the measurement comply to the marking aspect,

YES – 10 points/NO – 1 point

7.2.1 or Graduated Objective Marking:

Score 1, 5 or 10

Do the measurements comply to the graduated marking aspects, e.g.

Marking Aspect Score

X-Ray to ISO 5817 1, 5 or 10 points

D-Class = 1 point

C-Class = 5 points

B-Class = 10 points

Total score if B class is met = 10 points

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7.2.2 The test projects shall consist of the following welding processes, each process is required in the project:

- a) Oxy-acetylene welding OAW (optional)
- b) Manual metal arc welding MMAW - SMAW
- c) Gas metal arc welding GMAW - MIG/MAG
- d) Tungsten inert gas welding TIG - GTAW
- e) Flux cored arc welding FCAW

7.2.3 Percentage break down of welding processes

- a) OAW 5%
- b) MMAW 25%
- c) MIG/MAG - GMAW 25%
- d) TIG - GTAW 20%

e) FCAW 25%

7.3 Rating

Section Item Maximum Points

A Visual assessment of weld seams 25

B Pressure test 20

C Destructive tests (bend test or nick breaks) 15

D Non-destructive tests (X-ray). 15

E Assembly according to prints 10

F Competency interpretation 10

G Correctly following welding instructions 5

H

7.3.1 The experts will prepare a rating sheet with the marking criteria and tolerances.

Note: Weld sizes shall conform to national/international standards and are to be assessed objectively, utilising measuring equipment.

7.3.2 Weighting of projects to objective visual inspection and shall be as per the following:

Aluminium GTAW Project 20%

Stainless steel GTAW Project 20%

Mild Steel test plates 17%

Pressure Vessel 27%

7.4 Conversion to the 400 - 600 scale will be done by computer.

8 Competition Procedure

8.1 Competitors will have two (2) hours at their disposal to familiarise themselves with material and processes. Where processes are particularly difficult, the host country will provide a subject matter expert to demonstrate the process and the competitors will be given the opportunity to practice.

8.2 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition so that they may study the requirements

8.3 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for completion of modules.

9 Judging procedural requirements

9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.

9.2 Every completed task will be marked on the same day in which it was completed.

9.3 No marking and testing will take place without the attendance of two experts.

9.4 At no time may the expert from the same country of origin as the competitor be involved in any discussion.

10 General safety requirements

10.1 All competitors must use safety glasses when:

- using any hand or power tools likely to cause or create dust chips or fragments that may injure the eyes
- grinding, brushing, hammering, cutting, welding etc.

10.2 All competitors must wear gloves when working in the shop

10.3 Competitors must keep their workspace clear of obstacles and the floor space clean of material and equipment - any items likely to cause the competitor to trip, slip or fall.

10.4 Failure by the competitor to comply with safety directions or instructions will incur loss of marks for safety.

10.5 Judges will wear the appropriate personal safety equipment when commissioning a competitors project.



NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

The National Skills Competition Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, subject to change by the National Skills Competition Steering Committee.

1 Name and description of trade

1.1 The name of the trade is:

CNC - Turning

1.2 CNC - Turning covers the processing of work pieces through metal cutting with CNC lathes.

1.2.2 Programming of the CNC machine takes place through well-known control and CAM system. The competitor has the choice of using the provided machine control and/or the provided CAM system for programming.

1.3 This technical description must be known to every candidate.

1.4 In the event of any query or conflict within the technical descriptions, the English copy will take precedence

1.5 Words implying masculine gender only shall include the feminine gender

2 Scope of work at WorldSkills Competitions

2.1 The test projects consist only of practical work, comprising programming, set-up and actual machining work.

2.2 All components may be programmed using the full capacity of the provided control and CAM system.

2.3 The project work is modular, meaning the competitor starts a new project every day.

2.4 Competitors are not forced to have knowledge of both programming systems (CAM and Machine control), they may choose between the provided systems.

2.5 The Chief Expert will assign project design to participating experts prior to the competition.

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2.5.1 The modules may be as follows:

Module 1 Module 2 Module 3

Day 1 – 6 hours Day 1 – 6 hours Day 1 – 6 hours

Day 2 – 6 hours Day 2 – 6 hours Day 2 – 4 hours

Day 3 – 6 hours Day 3 – 4 hours Day 3 – 6 hours

Day 4 – 4 hours Day 4 – 6 hours Day 4 – 6 hours

2.5.2 Point 2.5 can only be accomplished when each competitor has his/her own machine to work on. If two competitors need to share one machine, as in St. Gallen 2003, the projects need to be reduced to a reasonable time (e.g. 5 hours) for each day and the competitors need to be divided in groups.

Example:

Time Group 1 Group 2

7:15 Study Drawing Free Time

7:30 Start Competition Free Time

12:00 ----- Lunch

12:30 End Competition – Start Clean Up -----

13:15 End Clean Up – Go To Lunch Study Drawing

13:30 Lunch Start Competition

18:30 Free Time End Competition – Start Clean Up

19:15 Free Time End Clean Up

2.5.3 The groups will alter their schedule, meaning that group 1 starts in the morning of the 1st competition day, in the afternoon of the 2nd competition day, in the morning of the 3rd competition day and in the afternoon of the 4th competition day.

This schedule allows for the following:

- Competitors get more time to explore the other trades of the competition.

- In such a case, the host country has the challenge to ensure appropriate transportation for the competitors in this trade.

2.6 Each participating expert is to design a test project and selection of the project will take place on site. Refer to the document – **See Appendix 3 (Trade 6**

Project features)

3 Practical Work

3.1 The competitor has to carry out independently the following tasks:

- Prepare, based on the drawing, usable CNC-programs
- Calculate the points of intersection on profiles if not shown on the drawings by means of any kind of calculator or the provided CAM system or the machine control
- Select the tools and independently mount, set-up and measure them
- Machine and measure the test project
- Comply with the safety instructions by the machine manufacturer and with the national safety regulations, as well as IVTO regulations

3.1.1 The tool data have to be found and entered at the machine. No external toolsetting equipment will be provided.

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3.2 The provided CNC programming software will be known worldwide, ideally used.

(Fanuc, Master-CAM...)

Competitors will get an on-site orientation to the equipment before the 1st day of competition – See section 6.3 below.

The host country is to provide the technical specifications of the provided equipment to the technical delegates of the participating countries at least eight months before the WorldSkills Competition.

Free training on machine and software must be provided a four months prior to the competition. Travel, lodging and food expenses for this training are to be carried by the competitor or his/her sponsor.

The host country is obligated to schedule this training at least four (4) months before the competition, and notify the participants at least six (6) months before the competition. Participating in the provided training is the choice of the

competitors and/or their sponsor.

The machine manufacturers must supply specialists and service staff for the software and the CNC machines in adequate numbers to ensure that the competition runs smoothly. These specialists will be available at all times before and during the competition, as well as during marking of test projects.

4 Theoretical Knowledge

4.1 Interpretation and execution of manufacturing drawings according to ISO-A or ISO-E standard, depending on the competitor's preference.

4.2 Knowledge of materials used and the correct processing.

4.3 Knowledge of CNC programming to " DIN-ISO " and knowledge of the programming language of the provided control and machine.

4.4 Knowledge of programming and transferring data of the provided CAM software.

4.5 Knowledge of Trigonometry or other mathematical means of calculating tangent and intersection points.

5 Materials

5.1 - Low Carbon Steel (tensile strength 400 to 550 N/mm²)

- Aluminium (good machineable quality)

The size of the raw material shall not exceed Ø100mm.

6 Workshop Installations

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6.1 The general layout of the workshop venue will be as below, with sufficient space for the workstation and for the competitors working area as defined in 6.3 below.

Please note that this is an example of the layout, and is not definitive. The minimum area requirements will be available.

6.1.1 The following machines and equipment shall be made available for each competitor:

- 1 CNC Lathe

- Max. turning Ø must exceed Ø200mm

- Min. of 10-station automatic tool turret. (ability for through-tool coolant supply)

- Capable of min. 5000 rpm spindle speed

- Bar size min. Ø 50mm
- Standard tool shank size 20 or 25 mm.
- Spindle motor min. 6KW
- Coolant pump strong enough to support internal cooling for Udrills
- Filled with cutting fluid (coolant)
- Supplied with hydraulic 3-jaw chuck (hollow center),
 - 1 set of hard jaws, min.
 - 2 sets of soft jaws
- Tailstock and suitable life center

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- Control worldwide known and used (NOT a prototype, control needs to be well established and available on the market for at least 1 year)
- Chip hook and/or safety gloves
- 1 workbench with vise and protective aluminum jaws, and a chair
- Space for a tool cart
- Basic set of cutters and inserts for internal and external machining and suitable holders
 - including drill chucks (Ø1mm-13mm), collet holders and collets.
 - Twist drill Ø 15mm / Ø18mm / Ø20mm and appropriate Morse taper adapter
 - Adapters for U-Drills (Ø20mm and Ø25mm)
- 1 PC with CAM software and functional data transfer to the machine control

6.1.2 If there is only ONE machine for 2 competitors, then the following should apply :

For two competitors :

- 1 CNC Lathe as described in point 6.1
- 1 workbench with vise and protective aluminum jaws, and a chair
- 1 PC with CAM software and functional data transfer to the machine control

For EACH competitor :

- Space for a tool cart

- Basic set of cutters and inserts for internal and external machining and suitable holders including drill chucks (Ø1mm-13mm), collet holders and collets.

- Twist drill Ø 15mm / Ø18mm / Ø20mm and appropriate Morse taper adapter

- Adapters for U-Drills (Ø20mm and Ø25mm)

6.1.3 1 spare machine, which will be used for public relation. In the event of a machine failure this spare machine will take place in the competition.

6.1.4 The host country is responsible to ensure correct and updated listings of the provided equipment on the Web page for the event. If no Web page is available, the listing has to be provided to the technical delegates by other means.

6.2 The competitor must bring all equipment not provided for machining, measuring and testing as required.

- The document "**Trade 6 Project features**" (Available from the General Secretariat) each member will get an idea of what to expect, and it is recommended to bring those with to the WorldSkills Competition.

- Restrictions of tool-usage will be established on site prior to the competition by the panel of experts.

- Prior to and during the competition, experts will check each competitors workstation and toolboxes and confiscate "forbidden" tools.

6.3 The host country is to arrange for an appropriate "orientation" on the competition site in order for the competitors to have the opportunity to familiarize themselves with the equipment (machine and control and the CAM software) for 1-2 full days. Technicians have to be on site to assist the orientation and answer questions of competitors (ideally 1 technician per 4 competitors).

This helps competitors with the use of the equipment and reduces the risk of injury and/or damage.

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6.4 The host country is obligated to provide, 8 months before the competition, the following information:

- Machine to be used (complete technical specifications. e.g. Tool size,

chuck size, Ø of through hollow of spindle, power, tailstock, MT - size etc)

- Control and software to be used and all specifications
- Free training software and training if necessary

6.5 The machine manufacturers must supply technicians and service staff for the machines to ensure that the competition runs smoothly. These technicians will be available at all times before and during the competition, as well as during the marking of test projects.

6.6 1 Measuring and control station in the vicinity of the work area shall be provided for competitors, which comprises:

- 1 Hard stone surface block quality grade 00, (minimum size 600 x 800 mm) on a stand
- Digital height gauge, minimum range 600 mm, minimum resolution 1/1000 mm, measuring accuracy 0.005 mm on 300 mm
- 1 Dial indicator , accuracy 0.01mm, on stand
- 1 90° angle plate, quality grade 00
- Min. 2 sets of the following Measuring equipment:
 - o Outside micrometer 0 - 100 mm
 - o Inside micrometer 0 – 80 mm
 - o Micrometer depth gauge 0 - 100 mm
 - o Depth gauge 0 - 250 mm
 - o Taper ring and taper plug gauges as required
 - o Screw thread micrometer 0 – 50 mm (pitches 1-3mm)
 - o Gage block set
 - o Go / No-go gage (plug gage) for Internal thread M30x1.5 and M20x1.5, tol. 6g

6.7 Measuring and control station for measuring competitors workpieces by the experts:

- 1 Programmable 3D-measuring appliance, x /y /z measuring range min. 300 mm, accuracy 0.003mm, equipped with accessories to measure and hold round parts (V-Blocks, vice, etc.)
- Technicians from the manufacturer, to execute the measuring of projects

- 1 Printer to print measuring results
- 1 Surface roughness tester and suitable accessories to hold round parts.
- Optical comparitor, equipped with templates for measuring radii and suitable accessories to hold round parts
- If possible, one (1) contracer for easy measuring of counters, also with Technician, suitable software and hardware, as well as suitable accessories to hold round parts
- 1 electric pencil or other means of marking the competitors workpieces permanently

6.8 Meeting room for experts, supplied with tables, chairs, flip chart and the IVTO computer with printer. Also a secure cabinet to lock away test projects (2 keys)

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6.9 Public relations

- The host country shall provide appropriate equipment for public relations
- 1 extra machine may be used for public relation (maybe for a phantom part to be run) as in point 6.3
- This extra machine could also be used to machine little “ take-home “ gifts for the public.
- A TV may be set up to have a video display the technology to the Public.
- A table may be set up with “sample parts“ for better relation of the public.
- Experts do have the duty to help with presenting the trade to the public.

7 Test Project Marking

7.1 The experts will decide together on the test project, the marking criteria and the dimensional tolerances on forms 5, 5A and 6.

7.2 Marks:

Perfect = 10 points

Very good = 9 points

Good = 8 points

Rather good = 7points

Sufficient = 6 points

Medium = 5 points

Weak = 4 points

Insufficient = 3 points

Very bad = 2 points

Zero = 1 point

7.3 Rating

Section Item Maximum Points

A Conformity to drawings 10

B Surface finish 10

C Main dimensions 50

D Secondary dimensions 25

E Use of material 5

F

G

H

7.3.1 Conformity to drawing: Maximal 10 marking aspects.

- Visual check if features and characteristic of the test part is according to print, if features are missing, if additional features are on the part!
- Check for corner-break and chamfers
- Check for burrs on the part
- Check for damage to part (scratches, clamp-imprints, marks etc)
- Visual check of surface finishes not specified for measuring

7.3.2 Surface finish: Maximal 5 marking aspects.

Measure specified locations (marked on print) for Ra.

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7.3.3 Main dimensions: Must be 10 marking aspects.

Each dimension equals 5 points.

7.3.4 Secondary dimensions : Maximal 15 marking aspects.

Each dimension equals 1.0, 1.5, 2.0, 2.5, 3.0 or 3.5 points.

7.3.5 Use of Material:

+ 5 Points if NO additional Material is used

+ 0 points if ONE additional material is used

Competitors may ONLY receive ONE extra piece of material.

7.3.6 Even though the total score for the four (4) days is 100 points, each project will be scored to 100 points and will be divided by four (4) to have a maximum total of 25 points each day.

7.4 Conversion to the 400 - 600 scale will be done by computer.

8 Competition Procedure

8.1 The competition will be worked on over all four days of the competition. One module will be completed on each day for all competitors so that progressive marking can take place, and for results to be made available each day.

8.2 Competitors will have time at their disposal to familiarise themselves with material and processes. Where processes are particularly difficult, the host country will provide a subject matter expert to demonstrate the process and the competitors will be given the opportunity to practice.

8.3 Competitors will be given the test drawing and the test material to study for a reasonable time (e.g. 15 minutes). Within this time competitors may ask questions or complain about wrong material received. They also may start preparing their tools. However, machine-setup, programming or calculations may not be done during this time. The competition begins after the assigned study time.

8.4 Prior to the start of the competition, each competitor will receive a detailed timetable reflecting the timing for completion of modules.

8.5 After the allotted time for the particular test projects, experts will collect the test parts and will mark them with the competitor's number. No bonus points will be allotted for early finishing.

8.7 One extra piece of material will be available for each competitor per test-part. If the competitor requests extra material, the current material has to be turned in permanently to the experts. Only then may any new material will be handed out. The competitor will receive a penalty in scoring (refer to point 7.2) if extra material is assigned.

8.8 All data stored by the competitor in the machine control, the CAM system and the provided PC will be deleted after each competition day. All parameters will be

reset to original manufacturer status.

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9 Judging procedural requirements

9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.

9.2 Marking of the test projects will take place on a daily basis. ONLY the machined test part will be marked.

10 Safety requirements

10.1 Refer to Appendix 1

10.2 During the competition assigned experts will roam the site to ensure safety and fairness. These experts may interfere with the competitor's work if necessary.

Competitors are allowed to ask these experts for help in case of equipment failure or other concerns. Experts will not provide help on completing the test projects.



NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

The National Skills Competition Committee has adopted the following minimum requirements for applicants' entry in the National Skills Competition.

The effective date will be that date on which this document is issued, subject to change by the National Skills Competition Steering Committee.

1 Name and description of trade

1.1 The name of the trade is:

Instrument Making

1.2 Instrument making covers the manufacture of precision parts, mainly of metallic materials. The parts are then assembled to make apparatus devices, instruments and fixtures devices in accordance with the drawings and ISO-standards. The task includes all necessary settings, manufactures, adjustments, tests and maintenance.

1.3 This technical description must be known to every candidate.

1.4 In the event of any query or conflict within the technical descriptions, the English copy will take precedence

1.5 Words implying masculine gender only shall include the feminine gender

2 Scope of work at WorldSkills Competitions

2.1 The test project consists only of practical work.

2.2 The theoretical knowledge is limited to that necessary to carry out the practical work.

3 Practical Work

3.1 The competitor has to carry out, independently, the following tasks:

- manufacturing and assembling components into precision devices in accordance with the drawings, which includes:
 - o material machining techniques
 - o assembly, regulation and control operations

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3.2 Competitors must use the necessary and appropriate technical skills to complete the tasks.

3.3 The appropriate technical skills are:

- tracing, marking, forming with and without removal of material, joining, measuring and testing
- drilling, countersinking, tapping, reaming, turning, milling, grinding and filing
- assembly, gluing

4 Theoretical Knowledge

4.1 Interpretation and execution of drawings and sketches according to ISO standards.

4.2 Knowledge of materials and processes.

5 Materials

5.1 All work is to be carried out using materials and equipment normally used in the host country with the exception of supplied parts brought by the project designer.

5.2 The competitor may be required to work with any of the materials specified below:

- steel
- construction steel
- free cutting steel
- silver steel 2 - 10 mm diameter
- plate 2 mm thick, cast iron
- non-ferrous metals – brass, bronze aluminium alloys (hard and soft)
- plastics
- cutting fluid

- auxiliary materials
- glue

6 Workshop Installations

6.1 Each competitor will have a stable working table, 1500mm x 700 mm minimum, with a clean surface plate, bench vice 100mm minimum, working lamp minimum 300 lux and a print holder.

6.2 The general layout of the workshop venue will be as below, with sufficient space for the booth and for the competitors working area as defined in 6.3 below.

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Key to the layout below is:

Please note that this is an example of the layout, and is not definitive. The minimum area requirements will be available.

6.2.1 General requirements

The following machines and equipment will be made available for competitors:

- universal milling machines min speed 3000 r.p.m. (2 for every 3 competitors), table size 500 x 300 mm, fully automatic feed, horizontal fast feed, machine lighting, cooling system, auxiliary tools adapted to the machines (cutter holder, precision vice, dividing head, rotate table, lighting minimum 300 lux etc.)

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- universal precision lathes min speed 3000 r.p.m (1 for every 2 competitors), distance between centres max. 600 mm, height of centres max. 200 mm, threading spindle, collet jaws 1 - 20 mm, cooling system, auxiliary tools adapted to the machines (3 & 4 jaw chuck, drill chuck with MT taper, lighting minimum 300 lux etc.)
- bench drills (1 for every 3 competitors), diameter 13 mm/ MT3, speed 50-5000 rpm, cooling system, lighting, power 1.5 kw, auxiliary devices adapted to the machines, e.g. parallel vice.
- surface grinders (1 for every 5 competitors), table size 200 x 500 mm, magnetic table, cooling system, fully automatic horizontal table drive, grinding wheels max. 180 mm, auxiliary tool adapted to the machines,

e.g. diamond dresser

- tool stand grinder, 1 for 3 competitors, wheel size max. 150 mm, power .7kW coolant container; 3000 rpm
- 3-D measuring machine with operator
- compressed air 5 kg/ cm² (gauge)
- water containers
- fire extinguisher

6.3 The personal working area for each competitor shall be at least 3m x 3m, and shall also allow for the equipment and machines specified in Sec. 6.4 below.

6.4 The following machines and equipment will be made available to each competitor:

- parallel vice, width of jaws 100 mm, ground jaws surfaces, distance between jaws max. 100 mm, with height regulation
- flat and profile files, wrenches, screwdrivers, saws
- pliers and special purpose pliers
- centre punches, piercers, hammers, wetting stones, drills
- auxiliary materials
- measuring and control instruments
- Vernier caliper, range 0 - 150 mm, .02 mm precision
- micrometers, ranges 0 – 25, 25 – 50, 50-75, and 75-100mm
- surface dial gauge, height 200 mm
- gauge blocks, ISO-tables
- limit plug gauges, dia. 1 – 20
- gauging rings M2 - M12
- surface control instrument (0.8 + 3.2 mm)
- centre gauge
- precision square, protractor (set)
- feeler gauges 0.01-0.10mm step 0.01mm, 0.1-1mm step 0.1mm
- R gauge 2-20 mm 0.5 mm step
- Screw gauge M5-16
- Screw pitch gauge M2-16

- marking ink and stamp
- box for test project

6.5 The competitor must bring the remaining tools required to perform the technical skills listed in Sec. 3.3 in a toolbox. No special tools that could give the competitor an important advantage developed for competition only.

7 Test Project Marking

7.1 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 any changes to the material list.

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7.2 Marks:

Objective marking

Go-10points

No go and not finished -0 point

Subjective marking

Perfect = 10 points

Very good = 9 points

Good = 8 points

Rather good = 7points

Sufficient = 6 points

Medium = 5 points

Weak = 4 points

Insufficient = 3 points

Very bad = 2 points

Zero = 1 point

7.3 Rating

Section Item Maximum Points

A Function 30

B Dimensions with close tolerances 35

C Dimensions with wide tolerances 15

D Flatness and angles 5

E General execution (ex, roughness....) 10

F Use of materials 5

G

H

7.4 Conversion to the 400 - 600 scale will be done by computer.

8 Competition Procedure

8.1 Competitors will have three hours to familiarise themselves with machines, equipment and processes. The host country will provide a subject matter expert to demonstrate the operations and the competitors will be given the opportunity to practice.

8.2 The competitors will be given all competition documents including the marking criteria one hour prior to the commencement of the competition.

8.3 The workstation and machines will be drawn by the competitor's themselves before their familiarisation with the machines.

8.4 The parts, material, drawings and marking sheets will put in box after each day's work and will put in the locker for security.

8.5 Before the competition the experts should check all the materials, and a different stamp for identification will be used on each side of each competitor's material.

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8.6 At least one stamp-mark must remain on each part of the competitor's material at the end of day for of the competition. Where there is no stamp mark on the competitor's materials or project parts, marking will not occur.

8.7 No sand paper may be used on any part of the project.

8.8 During the competition the candidates are not allowed to communicate with a compatriot expert alone.

8.9 The working hours for competition may only be changed before the end of the 1st day only.

9 Judging procedural requirements

9.1 The experts that attend the competition will be divided into marking groups to deal with each section of the marking criteria.

9.2 No marking will be carried out in the case of **objective** marking without the

attendance of **two or more experts**.

9.3 No marking will be carried out in the case of **subjective** marking without the attendance **all of the experts**.

9.4 During any objective marking, no expert will measure or mark any part of the project of a compatriot competitor (from his own country). The expert will be replace by the chief expert in this instance.

9.5 Each expert has opportunity to check the results from other marking groups, once all marking and results is complete.

10 General safety requirements

10.1 All competitors will wear working clothing and safety shoes. Competitors shall also use safety glasses when using any machines, hand or power tools likely to cause dust , chip, or flying fragments.

10.2 Competitors may not wear gloves, finger rings or jewellery, or any loose wear (tie, scarf or long neck-chains) when operating machinery.

10.3 Competitors must keep their workspace clear of obstacles and the floor space clean of oil, material and equipment – any items likely to cause the competitor to trip, slip or fall.

10.4 Failure be the competitor to comply with safety directions or instructions will incur loss of marks for safety

10.5 The chief expert may identify additional risk factor or safety requirements, which will be complied with.

10.6 All machinery, equipment and safety clothing must comply with the safety rules of the organising country.

10.7 Before the competition the competitors and experts shall be made aware that an emergency plan exists

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11 Additional Documentation

11.1 The following additional documentation relates to this trade.

Document TM3 – Trade Management Procedures

Document PD3 – Project Design Criteria

11.2 The following additional documentation relating to this trade has yet to be defined

at the next WorldSkills Competition to be held in St Gallen in 2003.

Document WS3 – Workshop Setup