NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

WELDING

(IMW#6)

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INTRODUCTION

WorldSkills Jamaica, by a resolution of the National Organizing Committee and in accordance with the Constitution, the Standing Orders and the Competition Rules, has adopted the following minimum requirements for this skill for the National Skills Competition.

The Technical Description consists of the following:

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

Effective 01.04.07

Grace Mclean (GM)
Chairman, Competition Committee
01.04.07

NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

WELDING

(IMW#6)

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

1.1.1. 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: -

a. Oxy acetylene welding, OAW (311).
b. Manual metal arc welding, MMAW (111).
c. Metal inert gas welding MIG (131).
d. Metal active gas welding MAG (135)

e. Flux core arc welding (136) and or Metal cored arc welding (136)

f. 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 Words implying masculine gender only shall include the feminine gender

2. SCOPE OF WORK AT 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: Aluminum Structure:
- Task 3: Stainless Steel Structure:
- Task 4: Pressure Vessel:
- Task 5: Working Correctly to Welding Procedures:
- Task 6: Competency Interpretation:

2.1.2 The total time allocation for the whole project is 10 hours.

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

1.2. 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.

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 welding machines which can be used in basic modes of operation be provided.
- Welding machines may be used to their full technical potential.

- It is a requirement that the committee provides to all competitors detailed operation manuals 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.

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 equipment. The competitor's equipment must comply with safety regulations.

3. SKILL MANAGEMENT PROCEDURES (SM)

1.3. DOCUMENTS REQUIRED

3.1.1 The Chief Expert will have available a current copy of all documents associated with this skill for the Competition.

3.1.2 The documents required are:

- Technical Description
- Competition Rules

- Health and Safety documents
- QAMS – all documents
- Any other documents referred to in the documents listed above.

3.1.3 While it is understood that the Chief Expert will have a copy of these documents in there shall also be a complete set that is available for the experts and other competition workers.

3.1.4 The Chief Expert is expected to have a sound knowledge of the requirements and procedures specified in the documentation.

3.1.5 The Jury President is expected to have a thorough knowledge and understanding of the requirements and procedures specified in the documentation.

1.4. PRE-COMPETITION RESPONSIBILITIES

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

1.5. SKILL MANAGEMENT PROCEDURES FOR THE CHIEF EXPERTS

The following speaks to the procedures prior to and during the Competition

3.3.1 The procedures specified below must be adhered to.

3.3.2 On arrival at the Competition site for the first time, the Chief Expert must:

- Welcome the experts and ensure introductions are made
- Inform them of their duties and responsibilities in terms of the Competition Rules and Standing Orders

• Ensure that the project is endorsed by all the experts and that a copy is signed by all the experts

3.3.3 The Chief Expert will then divide the experts into teams for the following activities:

• Verify that the material on site is appropriate and sufficient

• Verify again that the quantities of material as specified on the material list is accurate

• Develop a program for the competitors to complete the modules

• Develop timetables for activities

• Set up equipment

• Confirm that the layout, work areas and equipment are in accordance with the workshop setup requirements

• Confirm that all machinery/equipment is in a safe working order

• Confirm that all workstations/machinery/equipment are in accordance with the plan, and that they are numbered

• Confirm that there is sufficient illumination

• Confirm that there is sufficient space for the competitors to work efficiently

• Confirm that the barriers are far enough removed from the competitors to ensure that there will be no interference, and if they are not, set up a roster among the experts to police the area during the Competition

• If necessary, set up duty rosters for activities during the Competition – e.g. keeping watch during lunch, preventing access of unauthorised persons, etc

3.3.4 The Chief Expert will then divide the experts into teams for purpose of marking and setting up marking schedules in accordance with the requirements.

3.3.5 Suggestions and comments for the revision and improvement of the Technical Description are to be provided to the Deputy Chief Expert in writing. The Deputy Chief Expert will reduce the information to a single typed document ready for discussion by all experts. Prior to leaving the Competition site, the Chief Expert, the Deputy Chief Expert and the Jury President will facilitate the discussion and revision of the Technical Description.

3.3.6 At any time that a unanimous decision is not achieved within a reasonable time, the Chief Expert will put the matter under discussion to the vote. A majority will be 50% of the experts present plus one. This decision will be final. In the event that an expert is absent at the time that the vote takes place, he/she has the right to be informed of the decision but the matter will not be raised again or voted upon again. The exception to this majority rule will be in the case of approval of the changes to the Technical Description, where the majority of 80% is required.

3.3.7 In the event that an extension of time is requested for the Competition to exceed the allotted hours, the matter must be discussed with the Jury President. All possible alternative solutions must be investigated before approval of an extension of time is requested, or will be approved.

3.3.8 Prior to the end of the Competition, the Jury President will facilitate the selection of the Chief Expert and Deputy Chief Expert for the next national Skills Competition.

3.3.9 Experts are eligible for selection as a Chief Expert if they:

- Have attended the National Skills Competition at least twice before (if less than 4 experts have been to the National Skills Competition before, this criterion may be relaxed at the discretion of the Jury President)
- Demonstrate a high degree of expertise in the skill
- Demonstrate leadership qualities.

• Are competent using a computer and the Internet – specifically to facilitate the Discussion Forum for their skill category.

3.3.10 The process by which selection will take place is by secret ballot and is as follows:

• Each expert present will list their choice of three experts in order of preference • The Jury President will allocate a score of three (3) points to each experts first preference, two (2) points to the second preference and one (1) point to the third preference

• The Jury President will then calculate total scores and announce the three highest scoring experts

• The expert with the highest score will be appointed Chief Expert for the next National Skills Competition

• If the first choice cannot attend, then the second choice will be Chief Expert

• If the first and second choice cannot attend, then the third choice will attend

• If none of the choices can attend, then the jury president will appoint, or facilitate the appointment of a Chief Expert

• The names of the selected experts will be entered into the provided documentation and signed by the Jury President and returned to the co-chair of the competitions committee.

3.3.11 Changes to the method of Competition design or suggestions offered for the next Competition design process or tasks must be written down and signed by 80% of the experts.

3.3.12 The Deputy Chief Expert's primary role is to ensure that the Technical Description is updated to reflect the technological advances of the skill category and include overall improvements for the preparation and running of the Competition. He/she will ensure that all changes to the

Technical Description are entered, that all experts sign it, and that it is delivered to the co-chair of the competitions committee as a hard copy and digitally.

3.3.13 The Deputy Chief Expert also assists in the distribution and collection of the QAMS Audit Questionnaires and assists the Chief Expert where necessary.

1.6. HONESTY AND TRANSPARENCY

3.4.1 The competitors that attend the National Skills Competition have the right to expect fair and honest treatment during the Competition in terms of the following:

- Instructions that are clear and unambiguous
- Marking schedules that provide no advantage to an opposing competitor
- All necessary equipment and material specified within the skill documentation that are required to complete the Competition
- The assistance necessary from judges and officials to ensure that he is able to complete the project. (The assistance deemed necessary will be provided equally and at the same time to all competitors present)
- No undue interference by officials or spectators that may hinder them in the completion of their project

3.4.2 Every competitor has the right to expect and demand that no opposing competitors will receive undue or unfair assistance or intervention that may provide that opposing competitor with an unfair advantage.

3.4.3 All officials and judges present on the Competition site are expected to ensure that paragraphs 3.4.1 and 3.4.2 above are complied with and maintained.

3.4.4 It is the responsibility of the Chief Expert or his Deputy to ensure that all competitors, interpreters, officials and judges comply with and maintain the integrity of the Competition, and additionally ensure that all necessary steps are taken to ensure that:

• Outside influences do not unduly improve or decrease competitors' abilities to provide a worthy performance.

3.4.5 A briefing will be provided to all experts and competitors on the requirements for integrity during the Competition.

3.4.6 Additionally, the Chief Expert is expected to identify these and any other factors that may exist on the Competition site that may results in the contravention of paragraphs 3.4.1 and 3.4.2 above, and reduce them to a checklist for continuous reference.

3.4.7 In the event that any competitor, judge, official, observer or competitor compatriot is found to be attempting to gain or provide assistance in any form that may result in an unfair advantage, the Chief Expert is to immediately refer the matter to the Jury President.

3.4.8 The Chief Expert will receive nominations and appoint a Security Officer whose responsibility it will be to ensure that these requirements are carried out.

3.4.9 It will be explained to all experts and competitors that nothing is to come in or out of the site unless specified by the Chief Expert as being allowed after being briefed on this topic.

3.4.10 Security checks will be carried out each day on experts and competitors (by experts and competitors) upon entry and exit to the site.

1.7. INFORMATION POLICY

3.9.1 During the competition a modified project plan without measurements is to be made available to the public.

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 fulfill 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 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.

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:

1.7.1. 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
  - Steel filler rods, diam. 1.5mm to 3.2mm AWS A5.2 R60 or AWS ER70S-2
- For Manual Metal Arc Welding
  - 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

- 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

- Low carbon steel wire electrodes, diam. 0.8mm, 0.9mm and 1.0mm AWS A5.18 ER70S-6 or E70C-6.
- Stainless steel wire electrodes, diam. 0.8mm, 0.9mm and 1.0mm AWS A5.9 ER308LSi or ER316Lsi
- 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)

- AWS A5.18 R70S-2 or R70S-4.
- AWS A5.10 R5356 or R4043 or R5183.
- 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 C_2H_2
- Oxygen O_2
- Pure Argon Ar (99.9%)
- Carbon dioxide CO_2

5.5 Notification of welding consumables & gases

Welding Consumables (filler metals) and Shielding Gas combinations, chemical compositions/classifications must be provided to the competitors prior to the competition.

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..1 The logistics committee 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
- 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)

6.5 The personal working area for each competitor shall be at least 2.5m x 2.5m. and shall also allow for the equipment and machines.

6.6 The committee 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

6.7 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)
- 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.

7.2 MARKING

Score 1 or 10

Does the measurement comply with 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 with the graduated marking aspects, e.g. Marking Aspect Score X-Ray to ISO 5817 1, 5 or 10 points

D - Class = 1 point 1

C - Class = 5 point 5

B - Class = 10 point 10

Total score if B class is meet = 10 points

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

Points will also be awarded for creativity, innovation, speed etc. (This will be developed by the judges depending on the nature of the test project).

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%

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 organizing committee 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 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.

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.