

NATIONAL SKILLS COMPETITION  
Competitions Sub-Committee  
Mechanical Engineering, Drawing and Design  
(CADD)

**Table of Content**

<b>1. NAME AND DESCRIPTION OF TRADE.....</b>	<b>3</b>
<b>1.1.1. MECHANICAL ENGINEERING, DRAWING AND DESIGN – CADD .....</b>	<b>3</b>
<b>2. SCOPE OF WORK AT THE COMPETITIONS .....</b>	<b>3</b>
<b>2.3 PRACTICAL WORK.....</b>	<b>4</b>
<b>3. SKILL MANAGEMENT PROCEDURES (SM).....</b>	<b>8</b>
<b>1.1. DOCUMENTS REQUIRED.....</b>	<b>8</b>
<b>1.2. PRE-COMPETITION RESPONSIBILITIES .....</b>	<b>9</b>
<b>1.3. 3.3 SKILL MANAGEMENT PROCEDURES FOR THE CHIEF EXPERTS.....</b>	<b>9</b>
<b>1.4. 3.4 HONESTY AND TRANSPARENCY .....</b>	<b>12</b>
<b>1.5. INFORMATION POLICY .....</b>	<b>14</b>
<b>4. THEORETICAL KNOWLEDGE.....</b>	<b>14</b>
<b>5. MATERIALS .....</b>	<b>14</b>
<b>6. WORKSHOP INSTALLATIONS .....</b>	<b>17</b>
<b>7. TEST PROJECT MARKING.....</b>	<b>18</b>
<b>8.1 METHOD.....</b>	<b>18</b>
<b>8.2 MARKS:.....</b>	<b>19</b>
<b>1.6. RATING.....</b>	<b>19</b>
<b>8. COMPETITION PROCEDURE.....</b>	<b>20</b>
<b>9. JUDGING PROCEDURAL REQUIREMENTS.....</b>	<b>20</b>
<b>10. GENERAL SAFETY REQUIREMENTS.....</b>	<b>21</b>

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
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**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

## **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**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

The National Skills Competitions Sub-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, and is subject to change by the Skills Jamaica Competition Steering Committee.

## **1. NAME AND DESCRIPTION OF TRADE**

1.1 The name of the trade is:

### **1.1.1. 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**

2.1 The test projects consist only of practical work

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

2.2 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.

## **2.3 PRACTICAL WORK**

2.3.1 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.

### **2.3.2 Competition project categories**

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

### **2.3.3 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

#### 2.3.4 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.

#### 2.3.5 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

#### 2.3.6 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.

##### 2.3.6.1 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

2.3.6.1.1 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.

2.3.7 D 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.

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.

2.3.8 Kinematics

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

2.3.9 Output Solutions will be supplied in the following formats:

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

2.3.10 Rawings plotted on paper in sizes A1 and smaller.

- Charts, tables and documents printed by laser printers on paper sizes A3 and smaller.
- Renderings, shaded models and drawings printed by color and mono chrome laser printers and color plotters.
- 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.

2.4 Appropriate related skills

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

2.4.1 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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.

### **3. SKILL MANAGEMENT PROCEDURES (SM)**

#### **1.1. DOCUMENTS REQUIRED**

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

3.1.2 The documents required are:

- Technical Description
- 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

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

**1.2. 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.

**1.3. 3.3 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

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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.

**1.4. 3.4 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)

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

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.

### **1.5. 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 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.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

- 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).

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

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.

5.5.1 One new package of the software.

5.5.2 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.

5.5.3 Provide full time technical assistance during the contest, and the configuration and support for plotting of the drawings.

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

## **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

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

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**

### **8.1 METHOD**

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

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

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.

**8.2 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

**1.6. RATING**

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

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

**NATIONAL SKILLS COMPETITION**  
**Competitions Sub-Committee**  
**Mechanical Engineering, Drawing and Design**  
**(CADD)**

## **8. COMPETITION PROCEDURE**

- 9.2.1.1 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.
- 9.2.1.2 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.
- 9.2.1.3 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.
- 9.2.1.4 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.

NATIONAL SKILLS COMPETITION  
Competitions Sub-Committee  
Mechanical Engineering, Drawing and Design  
(CADD)

**10. GENERAL 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.