

NATIONAL SKILLS COMPETITION

Competitions Sub-Committee

CNC – TURNING - (IMT#7)

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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

Daphne Simmonds

Co-Chair

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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. CNC - Turning

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

1.2.1 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 Words implying masculine gender only shall include the feminine gender

2. SCOPE OF WORK AT COMPETITIONS

2.1 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.

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- 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.

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, 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
1:15	End Clean Up – Go To Lunch	Study Drawing
1:30	Lunch	Start Competition
4:30	Free Time	End Competition – Start Clean Up

This schedule allows for the following:

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

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- 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)**

2.1. 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 tool setting equipment will be provided.

- 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 competition's committee is to provide the technical specifications of the provided equipment to the technical delegates.

Free training on machine and software will be provided prior to the competition.

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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.

3. SKILL MANAGEMENT PROCEDURES (SM)

3.1. DOCUMENTS REQUIRED

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

3.1.2 The documents required are:

- Technical Description
- 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.

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3.2. 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.

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
 - 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

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- 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

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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

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- 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.

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)
 - No undue interference by officials or spectators that may hinder them in the completion of their project

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- 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 result 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.

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- 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.

3.5. 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 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.

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6. WORKSHOP INSTALLATIONS

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.

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

- 1 CNC Lathe
- Max. turning \varnothing must exceed $\varnothing 200\text{mm}$
- Min. of 10-station automatic tool turret. (Ability for through-tool coolant supply)
- Capable of min. 5000 rpm spindle speed
- Bar size min. $\varnothing 50\text{mm}$
- 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
- 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 aluminium jaws, and a chair
- Space for a tool cart

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- Basic set of cutters and inserts for internal and external machining and suitable holders
- Including drill chucks (Ø1mm-13mm), collets 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 vice and protective aluminium 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), collets holders and collets.
- Twist drill Ø 15mm / Ø18mm / Ø20mm and appropriate Morse taper adapter
- Adapters for U-Drills (Ø20mm and Ø25mm)

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- 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.
- 6.2 The competitor must bring all equipment not provided for machining, measuring and testing as required.
- 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 competitor's workstation and toolboxes and confiscate “forbidden tools”.
- 6.3 The organizing committee 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.
- 6.4 The following information will be provide:
- 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

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technicians will be available at all times before and during the competition, as well as during the marking of test projects.

6.5.1 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

6.6 Measuring and control station for measuring competitors work pieces 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

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1 Printer to print measuring results

1 Surface roughness tester and suitable accessories to hold round parts.

Optical comparator, 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 work pieces permanently

6.7 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)

6.8 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.

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7. TEST PROJECT MARKING

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

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

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).

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- 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.
- 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.

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8. COMPETITION PROCEDURE

- 8.1 The competition will be worked on over 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 at their disposal to familiarise themselves with material and processes. Where processes are particularly difficult, the committee 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.
- 8.6 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.

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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.

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 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.