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National
Skill Development
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Transforming the skill landscape

Sample Test Project

Regional Skill Competitions – Level 3

Skill 07 – CNC Milling

Category: Manufacturing and Engineering Technology

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SAMPLE

Section - A

A. Preface

Skill Explained:

Computer Numerical Control (CNC) technology has reached the stage of having become universal. Most people cannot imagine how important these technologies are in their lives. It is present in products and objects of everyday life as e.g. cars, airplanes, components of machines of all types, moulds for tools used for household machines, medical prosthetics, cell phones, and toys etc.

CNC-milling machines are machine tools which are used for the shaping of metal and other solid materials. These machines exist in two basic forms: horizontal and vertical.

CNC refers to a computer (“control”) that reads and stores instructions. This numerical information generally “G and M” codes (a programming language) is then used to control and drives a machine tool, a powered mechanical device (“machining centre”). A machining centre is used to fabricate components using cutting tools for removal of material.

To form the finished part, the cutting process can be started from a solid block, pre-machined part, casting, or forgings.

For those scenarios, the skill requires the CNC-milling machinist to read and interpret complex technical drawings and work to a high degree of precision. A programme is required to operate the machine tool, can be generated manually or using Computer Aided Design Computer Aided Manufacture (CAD/CAM) software.

To achieve the finished part, the CNC-milling machinist professionals undertake a sequence of essential activities:

- Interpret engineering drawings and follow the specifications;
- Generate a process and programme (logical process plan) with a CAD/CAM system and/or G and M-codes
- Set up the tooling, work holding device and work piece on the CNC-milling centre;
- Manipulate cutting conditions, based on the properties of the material and tooling used;
- Operate, inspect and maintain the accuracy of dimensions within the specified tolerances.
- Optimize the process taking into account the production type: large quantities of one part, small batches or one-of-a-kind items.

Today a wide range of industries require CNC-milling machinist’s professionals to programme, operate, and keep sophisticated machining centre’s running in an efficient and reliable way. Large enterprises such as automobile plants, medium sized enterprises such as mould making and small enterprises in the maintenance field are some of many examples of where the CNC-milling machinist professional plays a key, integral role to the success of the metalwork industries.

Eligibility Criteria (for IndiaSkills 2018 and WorldSkills 2019):

Competitors born on or after 01 Jan 1997 are only eligible to attend the Competition.

Total Duration: 10 Hrs

Section - B

B. Test Project

Perform the following machining operations:

- Facing
- Roughing and finishing
- External contours
- Island milling
- Pocket (circular and rectangular)
- Canned cycles
- Through hole boring
- Reaming
- Tapping
- Drilling

The test module PDF is attached as annexure.

Section – C

C. Marking Scheme

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the Competition, in that it ties assessment to the standards that represent the skill. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards Specification.

The Marking Scheme and Test Project may be developed by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project must be approved by the whole Expert Jury prior to submission for independent quality assurance.

In addition, Experts are encouraged to submit their Marking Schemes and Test Projects for comment and provisional approval well in advance of completion, in order to avoid disappointment or setbacks at a late stage.

A – Main dimensions (50 out of 100 marks)

Dimensions range from 0.02 to 0.04; Reamed bores: IT7; Hollow out bores: IT7; inside thread and outside thread: IT6

Form and positional tolerances as per DIN ISO 1101

B – Secondary dimensions (25 out of 100 marks)

Dimensions with general tolerance should be ± 0.04 oriented of the nominal size; e.g. 73.8 mm Should be in between 73.76 mm and 73.84 mm.

Depth of hole and thread: $0/+2$ mm; e.g. Depth size 16 should be 16.00 mm to 18.00 mm

Depth of bore: $0/+0.5$ mm; e.g. Depth size 22 should be 22.00 to 22.50 mm

Radius: ± 0.2 ; e.g. R12 should be R11.8 mm to 12.2 mm

Angle: $\pm 0.5^\circ$; e.g. 30° should be 29.5° to 30.5°

C – Surface quality (10 out of 100 marks)

Surface quality = Ra 0.8 to 3.2

D – Conformity with drawing (10 out of 100 marks)

D1 Chamfering edges by machine	2 marks
D2 Chamfering edges manual	1 mark
D3 Contour damage	1 mark
D4 Conformity with drawing – face one	2 marks
D5 Conformity with drawing – face two	2 marks

D6 Conformity with drawing – face three

2 marks

E- Material Usage **(5 out of 100 marks)**

Marking and judgement scheme is attached as annexure.

SAMPLE

Section - D

D. Infrastructure List

INFRASTRUCTURE LIST		SKILL: 07	Name: CNC MILLING	
SI NO	Description	qty	Remark	
1	Work Table			
2	Chair			
3	Computer with I 7 configuration			
4	Working vice			
5	Milling Machine CNC			
6	Milling Machine Conventional			
7	compressed air			
8	Air gun			
9	Soft hammer			
10	Cleaning waste			
11	Cutting oil			
12	Raw materials (for competition)			
13	Raw materials (for familiarization)			
CUTTING TOOLS				
14	NC Centre Drills 90° Ø8.0			
15	NC Centre Drills 90° Ø10.0			
16	HSS Drills Ø5.00			
17	HSS Drills Ø6.0			
18	HSS Drills Ø10.0			
19	HSS Drills Ø14.0			
20	HSS Drills Ø16.0			
21	End Mill (roughing) Ø8.0			
22	End Mill (roughing) Ø10.0			
23	End Mill (roughing) Ø12.0			
24	End Mill (roughing) Ø16.0			
25	End Mill (finishing) Ø6.0			

26	End Mill (finishing) $\varnothing 8.0$		
27	End Mill (finishing) $\varnothing 10.0$		
28	End Mill (finishing) $\varnothing 12.0$		
29	End Mill (finishing) $\varnothing 16.0$		
	MEASURING INSTRUMENTS		
29	Vernier caliper 0-150 mm		
30	Depth micrometers 0-25		
31	Outside micrometers 25-50		
32	Outside micrometers 50-75		
33	Outside micrometers 75-100		
34	Plain protractor		
35	Dial indicators with magnetic stand		
36	Universal dial (0.01mm)		
37	Straight edge 150 mm		
38	Scriber		
39	Height gauge 0-300		

Section – E

E. Instructions for candidates

- 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.
- Experts will use the appropriate personal safety equipment when inspecting, checking, or working with a Competitor's project.
- The documentation 'Safety and Fairness' will be prepared by the Experts.
- The Competitor must comply with the machine manufacturer's safety instructions.

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Section – F

F. Health, Safety, and Environment

1. All accredited participants, and supporting volunteers will abide by rules and regulations with regards to Health, Safety, and Environment of the Competition venue.
2. All participants, technicians and supporting staff will wear the required protective Personnel clothing.
3. All participants will assume liability for all risks of injury and damage to property, loss of property, which might be associated with or result from participation in the event. The organizers will not be liable for any damage, however in case of Injury the competitor will immediately inform the immediate organizer for medical attention.