Technical Description

CNC Turning

Manufacturing and Engineering Technology

WorldSkills International, by a resolution of the Competitions 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 WorldSkills Competition.

The Technical Description consists of the following:

Effective 22.08.18

Stefan Praschl
Chair of the Competitions Committee

Michael Fung
Vice Chair of the Competitions Committee

1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

CNC Turning

1.1.2 Description of the associated work role(s) or occupation(s).

CNC Turning is a branch of engineering. Engineers have to find mechanical solutions that can make complex designs possible. Within an assembly that you may see and use every day, every single part interacts with all others. This is true of cars, smartphones, aeroplanes, and so on; the possibilities are endless. For example, there are about 10,000 parts in just one car. Engineers create assemblies of many parts, and using many different materials, through CAD (Computer Assisted Drawing) software.

Each part of an assembly is made of different materials, and needs different geometries, dimensions and surface qualities. The engineer brings all these requirements into technical drawings which are called "blueprints". But who will build these parts? To answer that question: engineers have to decide the best way to produce each part. There are many ways of doing this, like welding, milling, casting, and 3D Printing. One very important method is CNC Turning.

A CNC lathe is a very accurate computer-driven machine, mainly for round parts, where cutting tools driven by computer software are moved to cut away excessive material to result in the expected part. The CNC Turning Machinist receives the blueprint, then they use the lathe in many ways to find solutions in order to build the part. These machines are very expensive, because they can do remarkable things. To have an idea of this, think what it means to achieve accuracy below ten microns, which is six to 10 times thinner than a human hair.

The CNC Turning Machinist has to use a computer to tell the lathe how to move the tools and cut the part. He/she also has to set up the lathe with all the clamping devices, support devices, and cutting tools. These tools can cut almost every material (stainless steel, plastic, soft steel, aluminium, bronze, and so on). But engineers have to choose well to avoid temperature mistakes or vibration, that can be the reason for bad quality.

When the machine starts cutting material, the machinist makes sure that the dimensions exactly fit the blueprint specifications. For this, very accurate inspection tools are used. A smart machinist will get the part to fit the blueprint specifications at the very first attempt.

The finished and quality-controlled part is sent to the assembly line with every other part, and in the end, if everyone has done their job well, the finished assembly will meet expectations and please its customers.

1.1.3 Number of Competitors per team

CNC Turning is a single Competitor skill competition.

1.1.4 Age limit of Competitors

The Competitors must not be older than 22 years in the year of the Competition.

1.2 THE RELEVANCE AND SIGNIFICANCE OF THIS DOCUMENT

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods, and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

CNC TURNING

1.3 ASSOCIATED DOCUMENTS

Since this Technical Description contains only skill-specific information it must be used in association with the following:

- WSI – Competition Rules
- WSI – WorldSkills Standards Specification framework
- WSI – WorldSkills Assessment Strategy
- WSI Online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations

2 THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

2.1 GENERAL NOTES ON THE WSSS

The WSSS specifies the knowledge, understanding, and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSSS).

The skill competition is intended to reflect international best practice as described by the WSSS, and to the extent that it is able to. The Standards Specification is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standards Specification is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards Specification. This is often referred to as the "weighting". The sum of all the percentage marks is 100.

The Marking Scheme and Test Project will assess only those skills that are set out in the Standards Specification. They will reflect the Standards Specification as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme and Test Project will follow the allocation of marks within the Standards Specification to the extent practically possible. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Standards Specification.

2.2 **WORLDSKILLS STANDARDS SPECIFICATION**

SECTION		RELATIVE IMPORTANCE (%)
1	**Work organization and management**	5
	The individual needs to know and understand: • The scope and limits of the workshop and the workspace • Standards for the environment, safety, hygiene, and prevention of accidents • Safety equipment (how to use, when to use, etc.) • Different types of energy supplies for the CNC Lathe (electric, hydraulic, pneumatic) • Machine Accessories such clamping devices, tailstock, part-catching devices, etc. • Simple maintenance of CNC machines to ensure reliability • The use and care of the available computer operating systems • Programming, setting operating of CNC lathe with live tooling • CNC-programming Systems (Din-ISO (G-Code writing), CAM software) • Principles of technical design and process planning • Mathematics, especially calculations in trigonometry • Principles of cutting- and chip-removal technology • The importance of effective communications and team-work • The importance of machinery-handbooks, datasheets, and tables • The calibration, accuracy and use of measurement- and gauging tools	
	The individual shall be able to: • Organize the workspace for optimal performance • Check the condition and functionality of the workspace, equipment, tools and materials • Interpret and apply quality standards and regulations • Promote and apply health and safety regulations and best practice • Set up and operate CNC lathe safely • Use computer related professional software effectively • Consistently apply mathematical and geometrical principles for the programming processes of CNC Turning • Select and apply appropriate cutting technology for the provided material, equipment and cutting tools • Interpret and apply manufacturer's instructions • How to find appropriate Data in a handbook, tables, or charts	

2	Interpret engineering drawings	10
	The individual needs to know and understand: • ISO E and/or ISO A (European and American) drawing representation • Technical terms and symbols used in drawings and plans • Standards, symbols, and tables • Technical data sheets • Drawing legends	
	The individual shall be able to: • Interpret engineering drawings and follow the specification • Locate and identify dimensions of features • Locate and identify surface finish requirements • Locate and identify geometric specifications • Make 3D mental representations of the parts • Identify the materials that parts are made of • Identify critical sequences (high possibility damage or unsafe practice)	
3	**Process planning**	**10**
	The individual needs to know and understand: • The importance of good planning for reliable machining operation • Successful timing of the selected sequences • Identification of critical sections • How material, tools and machine accessories will react in different cutting processes • How material and clamping-devices will react in the clamping process • Methods of work holding techniques • Methods to avoid crash or collision for the selected sequences • Identification of work piece-features and the appropriate machining- and measuring processes	
	The individual shall be able to: • Imagine solutions using capacities of the workshop-environment and according to the required work (size of batch, complexity) • Identify the features of the work piece and the appropriate machining and measuring processes • Identify and prepare the best work holding method • Identify, prepare, and calibrate the correct measuring tools • Identify and prepare the correct cutting tools • Identify critical sections (high possibility damage or unsafe practice) and think of alternatives • Imagine innovative ways of using the environment to solve technical issues • Check if the solution will be reliable until the end of the process • Weigh each solution and choose the best (consider speed, safety, and price) • Make a final choice and lock the strategy • Plan the operations and sequences (machining strategy) based on specified data • Create awareness actions for critical operations where no alternative is available	

4	Programming	10
	The individual needs to know and understand: • CNC-Programming as the creation of a logical process plan • Different methods and techniques to generate a program (manual, CAM etc.) • CAM system programming and the techniques of tool-modelling and profile drawing • Cutting-effect (temperature, bending, force etc.) on: • Geometric complex constructions in the work piece design • Work holding devices • Tool holding devices • Machine-accessories • Selection the cutting tools for machining the required material and operation • Mathematics (especially trigonometry) • Speeds and feeds for different materials and tools and work holding devices • Choosing a postprocessor • Generating G-Code • Dialoguing with the CNC Lathe • How to use Canned cycles to program work piece features like diameters, steps, threads, bores and grooves (outside and inside)	
	The individual shall be able to: • Select the best methods according to the production type and part specification • Effectively use skill specific software and related hardware • Generate a programme using a CAD/CAM system • Create a CNC Program using the provided drawing and the provided software	
5	Metrology	5
	The individual needs to know and understand: • Chip removal behaviour of provided materials and tools • Temperature behaviour of provided materials and tools and accessories • Effect of cutting force on material, tools, and accessories • Range of tools and gauging instruments and their applications • Understand how temperature may influence the measurements	
	The individual shall be able to: • Select appropriate measuring- or gauging instruments • Calibrate measuring tools • Use selected tools to make measurements on all components on the drawing • The properties, uses, and handling of material	

6	**Setting and operating CNC lathe**	55
	The individual needs to know and understand: • The different steps that lead to the setup of the machine • The different modes of machine operation • Power up sequence • Initializing CNC Lathe • Manipulating CNC Lathe • Mounting tools, setting tool parameters • How to modify clamping device, such as jaws, etc. • How to transfer a CNC program to the CNC lathe, using provided software, cable, memory devices, or wireless technology • How to test a program, simulation, dry run etc. • How to clamp the part, correctly, and safely • How to set the work shift and offset system • How to run the programme safely • Stopping and restarting a cycle • Emergency stopping	
	The individual shall be able to: • Follow his/her selected process-strategy • Upload generated CNC program to the CNC lathe and test run • Identify and designate the different machining processes on the CNC lathe • Mount and align selected tools • Mount and align selected work holding devices • Mount and align selected accessories (Tailstock, Partscatcher, etc.) • Avoid vibration in the machining sequences • Apply burr-removal techniques on the work piece • Optimize the machining strategy • Quickly react if anything goes wrong • Get dimensions, geometries, surface roughness by interacting with the CNC Lathe • Get the final part to conform to the blueprint • Report any health, safety and environment issue to the appropriate personnel • Report equipment failure to the appropriate personnel	
6	**Finalize and deliver work piece**	5
	The individual needs to know and understand: • The procedures and calculations required for scheduling time with software and machinery • The importance of completing the work piece to the required standard within their capabilities • The circumstances in which referral should be made to other appropriate personnel	

	The individual shall be able to: • Make a final check by re-using measurement instruments • Clean the part • Deliver the part, drawing and digital memory devices back to the appropriate location and/or personnel as required by the organization • Dismount tools, clamping, accessories • Clean the machine • Set the environment to its initial state, ready for next job	
	Total	**100**

3 THE ASSESSMENT STRATEGY AND SPECIFICATION

3.1 GENERAL GUIDANCE

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: measurement and judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards Specification. The Test Project is the assessment vehicle for the skill competition, and also follows the Standards Specification. The CIS enables the timely and accurate recording of marks, and has expanding supportive capacity.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed and developed through an iterative process, to ensure that both together optimize their relationship with the Standards Specification and the Assessment Strategy. They will be submitted to WSI for approval together, in order to demonstrate their quality and conformity with the Standards Specification.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors in order to benefit from the capabilities of the CIS.

4 THE MARKING SCHEME

4.1 GENERAL GUIDANCE

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 WorldSkills 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.

By reflecting the weightings in the Standards Specification, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards Specification, if there is no practicable alternative.

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. The exception to this process is for those skill competitions which use an Independent Designer for the development of the Marking Scheme and Test Project. Please see the Rules for further details.

Experts and Independent Designers are required 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. They are also advised to work with the CIS Team at this intermediate stage, in order to take full advantage of the possibilities of the CIS.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition using the CIS standard spreadsheet or other agreed methods.

4.2 ASSESSMENT CRITERIA

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived in conjunction with the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards Specification; in others they may be totally different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme as a whole must reflect the weightings in the Standards Specification.

Assessment Criteria are created by the person(s) developing the Marking Scheme, who are free to define criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I). It is advisable not to specify either the Assessment Criteria, or the allocation of marks, or the assessment methods, within this Technical Description.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria.

The marks allocated to each Criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each Aspect within that Assessment Criterion.

4.3 SUB CRITERIA

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form. Each marking form (Sub Criterion) contains Aspects to be assessed and marked by measurement or judgement, or both measurement and judgement.

Each marking form (Sub Criterion) specified both the day on which it will be marked, and the identity of the marking team.

4.4 ASPECTS

Each Aspect defines, in detail, a single item to be assessed and marked together with the marks, or instructions for how the marks are to be awarded. Aspects are assessed either by measurement or judgement.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it.

The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the skill in the Standards Specification. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1)

		CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE
		A	B	C	D	E	F	G	H			
STANDARDS SPECIFICATION SECTION	1	5.00								5.00	5.00	0.00
	2		2.00					7.50		9.50	10.00	0.50
	3								11.00		10.00	1.00
	4			5.00						5.00	5.00	0.00
	5				10.00	10.00	10.00			30.00	30.00	0.00
	6		8.00	5.00					9.00	24.50	25.00	0.50
	7			10.00				5.00		15.00	15.00	0.00
TOTAL MARKS		5.00	10.00	20.00	10.00	10.00	10.00	15.00	20.00	100.00	100.00	2.00

4.5 ASSESSMENT AND MARKING

There is to be one marking team for each Sub Criterion, whether it is assessed and marked by judgement, measurement, or both. The same marking team must assess and mark all Competitors, in all circumstances. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (See 4.6.)

4.6 ASSESSMENT AND MARKING USING JUDGEMENT

Judgement uses a scale of 0-3. To apply the scale with rigour and consistency, judgement must be conducted using:

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts or separate guidance notes)
- the 0-3 scale to indicate:
    - 0: Not acceptable   (Customer is most unhappy)
    - 1: Bad   (Customer is disappointed)
    - 2: Good   (Customer has only minor complaints)
    - 3: Excellent   (Customer is pleased)

Three Experts will judge each Aspect, with a fourth to coordinate the marking and acting as a judge to prevent compatriot marking.

4.7 ASSESSMENT AND MARKING USING MEASUREMENT

Three Experts will be used to assess each aspect. Unless otherwise stated only the maximum mark or zero will be awarded. Where they are used, the benchmarks for awarding partial marks will be clearly defined within the Aspect.

4.8 THE USE OF MEASUREMENT AND JUDGEMENT

Decisions regarding the selection of criteria and assessment methods will be made during the design of the competition through the Marking Scheme and Test Project.

4.9 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

A) Conformity to drawing   10% of the total score

    a) all features optically finished

    and optically on the right place

    and optically without damage (clamp marks, scratches, crash marks etc.)

    and no unwanted feature on the part

    b) Product is free of burrs and free of chips (cleaned)

B) Surface finish   10% of the total score

C) Main dimensions   50% of the total score

D) Secondary dimensions   25% of the total score

E) Use of material   5% of the total score

    a) Award marks only if no additional material is used by the Competitor

4.10 SKILL ASSESSMENT PROCEDURES

- The Experts participating in the Competition will be divided into marking groups to deal with the assigned sections of the marking criteria;
- Marking of the Test Project modules will take place on a daily basis;
- ONLY the machined test part will be evaluated.

5 THE TEST PROJECT

5.1 GENERAL NOTES

Sections 3 and 4 govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the skills in each section of the WSSS.

The purpose of the Test Project is to provide full, balanced and authentic opportunities for assessment and marking across the Standards Specification, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme and Standards Specification will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards Specification, or affect the balance of marks within the Standards Specification other than in the circumstances indicated by Section 2.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work.

The Test Project will not assess knowledge of WorldSkills rules and regulations.

This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards Specification. Section 2.1 refers.

5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The Test Project is a series of three standalone modules.

The modules are comprised of programming, set-up, and actual machining work.

One module covers the tasks for a complete Competition day and shall not be interrupted with work from other modules (in other words, the Competitor receives one task at a time).

The floor-space and the CNC machine requirements are so intensive, that it is impossible to get a working situation where Competitors have a CNC machine totally at their disposal.

Therefore, the shift rotation basis will apply, meaning Competitors have to share the CNC machine in a shift rotation (morning shift/afternoon shift). This reflects common industry situations.

Sequences example:
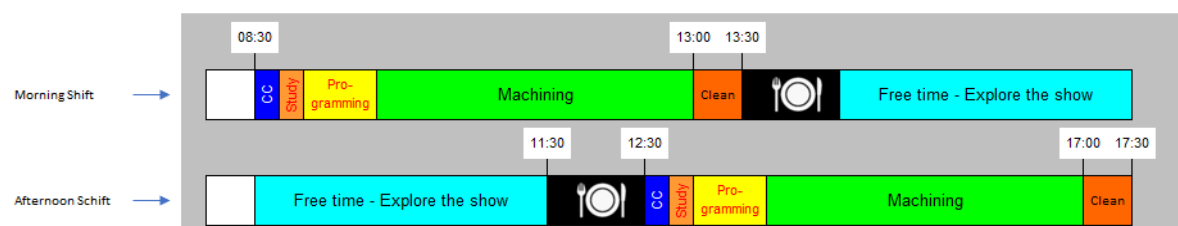
Considering that one hour of CAM programming can lead to approximately three hours of uninterrupted machining (set-up and turnaround included), it is desired to keep the scheduled machining time at the maximum.

It is important to have the reset-time between shift changes. During this reset-time the control-unit will be cleared, machine parameters will be reset to original stage and tools and tool holders will be taken out. The machine will be cleaned by the Competitor and made ready for the next shift to start their Test Project.

The Sequence of a module will be (example morning shift):

1:	8:30	Competitor Communication (Without Test Project)
		Includes overview of project with designer (Experts and Interpreters present)
2:	8:45	Competitors receives drawings and materials (including data transfer equipment e.g. memory stick) and has 15 minutes for planning their work (without any other person).
3:	9:00	Buzzer will indicate the beginning of the programming time.
		Competitor is only allowed to use the provided computer for writing the CNC programme, no action at the machine is allowed.
4:	9:45	Buzzer will indicate beginning of the machining time.
		At this point the Competitor is allowed to use both, the computer and the CNC machine.
5:	13:00	Buzzer will indicate the finishing of the module.
		The reason that during the programming time (CAM, indicated above in yellow) the Competitor is only allowed to use the computer and not the machine, is the shift rotation system. (equal Situation for both shifts)

5.3 TEST PROJECT DESIGN REQUIREMENTS

Prior to the Competition the WorldSkills Secretariat will choose an Independent Designer in consultation with the Skill Competition Manager.

The Document "Project Design Criteria Skill 06" describes a variety of material, sizes and desired features. The Skill Competition Manager must coordinate and ensure that all features are included in the Test Project.

Such a Test Project is one complete module. One module is the work of a full competition day.

The modules must be designed in metric and to the standards described in the document "Project Design Criteria Skill 06".

The Test Project design criteria are developed to:

- Ensure features on modules reflect modern industry;
- Minimize the amount of cutting tools for the Competitor to bring;
- Minimize the amount of inspection tools for the Competitor to bring.
- Project design must meet criteria of document "Project Design Criteria Skill 06";
- The Drawings of the Test Projects shall have as little Text as possible. In the project design the focus is on "technical language" only, like dimensions and international symbols, there shall be no need for translation
- The designer must bring a machined sample part of the design. This is needed to programme the CMM (Coordinate Measuring Machine).
- The designer includes the proposed marking scheme for each module.

5.4 TEST PROJECT DEVELOPMENT

The Test Project is created by an Independent Designer and is kept confidential until the start of the particular module. The drawings will be using the templates provided by WorldSkills International (www.worldskills.org/expertcentre). Use the Word template for text documents and DWG template for drawings.

5.4.1 Who develops the Test Project or modules

The Test Project modules are developed by an Independent Designer.

5.4.2   How and where is the Test Project or modules developed

The Test Project modules are developed by an Independent Designer.

5.4.3   When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
Ten (10) months before the Competition	A WorldSkills International Member or Experts from this skill identify and investigate possible Independent Designer which are capable of and willing to develop the Test Project.
Nine (9) months prior to the Competition	The Director of Skills Competitions enters into an Agreement with the Independent Designer.
Eight (8) months before the Competition	Initial meeting with Independent Designer
Seven (7) months before the Competition	Second meeting with Independent Designer. After this, no Expert is allowed to communicate directly with Independent Designer. The Independent Designer starts to develop TP in accordance with the TD and IL.
Three (3) months before the Competition	The Independent Designer completes the design of the Test Project and Marking Scheme and prepares the documentation in English.
At the Competition	Have the designer at all times at the skill competition. They shall be available at all times and be a coordinated between Skill Management Team and the Skill Advisor.

5.5   TEST PROJECT VALIDATION

The Independent Designer shall bring machined sample parts of their design for each day.

5.6   TEST PROJECT SELECTION

The Test Project is selected by the Independent Designer

5.7   TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The Test Project is not circulated.

5.8   TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

Coordination of the Test Project will be undertaken by the Skill Competition Manager.

5.9 **TEST PROJECT CHANGE AT THE COMPETITION**

Not applicable.

5.10 **MATERIAL OR MANUFACTURER SPECIFICATIONS**

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from www.worldskills.org/infrastructure located in the Expert Centre.

The Competition Organizer is to provide the technical specifications of the provided equipment on the Infrastructure List at least eight months before the Competition.

Free training on machine and software, where possible, must be provided at least four months prior to the Competition. Travel, lodging, and food expenses for this training are to be carried by the Competitors or their sponsor.

The Competition Organizer is obligated to schedule this training at least four months before the Competition and notify the participants at least six months before the Competition.

Participating in the provided training is the choice of the Competitors and/or their sponsor.

The sponsors 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 the marking of the Test Projects.

6 SKILL MANAGEMENT AND COMMUNICATION

6.1 DISCUSSION FORUM

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the skill specific Discussion Forum (http://forums.worldskills.org). Skill related decisions and communication are only valid if they take place on the forum. The Skill Competition Manager (or an Expert nominated by the Skill Competition Manager) will be the moderator for this Forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

6.2 COMPETITOR INFORMATION

All information for registered Competitors is available from the Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Marking Schemes
- Test Projects
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

6.3 TEST PROJECTS [AND MARKING SCHEMES]

Circulated Test Projects will be available from www.worldskills.org/testprojects and the Competitor Centre (www.worldskills.org/competitorcentre).

6.4 DAY-TO-DAY MANAGEMENT

The day-to-day management of the skill during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and Deputy Chief Expert. The Skill Management Plan is progressively developed in the eight months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations.

- Hearing protection is to be provided, but it is optional for both Competitors and Experts;
- Long pants and long sleeves are not a requirement in this skill;
- Jewellery, long hair, and the Accreditation Badge are a safety hazard and shall be taken off or covered;
- All other requirements are referred to the WorldSkills Health, Safety, and Environment policy and guidelines document.

8 MATERIALS AND EQUIPMENT

8.1 INFRASTRUCTURE LIST

The Infrastructure List details all equipment, materials and facilities provided by the Competition Organizer.

The Infrastructure List is available at www.worldskills.org/infrastructure.

The Infrastructure List specifies the items and quantities requested by the Skill Competition Manager on behalf of the Experts for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Items supplied by the Competition Organizer are shown in a separate column.

At each Competition, the Skill Competition Manager must review, audit, and update the Infrastructure List in partnership with the Technical Observer in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions of any requests for increases in space and/or equipment.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

8.2 COMPETITOR'S TOOLBOX

Competitor's toolboxes and shipping crate volume must comply with the following guidelines:

- Other than forbidden tools, the limitation of tools to bring is also dictated by "Shipping Crate Volume";
- The total volume of the shipping crate (or crates) including pallet may not be larger than 2.8 m³;
- Everything a Competitor brings, must fit in the shipping volume. (See sketch 1)
- Note: it is the TOTAL volume, if you bring two or more crates, the TOTAL volume will be calculated.
- The dimension will be taken on the OUTSIDE of the shipping crates, including the pallet;
- In the case of shipping toolboxes like in sketch 2, an imaginary box will be applied, like indicated in the sketch;
- The CE will assign Expert Teams to measure each crate size upon delivery of toolboxes;
- If Competitors bring more than the allowed volume, he/she (not the Expert, or translator, or any other 'helper') will have to use familiarization time, to reduce the tools to the allowed volume;
- The assigned Expert team will oversee this process until an agreement is found.

Sketch 1   Sketch 2
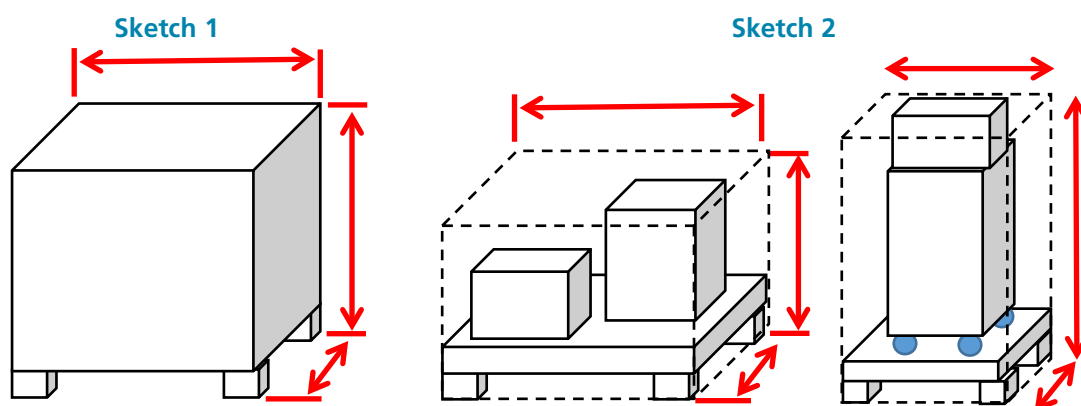
8.3 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

- To allow for innovation and learning from each other, the Competitor has no restrictions in bringing any equipment or accessories, as long as it conforms to the provided equipment and WSI-duplication rules. Of course, it must be within reasonable limits, for example, Competitors shall not bring their Tailstock or a Control-unit. In any debatable case the Skill Competition Manager shall make the final decision;
- Competitors must bring their own tooling, cutting tools, and measurement Instruments) to the Competition. The Competition Organizer will not be providing these infrastructure items for the Competitors, the items described and available in Infrastructure List are only spares.
- The Competitors must supply their own cutting tools; these must be compatible with the clamping system of the machine (Specifications of the machine to be supplied are to be considered – example tool shank metric/standard.)
- The Competitors are allowed to bring additional tools in relation to the list described in TD (be aware of the maximum diameter permitted by the machine tool manufacturer).
- The quantities and type of cutting tools to bring is a decision of participating country/region or Competitor only. (The IL is a good source of inspiration.)

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Not applicable.

8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

- Tools and holders that allow for pre-programmed offsets are NOT allowed;
- Any device that clearly reflects prior knowledge of the Test Project will be confiscated. This could be for example a special sleeve that was manufactured specifically for the Test Project;
- See Section 9 Skill-Specific Rules for further information

8.6 **PROPOSED WORKSHOP AND WORKSTATION LAYOUTS**

Workshop layouts from previous competitions are available at www.worldskills.org/sitelayout.

Example workshop layout:

The general layout of the workshop will be as above with sufficient space for the workstation, toolboxes, and for the Competitor's working area.

Please note that the following is an example of the layout and is not definitive.

Approx. space for 24 Competitors = 1670m²

Space requirements for 24 Competitors (subject to space availability) include:

- For two Competitors, one machine, one workbench, and two programming stations: 6m x 8m = 48m²;
- Number of machines: Number of Competitors divided by two PLUS one
- Expert Room: approx. 5m x 6m = 30m²
- Competitor briefing Room: approx. 9m x 8m = 72m²
  This room is needed to brief the 2nd shift Competitors on the Test module, while the 1shift Competitors are still working on the shared workplaces!
- Sponsor Room: approx. 6m x 6m = 36m²
- Workshop Manager Room: approx. 7m x 6m = 42m²
- SMT Room: approx. 6m x 6m = 36m²
- Space for inspection Area = approx. 120m²
- Space for Expert Work-group: (Tables and chair) + Competitor Project Study are = approx. 200m²;
- Space for PR and the CNC Team Challenge = approx. 100m²
- Add in some space for columns as well as Competitors toolboxes;
- Add in min. of 1m clearance around the visitor-barrier;

Based on 24 Competitors, 24 Experts, Workshop Managers, Equipment technicians, and some Interpreters, the space would be approx. 1670m² for the Competition.

9 SKILL-SPECIFIC RULES

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, internet access, procedures and work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – digital memory devices (such as memory stick, CD or DVD Rom, media players etc.)	• Competitors are only allowed to use digital memory devices provided by the Competition Organizer. No other memory devices are to be inserted into the Competitor computers or machines. • All digital memory devices are to be submitted to the Chief Expert at the end of each module (day) for safe keeping and must not be taken out of the workshop. • Note: The Competition Organizer may use specific software to check that the previous rules are strictly followed.
Use of technology – personal laptops, tablets and mobile phones	• Competitors are not allowed to bring personal laptops, tablets or mobile phones into the workshop. In the event that Competitors do bring these to the competition they shall be locked in the personal locker and shall not be taken to the workstation. • Experts and interpreters are allowed to use personal laptops, tablets and mobile phones in assigned areas only.
Use of technology – personal photo and video taking devices	• Competitors, Experts, and Interpreters are allowed to use personal photo and video taking devices in the workshop. Restrictions may be set by the Skill Management Team in situations where sensitive information is in the area.
Equipment failure	• If equipment or tools which are brought by the Competitor fail, no extra time will be allowed. • If equipment or tools supplied by the Competition Organizer fail extra time may be allowed only if the Technician of the sponsor or supplying company specifies and proves it is not a "user error", but truly an equipment failure without the fault of the user. (example: Power outage … this is in most cases NOT the fault of the user)
Health, Safety, and Environment	• Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.

10 VISITOR AND MEDIA ENGAGEMENT

The following list provides examples of how this skill may be more attractive for the media and visitors:

- Organize an area that has local instructor, apprentice or industry explaining the CNC turning machinist role in industry, local opportunities for training, career details etc.
- Display screens (video of CNC Turning Machining);
- Display a complete Test Project (description, parts and drawings) from past Competitions
- Display Competitor profiles - national flag, name of Competitor and a brief description of their studies;
- A display of industry parts, measuring tools, drawings, MasterCam running on a laptop. The CNC machine supplier could bring sample parts which they use at trade shows.
- The Try-a-Skill (where audience gets to try a hands-on an activity that reflects CNC Machining) option is a valuable way to draw interest, sample keychains where they programme their name and it becomes a take away.
- Competitions should try to capitalize on the visitor experience, in addition to running the competition, plan the media engagement in the process. (spare machine, volunteers in this trade to help engage audience), software running, sample parts, exposure of CMM measuring activity so audience see's the technology applied to trade.

10.1 POSSIBLE TEXT FOR MEDIA AND MARKETING

CNC Turning is a branch of engineering. Engineers have to find mechanical solutions that make complex designs possible.

There are many different single parts in things that you see or use on a daily basis. Just like in cars, Smartphones, aircraft, Aero-Space, and so on; the possibilities are endless. For example, there are about 10,000 parts in just one car. Engineers create assemblies of many parts, and using a variety of different materials.

But who will build these parts? The CNC Machinist…. we have to decide the best way to produce each part.

With a CNC Lathe we can build very complex parts. Computer-controlled tools are moved to cut away excessive material and shape the material to the form we want.

You, as the machinist receive the blueprint and must then develop a strategy to build the desired part. Which tools to use? Which clamping method without destroying the part? What sequence to develop? Are there alternatives? Faster, better or cheaper ways? Can you produce the desired Quality, in the desired time, to the desired price ... with the method's you developed?

These machines are very expensive, because they can do remarkable things. To have an idea of this, think what it means to achieve accuracy below ten microns, which is six times thinner than a human hair.

The CNC Turning Machinist has to use a computer to tell the Lathe how to move the tools and cut the part. He/she also has to set up the Lathe with all the cutting tools. These tools can cut almost every material (stainless steel, plastic, soft steel, aluminium, bronze and so on) but we have to choose well. There are more bad solutions as good solutions.

When the machine starts cutting material, the Machinist makes sure that the dimensions exactly fit the blueprint specifications. For this, very accurate inspection tools are used. A smart Machinist will get the part to fit the specifications at the first attempt, which not only gives you good quality, but a better price.

Have you finished the part? Quality control ok? Now send it to the assembly line, where in the end all parts must fit together.

And in the end, if everyone has done their job well, the finished assembly will meet expectations and the car can drive, the plane can fly and the rocket can fly into space.

11 SUSTAINABILITY

This skill competition will focus on the sustainable practices below:

- Recycling;
- Use of 'green' materials;
- Use of completed Test Projects after Competition;
- Use of digital information instead of paper.

12 REFERENCES FOR INDUSTRY CONSULTATION

WorldSkills is committed to ensuring that the WorldSkills Standards Specifications fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Standards Specification on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (http://www.ilo.org/public/english/bureau/stat/isco/isco08/)
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.onetonline.org/)

This WSSS (Section 2) appears most closely to relate to "lathe and turning machine tool setters, operators, and tenders, metal and plastic": https://www.onetonline.org/link/summary/51-4034.00, and/or "lathe and turning machine operator": http://data.europa.eu/esco/occupation/63042e8f-dd59-47fe-87f3-3b2ce21f196a

Adjacent occupations can also be explored through these links.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Standards Specification in place for WorldSkills Kazan 2019.

ORGANIZATION	CONTACT NAME
DMG MORI (RUSSIA)	Ilya Tonkikh, Academy Manager in DMG MORI Russia
DMG MORI SINGAPORE PTE LTD	Kevin Goh, Technical Director
Siemens AG	Karsten Schwartz, Head of CNC-Trainingscenter Erlangen