

Technical Description

CNC-Milling



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1 Introduction

1.1 Name and description of the skill competition

1.1.1 The name of the skill competition is

CNC Milling

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

Computer Numerical Control (CNC) technology has become omnipresent. Most people cannot imagine how important these technologies are in their lives. There is nothing that we use that hasn't in its manufacturing utilized CNC technology. It is present in products and objects of everyday life, such as cars, airplanes, components of machines of all types, moulds for tools used for household machines, medical prosthetics, cell phones, and toys.

CNC milling machines are machine tools used for the shaping of metal and other solid materials. These machines exist in two basic forms: horizontal and vertical. This refers to the orientation of the cutting tool spindle. Early milling machines were manually or mechanically automated, but technological advances have led to the development of Computer Numerical Control, such as the CNC machining centre. CNC refers to a computer-controlled device to read and store instructions. This numerical information, generally "G and M" codes (a programming language) is then used to control and drive a machine tool which is a powered mechanical device ("machining centre"). A machining centre is used to fabricate components using cutting tools for removing the 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 highly skilled CNC milling machinist must read and interpret complex technical drawings and specifications, and work to a high degree of precision and detail. They must be proficient in metal work and understand how metals react to various processes. They must be a skilled computer operator and machine operator. The programs can be generated manually or using Computer Aided Design/Computer Aided Manufacture (CAD/CAM) software.

To achieve the finished part, the CNC milling machinist undertakes a sequence of essential activities, from interpreting engineering drawings to optimizing the machining process:

- Interpreting engineering drawings and following the specifications
- Generating the processes and programs with the CAD/CAM system and/or G and M-codes
- Setting up the tools, work holding devices, and work pieces on the CNC milling centre
- Manipulating cutting conditions, based on the properties of the material and tools
- Operating, inspecting, and maintaining the accuracy of dimensions within the specified tolerances
- Optimizing the process, taking into account the production type: whether large quantities of one part, small batches, or one-of-a-kind items.

Today a wide range of industries require CNC milling machinists to program, 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 environments in which the CNC milling machinist plays a key, integral role to the success of the metalwork industries.

1.2 The content, relevance and significance of this document

This document incorporates a Role Description and Occupational Standards which follow the principles and some or all of the content of the WorldSkills Occupational Standards. In doing so

WSE acknowledges WorldSkills International's (WSI's) copyright. WSE also acknowledges WSI's intellectual property rights regarding 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.

1.3 Associated documents

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

- WSE – Competition Rules
- WSI – WorldSkills Occupational Standard framework
- WSE – WorldSkills Europe Assessment Strategy
- WSE – Online resources as referenced in this document
- WSE – Code of Ethics and Conduct
- Host Country – Health and Safety regulations

2 The Occupational Standards

2.1 General notes regarding WSOS / WSEOS

Where appropriate WSE has utilised some, or all, of the WorldSkills International Occupational Standards (WSOS) for those Skills Competitions that naturally align between the two international competitions. Where the Skill is exclusive to the EuroSkills Competition, WorldSkills Europe has developed its own Occupational Standards (WSEOS) using the same principles and framework to that used for the development of the WSOS. For the purposes of this document the use of the words “Occupational Standards” will refer to both WSOS and WSEOS.

The Occupational Standards 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. Helpfully, for the global consultation on the WSOS in 2014-2021, around 50 percent of responses came from European industry and business.

Each Skill Competition is intended to reflect international best practice as described by the Occupational Standards, and to the extent that it is able to. The Occupational Standards 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 not be separate tests of knowledge and understanding.

The Occupational Standards are 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 Occupational Standards. 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 Occupational Standards. They will reflect the Occupational Standards 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 Occupational Standards to the extent practically possible. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Occupational Standards.

2.2 Occupational Standards

Section		Relative importance (%)
1	Work organization and self-management	10
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The extent and impact of CNC-milling on modern life and industry • Quality standards for materials and quality of metals • Standards for the environment, safety, hygiene, and prevention of accidents at work • Computer operating systems 	

Section		Relative importance (%)
	<ul style="list-style-type: none"> • Mathematics, especially accurate and detailed calculations, and trigonometry • Properties of materials, especially steel and aluminum • Principles of technical design and process planning • CNC equipment technology (Vertical and Horizontal Machining Centre) • Programming by hand or CAM system software • Cutting technology according to the parameters, material, equipment and cutting tools • Health and safety regulations, legislation, and best practice • The importance of adhering to manufacturers' operating instructions • Ways to ensure the maintenance of sophisticated milling machines to promote efficient and reliable working • The importance of effective communications and teamwork • The importance of effective working methods with other professionals related to the CNC milling process 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Use computer related professional software • Interpret and apply quality standards and regulations • Promote and apply health and safety regulations and best practice • Use IT and related professional software • Apply mathematical and geometrical principles accurately for the preparation and programming processes for CNC milling • Develop creative solutions to complex design or technology challenges 	
2	Communication and interpersonal skills	10
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • ISO 1 and/or ISO 3 (European and American) drawing representation • Technical terms and symbols used in drawings and plans • Standards, standards symbol, and tables • Technical drawing legends 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Interpret and apply engineering drawings and follow specifications • Locate and identify main dimensions and secondary dimensions • Locate and identify ISO standards for surface finishes Locate and identify ISO standards for geometrical form and positional tolerances • Locate and identify ISO standards for geometrical form and positional tolerances 	

Section		Relative importance (%)
3	Process planning	15
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The importance of good planning for the successful execution of programming and operation/machining • How to plan, based on the type of operation and the sequence (machining strategy) of the data that must be specified • Types of machining tools used in CNC technology including lathes, multi-axis spindles, wire electrical discharge machines, and milling machines • Methods of work holding according to the shape of the base material 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Identify and set the different machining features • Identify the most efficient work holding solution to clamp the base material into the machine • Select the right cutting tools for machining • Define the cutting parameters as a function of the operation sequence, material type, and type of operation 	
4	Programming	20
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • Programming as the creation of a logical process plan • Different methods and techniques to generate the programs (CAM/CAD or manual) • CAM system programming • Skill related software 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Select the best methods according to the production type and part specification • Use skill specific software and related hardware • Generate programs by using the CAD/CAM system with the format of the initial data • Start with drawings in paper format to create the geometry in wireframe and/or surface and/or solid 	
5	Metrology	10
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The ranges of tools and gauging instruments and their applications • Main measuring techniques 	

Section		Relative importance (%)
	The individual shall be able to: <ul style="list-style-type: none"> • Select and use appropriate measuring tools and instruments • Make measurements on threaded elements 	
6	Operating	15
	The individual needs to know and understand: <ul style="list-style-type: none"> • The different steps that lead to setup machines • The different modes of machine operation 	
	The individual shall be able to: <ul style="list-style-type: none"> • Prepare measurements and cutting tools • Identify and design the functional parameters for operation on the CNC milling machine 	
7	Machining	20
	The individual needs to know and understand: <ul style="list-style-type: none"> • The different types of machine features • The machining sequence 	
	The individual shall be able to: <ul style="list-style-type: none"> • Identify and designate the different machining processes on a CNC milling machine • Optimize the machining strategy • Define and adjust the cutting parameters as a function of the operation sequence, material type, type of operation, and CNC machine tool • Start the cutting process from the raw material • Solid block • Perform the following machining operations: <ul style="list-style-type: none"> • Facing • Roughing and finishing • External contours • Island milling • Milling channels • Pocket (figurative) • Pocket (circular and rectangular) • Taper ribs • Thread milling • Internal <ul style="list-style-type: none"> • External • Canned cycles • Through hole boring • Blind hole boring • Reaming • Tapping 	

Section		Relative importance (%)
	<ul style="list-style-type: none"> • Drilling • 3D machining operations • Roughing • Finishing 	
	Total	100

3 The assessment approach & principles

3.1 General guidance

Note: this Section and Section 4 summarize a great deal of new information and guidance regarding assessment. Please refer to the Competition Rules for greater detail.

The Competition Committee (CC) establishes the principles and techniques to which assessment at the EuroSkills Competition must conform.

Expert assessment practice lies at the heart of the EuroSkills 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 EuroSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the EuroSkills Competition falls into two broad types: measurement and judgement. All assessments will be governed by explicit benchmarks, referenced to best practice in industry and business.

The Marking Scheme must include these benchmarks and follow the weightings within the Occupational Standards. The Test Project is the assessment vehicle for the Skill Competition, and also follows the Occupational Standards. 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 Technical Description and the principles for assessment as set out in the WSE Assessment Strategy. They will be agreed by the Experts and submitted to WSE for approval together, in order to demonstrate their quality and conformity with the Occupational Standards.

Prior to submission for approval to WSE, the Marking Scheme and Test Project will be reviewed by the WSE 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 standard that represents each skill competition, which itself represents a global occupation. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards.

By reflecting the weightings in the Standards, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill competition 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, if there is no practicable alternative.

For integrity and fairness, the Marking Scheme and Test Project are increasingly designed and developed by one or more Independent Test Project Designer(s) with relevant expertise. In these instances, the Marking Scheme and Test Project are unseen by Experts until immediately before the start of the skill competition, or competition module. Where the detailed and final Marking Scheme and Test Project are designed by Experts, they must be approved by the whole Expert group prior to submission for independent validation and quality assurance. Please see the Competition Rules for further details.

Experts and Independent Test Project Designers are required to submit their Marking Schemes and Test Projects for review, verification, and validation well in advance of completion. They are also expected to work with their Skill Advisor, reviewers, and verifiers, throughout the design and development process, for quality assurance and in order to take full advantage of the CIS's features.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition. Skill Advisors actively facilitate this process.

4.2 Assessment criteria

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived before, or in conjunction with, the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards; in others they may be 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.

Assessment Criteria are created by the person or people developing the Marking Scheme, who are free to define the 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). **The Assessment Criteria, the allocation of marks, and the assessment methods, should not be set out within this Technical Description. This is because the Criteria, allocation of marks, and assessment**

methods all depend on the nature of the Marking Scheme and Test Project, which is decided after this Technical Description is published.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria and Sub 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) specifies 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, and detailed descriptors or instructions as a guide to marking. Each Aspect is assessed either by Measurement or by 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 Standards. 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 refers.)

	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	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				2.50	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. Where this is impracticable (for example where an action must be done by every Competitor simultaneously, and must be observed doing so), a second tier of assessment and marking will be put in place, with the approval of the Competitions Committee Management Team. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (Section 4.6 refers.)

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). This is documented in the Standards and Assessment Guide.
- the 0-3 scale to indicate:
 - 0: performance below industry standard
 - 1: performance meets industry standard
 - 2: performance meets and, in specific respects, exceeds industry standard
 - 3: performance wholly exceeds industry standard and is judged as excellent

Three Experts will judge each Aspect, normally simultaneously, and record their scores. A fourth Expert coordinates and supervises the scoring, and checks their validity. They also act as a judge when required to prevent compatriot marking.

4.7 Assessment and marking using measurement

Normally three Experts will be used to assess each Aspect, with a fourth Expert supervising. In some circumstances the team may organize itself as two pairs, for dual marking. 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. To avoid errors in calculation or transmission, the CIS provides a large number of automated calculation options, the use of which is mandated.

4.8 Assessment overview

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

4.9 Skill Assessment Strategy

Module 1 = 30, Module 2 = 35, Module 3 = 35

- A – Main dimensions
- Dimensions range from 0,02 to 0,04, IT₇ ≥ 7; 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

- Dimensions with general tolerance should be +/-0.04mm oriented of the nominal size
- e.g. 73.8 mm should be in between 73.76 mm and 73.84 mm
- Depth of thread: 0/+2mm; e.g. Depth size 16 should be 16.00 to 18.00 mm
- Depth of bore: 0/+0,5mm; e.g. Depth size 22 should be 22.00 to 22.50 mm
- Radius: +/- 0,2; e.g. R12 should be R 11.8 to 12.2 mm
- Angle: +/-0,5° e.g. 30° should be 29.5° to 30.5°
- C – Surface quality
- Surface quality = Ra 0.8 to Ra 3.2

D – Judgment

- Judgment aspects are described in Experts Pocket Guide, that is shared on the Discussion Forum. In this guideline the independent Test Project Developer can choose 11 aspects depending on the modules. The total mark for judgment is 10 marks. As per module minimum of aspects must be 6. As per module maximum aspects can be 9.
- Expert Pocket Guide in the appendix page.

E – No additional material used

- The use of extra material may occur and is assessed in the following way according to objective criteria: candidates who use no extra material get the full points; candidates who use extra material are penalized and get points 0 (zero) points.

4.9.1 Assessment Strategy

After the time is over the competitors bring the parts for marking, after marking start the Experts with the Judgement (Aspect D) comes first.

After Judgement is finished the technician from the CMM are measuring the parts on the CMM (Aspect A and B)

Next the Experts are measuring the Surface (Aspect C) and checking and fill in the form if there was any additional material used (Aspect E)

4.10 Skill Assessment Procedures - Mark distribution

This section defines the assessment criteria and the number of marks (judgement and measurement) awarded. The total number of marks for all assessment criteria must be 100. The table below is advisory only for the development of the Test Project and Marking Scheme.

Assessment and marking are an intense process that depends upon skillful leadership, management, and scrutiny.

The definitive Judgement and Measurement Marking Forms are finalized by the Independent Test Project Developer.

Makeup of the marking groups and use of data;

Measurement Marking - A, B, C, and E;

Coordinate measuring machine – CMM, measurement marking - A and B;

Judgement Marking - D

Three Experts for the evaluation

One spare Expert and minute keeping

For Judgement Marking the Experts are divided into three working groups.

Formation of Expert groups: The groups shall be nominated by the Chief Expert and the Deputy Chief Expert. The group must be a mix of experienced senior Experts and Experts who are new in their functions.

Each group is responsible for the complete assessment of one module realized by all Competitors.

CMM teamwork in the workshop;

A-Main dimensions +/- 0.003 mm tolerance compensation

Assessment/Marking

Three Experts shall be assigned to assess each aspect of Judgement, whether or not attempted. Each Expert shall award a score between 0 and 3 displayed on flash cards based on the given benchmarks. To do this correctly, each Expert shall first assess the work by himself by comparing the Competitor's performance with these benchmarks and prepare the flashcard hidden. After, they display their scores at the same time as directed by the assessment team leader who is appointed by the Chief Expert.

Example:

Section	Criterion	Marks		
		Judgement	Measurement	Total
A	Assembly, programming and commissioning of a Station (Task A1) and Maintenance and troubleshooting (Task A2)	7	26	33
B	Assembly, programming and commissioning of a production line (Task B)	7,5	26,5	34
C	Optimizing of a production line (Task C1) Maintenance and troubleshooting in a production line (Task C2)	5	28	33
	Total =	19,5	80,5	100

This mark distribution is given as an example only and doesn't match the evaluation sheets provided for each task.

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 Occupational Standards.

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

The Test Project will not cover areas outside the Occupational Standards, or affect the balance of marks within the Occupational Standards other than in the circumstances indicated by Section 2.1.

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 the EuroSkills Competition's 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 Standard Specification. Section 2.1 refers.

5.2 Format/ structure of the Test Project

- Series of standalone modules

5.3 Test Project design requirements

Details of module one:

Item	Description
Material	Aluminium AlMgSi1 Nr. 3.2315
Dimensions	<ul style="list-style-type: none"> • Max. Raw Size (150 mm x 100 mm x 50 mm) • Min. finished Part Size (50 mm x 50 mm x 30 mm)
Time allowed	5,15 hours – 2 hours programming / 15 min Tool Preparation / 3 hours machining
Work on 3+2 movements are allowed	2D finished Drawing with a 3D shaded view (paper), must be accessible with suggested 2 tool holders
Customer Change	<ul style="list-style-type: none"> • Customer changes should come with a new 2D drawing • The following changes can be made after the elapsed time (change after one hour) • Example: Features can be changed to cut more material away

Item	Description
	<ul style="list-style-type: none"> • Additional Features machined into the original design
Machining Process:	<ul style="list-style-type: none"> • The following machining methods must be included in the module: • Channel milling, figuration pocket, gudgeon, outside contour, hollow-out bore, Reamed drilling hole, internal thread milling (M30 x 1.5), • The following features may be included in the module: • Circular pocket, rectangular pocket, drilling sample, thread drillings
Additional Information	<ul style="list-style-type: none"> • The total aspects for: • Criterion A: 20-23 • Criterion B 17-20 • Criterion C 4-6 must be possible to check with surface tester similar to: Mitutoyo 178-954-3A

Details of module two:

ITEM	DESCRIPTION
Material	Steel CK 45 Nr. 1.1191
Dimensions	<ul style="list-style-type: none"> • Max. Raw Size (150 mm x 100 mm x 50 mm) • Min. finished Parts Size (60 mm x 40 mm x 30 mm)
Time allowed	5,75 hours – 1,5 hours programming / 15 min Tool Preparation / 4 hours machining
Work on 3+2 movements are allowed	3D step module (CAD) with 2D finished drawing (paper)
Production Run	<ul style="list-style-type: none"> • the competitors programming a part milling and measuring the part and optimize the program, must be integrated in the marking scheme". After, they are milling several identical parts. The adjustment part is not measured. The other 2-3 parts are evaluated. • How many parts to manufacturing decide the external designer, but not more than 6 parts are allowed. Max. 3 to measure, this must be integrated in the marking scheme.
Machining Process	<ul style="list-style-type: none"> • The following features must be included: • Milling channels, figurative pocket, external contour, through hole boring, nose, circular pocket, reaming, • The following features may be included (optional): • Rectangular pocket, drilling sample, island milling, tapping

Additional Information	<ul style="list-style-type: none"> • The modules can be made as an assembly with fit limit. The designer can decide if modules will fit together • The total aspects for: <ul style="list-style-type: none"> • Criterion A: max 10 per part • Criterion B max 10 per part • Criterion C max. 4 - 5 per part must be possible to check with surface tester similar to: Mitutoyo 178-954-3A
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Details of module three:

ITEM	DESCRIPTION
Material	Aluminium AlMgSi1 Nr. 3.2315
Dimensions	<ul style="list-style-type: none"> • Max. Raw Size (150 mm x 100 mm x 50 mm) • Min. finished Part Size (50 mm x 50 mm x 30 mm)
Time allowed	4,75 hours – 1,5 hours programming / 15 min Tool Preparation / 3 hours machining
Work on 3+2 movements are allowed	3D step module (CAD) with 2D finished drawing (paper)
Machining Process	<ul style="list-style-type: none"> • The following machining methods must be included in the module: <ul style="list-style-type: none"> • Milling channels, external contours, hollow-out bore, thread drillings and nose • The following machining methods may be included in the module: <ul style="list-style-type: none"> • Round pocket, rectangular pocket, drilling sample, internal contour, milling external thread
Additional Information	<ul style="list-style-type: none"> • The total aspects for: <ul style="list-style-type: none"> • Criterion A: 18-22 • Criterion B 16-20 • Criterion C 4-6 must be possible to check with surface tester similar to: Mitutoyo 178-954-3A

Additional details for the modules

- The following additional details must be included in the module: machine chamfers 0.2 mm to 0.3 mm x 45 degrees;
- Every module must have a minimum of four geometric dimensioning tolerances criteria;
- It must be possible to complete the modules with the machining tools detailed in this Technical Description;
- It must be possible to check the modules with the measuring equipment and checking devices described in this Technical Description;
- Measurements of work pieces is performed on a coordinate measuring machine (CMM);
- The Competition Organizer will nominate a technician who is responsible for operating the coordinate measuring machine;

- The depth of the drilled or reamed hole will not be measured. The depth of the thread milling and tapped holes must be measured;
- For M6 and M10, core hole diameter 5.0 mm, 8.5 mm and the depth will not be measured;
- Tenons are not allowed under the machine vice.
- The Competition Organizer will try and supply the raw material + 0.15 mm/- 0;
- Competitors can use CAM software during the machining and tool preparation time.
- It must be possible to complete the modules with the machining tools and tool holders detailed in this technical Description

Tolerances

- The following tolerances apply to the Modules:
- Main dimensions: range from 0.02 mm to 0.04 mm, IT \geq 7;
- Reamed bores IT7;
- Hollow out bores IT7;
- Surface quality N6 to N8/average = Ra 0.8 to 1.6;
- Depth of thread 0+2 mm;
- Form and positional tolerances as per DIN ISO 1101.

Tool Preparation Time (15 minutes)

- Competitors can set up tool holders;
- Competitors can change tools; Competitors can measure tool with the provided tool-presetter.
- Competitors can continue to work on the CAM software;
- Competitors cannot set up the vice and cannot put the tools offset data in the CNC-Machine

Additional design requirements

The modules must meet the following requirements:

- Drawing ISO 1/E (First Angle Projection), Original Inventor model and Inventor drawing;
- Drawing ISO 3/A (Third Angle Projection), Original Inventor model and Inventor drawing;
- Drawing annotation to ISO 8015.
- A STEP file (3D surface model) created with the Nominal dimensions.
- Component model made from Aluminium (conform to drawing);
- Measurement report checked by hand so that the Competitors are able to check all assessed marks;
- Judgement and Measurement Marking Aspect descriptions should list both ISO 1/E and ISO 3/A dimensions, with ISO 3/A placed in brackets e.g. C6 (C4);
- The modules must be created with filename conventions (including filename extensions);
- Prior to the Competition, the modules must NOT be accessible to the Competitors.

Important note

The list of tools and instruments described in section 8.3 is the reference for the development of the Test Project proposal; this means that it is of utmost importance that all project modules are made in strict accordance with the list of tools described. None of the project proposals submitted by the Experts may use different cutting tools and diameters than those defined in the Technical Description.

5.4 Test Project development

The Test Project MUST be submitted using the templates provided by WSE. Use the Word template for text documents and DWG template for drawings. Please contact jordy.degroot@worldskillseurope.org for guidance.

If the Test Project is designed by an Independent Test Project designer, then the Test Project must be designed in accordance with the WSE Independent Test Project Guide v1.1.

If your Skill wishes to have an Independent Test Project designer, you must ensure that WorldSkills Europe is made aware of this, so that it can be assured that there is proper funding in place, or that the Independent Test Project designer is aware that he/she will do this task free of charge.

5.4.1 Who develops the Test Projects or modules

The Test Project / modules are developed under the supervision of:

- Independent Test Project Developer / Third party

5.4.2 How and where is the Test Projects or modules developed

The Test Project or modules are developed in the following manner:

- The Test Project is developed by an Independent Test Project Developer

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At the previous Competition	The Test project/modules are developed.
3 months prior to the Competition	Independent Test Project Designer completes the design of the Test Project and Marking Scheme. The final files and photos of the prototype are emailed to the EuroSkills Competition and IT Coordinator.
At the Competition	<ul style="list-style-type: none"> • C-2: The Test Project/modules are presented to Experts. • C1: The Test Project/modules are presented to Competitors.

5.5 Test Project validation

The Marking Scheme and Test Project is developed by the Independent Test Project Developer and should be checked by an independent third party. They should also supply a detailed CMM procedure report and programme. The CMM Programme is made by MiCAT Planner Software by CMM Supplier. The procedure will be validated through the EuroSkills processes.

5.6 Test Project selection

- Test Project is designed by an Independent Test Project designer, therefore there is no selection process

Alternatively if there is no Independent Test Project Developer assigned for the skill different Experts (or group of Experts) must develop the different modules. This so no one expert has access to all the modules. A selection process will occur if more than one expert creates the same module.

5.7 Test Project circulation

Please note that if a Test Project is known by the Chief- and/or Deputy Chief Experts, and/or any of the other Experts, it must be shared via the forums before the start of the Competition. This also means that this Test Project is subject to a 30% change before the start of the Competition.

The Test Project is circulated via the website as follows:

- Not circulated

5.8 Test Project coordination (preparation for competition)

Coordination of the Test Project will be undertaken by:

- Skill Management Team

5.9 Test Project change at the competition

Due to the Test Project being developed by an Independent Test Project Designer (ITPD), there is no change required to be made to the Test Project/modules at the Competition. Exceptions are amendments to technical errors in the Test Project documents and according to infrastructure limitations.

5.10 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitors to complete the Test Project will be supplied by the Host Organization and are available via the forums. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

The Competition Organizer provides information on the following equipment as per the Competition Rules:

- The machines;
- The machine control systems;
- The tool holders (e.g. Sk40 DIN 69871, BT 40, HSK A63);
- Release bolts for the tool holders;
- Machine vice;
- CAM programming station, software version, PC keyboard;
- Machine control training software;
- Possibility of practicing operating the machines intended for the Competition.

5.11 Software specifications

Not applicable.

6 Skill management and communication

6.1 Discussion forum

Prior to the EuroSkills Competition, all discussion, communication, collaboration, and decision making regarding the Skill Competition must take place on the skill specific Discussion Forum, which can be reached via www.worldskillseurope.org. Skill related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) 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 WorldSkills Europe website www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

The information includes:

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

6.3 Test Projects and Marking Schemes

Circulated Test Projects will be available at the WorldSkills Europe website from www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

6.4 Day-To-Day management

The day-to-day management of the Skill Competition during the EuroSkills Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed at www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

7 Skill specific safety requirements

7.1 Requirements

Refer to Host Country/Region Health and Safety documentation for Host Country/Region regulations. This document will be shared via the forums. One overall Health and Safety document will be published, as well as Skill specific safety requirements.

8 Materials and equipment

8.1 Infrastructure List

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

The Infrastructure Lists will be available at the WorldSkills Europe website from www.worldskillseurope.org. Please contact jordy.degroot@worldskillseurope.org for guidance.

The Infrastructure List specifies the items and quantities requested by the Experts for the next Competition. The Host Organization will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items.

At each Competition, the Experts must advise the Competition Manager of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

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 Competitors toolbox

WorldSkills Europe aims to minimize the sending of toolboxes as much as possible. We therefore ask you to keep this in mind when writing the section below. Please be advised that competitors should bring as little as possible and what they do bring **MUST** be true hand tools. Only items are allowed that would significantly affect their ability to perform the task and deliver the Test Project to a high standard.

Competitors can bring only **one** toolbox with the total external volume not exceeding 1.20 m³.





(Volume = Length x Height x Width, or $V = L \times H \times W$)



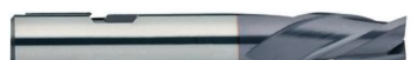





Volume measurement does not include a packing crate, other protective packing material, palette for transportation, wheels, etc.

The max. external volume from the toolbox include packing crate and transportation equipment not more than 2,50 m³.

8.3 Materials, equipment and tools supplied by Competitors in their toolbox

The following items are allowed to be carried in the toolbox:

Item	Description	Dimensions	EXAMPLE PHOTO
1	NC Centre Drills 90°	∅10.00	
2	Drills (DIN338/345)	∅5.00, ∅8.50, ∅9.80, ∅10.00, ∅11.80, ∅20.00	
3	Machine Reamer	∅10H7, ∅12H7	
4	Machine Tap (Blind Holes)	M6 x 1, M10 x 1.5	

5	Machine Tap (Through Holes)	M6 x 1, M10 x 1.5	
6	End Mill (roughing) (DIN844)	∅6x13, ∅8x19, ∅10x22, ∅12x26, ∅16x32, ∅20x38	
7	End Mill (finishing) (DIN844)	∅6x13, ∅8x19, ∅10x22, ∅12x26, ∅16x32, ∅20x38	
8	Ball Nosed End Mills	∅12	
9	Chamfering cutters 90°	∅10 or smaller	
10	Internal thread mill, pitch 1.5 mm	M30x1.5 (maximum length = 1.5 x ∅)	
11	External thread mill, pitch 1.5 mm	M42x1.5 (maximum length = 1.5 x ∅)	
13	Surface Milling Head	∅63	
14	Spare reversible carbide tips		

Competitor tooling length can be a maximum of 2 mm greater than the design maximum specified

Maximum 20 tool holders (e.g. BT40/SK40 holders)

All tooling must be assembled on site. No tooling can be measured beforehand.

Machine providers should inform experts 3 months before if the spindle and tool probe are provided. If provided we can use.

The competitors must bring all their own tools, tool holders, and pull studs, suitable for the supplied machine. Information will be shared on the forum regarding the tool holder type.

THERE WILL BE NO SPARE EQUIPMENT AT THE COMPETITION SO CARE MUST BE TAKEN TO BRING THE RIGHT TOOLS AND A SUITABLE QUANTITY OF CUTTING TOOLS.

THE COMPETITOR MUST BRING THEIR OWN MACHINE VICE

Competitors are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

Item	Description	dimensions
1	Vernier calliper DIN 862	0-150 mm
2	Depth micrometre	0-75 mm
3	Depth Vernier calliper	0-15 mm
4	Outside micrometres DIN 863/1	0-25, 25-50, 50-75, 75-100, 100-125, 125-150 mm
5	Inside micrometres	5-25, 25-50 mm
6	Disc micrometres	0-25, 25-50 mm
7	Three-point hole micrometres	5-25, 25-50 mm
8	(M30x1.5, M42x1.5)	
9	Thread plug gauges for good and rejected products	M6, M10, M30x1.5
10	Thread ring Gauges	M30 x 1.5, M42 x 1.5
10	Chamfering tester 45°	
11	Instrument for angular measurement, plain protractor	
12	Set of slip gauges	
13	Indicating micrometre with magnetic stand	
14	Dial indicator with magnetic stand	
15	Radius gauge R3-25 mm	
16	High-accuracy 90° angle, arm length 80 mm	
17	Straight edge 100 mm	

8.4 Materials, equipment and tools supplied by the Experts

Experts are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

8.5 Materials, equipment and tools prohibited in the Skill area

The following IT-based information (e.g. data, programmers etc.) and equipment allowing wireless contact outside the skill area (mobile-phones, laptops, etc.) are:

- Prohibited for Competitors.
- May be used by Experts in the workshop as defined by the Chief Expert prior to the Competition.
- The use of any other PC than that provided during the Competition is strictly prohibited.
- Competitors must only work with the software provided.
- Only the keyboards supplied by the Competition Organizer can be used.

Important Information

The equipment provided by the host or sponsor must be used by the competitors.

If provided a 5 axis CNC Milling Machine the competitors are allowed to use 3 plus 2 axes. The Post Processor must be able to create programs with 3 plus 2 axis. (X, Y, Z, A, C, (or B)) as the machine definition.

It's allowed to use the Coordinate System for the machine.

The Touch Probe (if provided) can also be used form the competitors (per CNC Machine / one Probe for 2 Competitors) the Competitor's it's allowed to use their own Touch Probe.

If the host organizes equipment via sponsors that can lead to a reduction of the tool box.

If the equipment provided is used at the competition. The toolbox has to be adjusted accordingly.

The Competitors are not allowed to bring their own linear height gauge or digital height gauges.

8.6 Workshop Layout

Workshop layouts from previous competitions are available by contacting the Competition and IT Coordinator at: jordy.degroot@worldskillseurope.org. New Workshop Layouts will be communicated via the forums when completed.

Please be advised that you will have the opportunity to discuss your Workshop Layout proposal with the Host Organization during the Skills Development Workshop (SDW) and the Competition Preparation Meetings (CPM).

For workshop layout development, please refer to the forums.

9 Skill-specific rules

9.1 Introduction

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 workflow, and documentation management and distribution. Breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System.

9.2 Personal laptops – USB – memory sticks – mobile phones

- For C-1, the familiarization day, the competitors may bring their own CAM software config and tool data on a personal USB. At the end of the day the USB goes to the Chief Expert locking the USB during the competition.
- During the Competition C1 - C3 the Competitors must only use memory sticks provided by the Competition Organizer. No other memory sticks are to be inserted into the Competitor computers except with permission from the Chief Expert.
- Memory sticks or any other portable memory devices cannot be taken outside the workshop.
- Memory sticks or other portable memory devices are to be submitted to the Chief Expert at the end of each day for safe keeping and must not be taken out of the workshop.
- Competitors, and Experts are not allowed to bring personal laptops, tablets, mobile phones, smart watches etc. into the workshop.
- If it's necessary the Supervisor Expert it's allowed to use their phones **to stop the time**, only with permission from CE and/or DCE.
- Competitors and Experts are allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition only.
- No drawings or information regarding the Test Project can be taken out of the workshop.
- The Competitor cannot bring their own drawings. During familiarization, drawings are supplied.

9.3 Personal photo cameras – video taking devices

- Competitors and Experts are allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition only.

9.4 Communication between compatriot experts and competitors

Communication between Compatriot Expert and Competitor is allowed during open communication, before and after the daily competition time, during the lunch time and if it's approved by the CE or DCE during the competition in present from other Experts (in situations when there is a problem during the competition to understanding and clarify what the problem is).

Example: Problems with equipment or with CAD CAM System or the CNC Machine and the competitor can't explain the problem the technician or the supervisor expert comes the compatriot expert according the CE / DEC to explain the problem.

9.5 Other

Due to the complexity of latest test projects and 5-axis machining, the machine tool provider must check machine kinematics and machine 3D probe calibration and provide the Chief Expert with evidence before C-1.

10 Visitor and media engagement

10.1 Engagement

Following is a list of possible ways to maximize visitor and media engagement, within the remit of the Competition Rules:

- Display screens (video of CNC milling machining);
- A show spot with a complete Test Project (description, parts, and drawings) from past Competitions that make easy the understanding of Competitor activity;
- Competitor profiles - provide a sticker with the national flag, the name of the Competitor, and a brief description of their studies;
- Daily reporting of Competition status;
- A demonstration area for Competitors to interact with visitors to explain their skill;
- Demonstration videos provided by the machine and CAD/CAM sponsors showing parts machining which are of interests to visitors: aerospace, automotive, etc.;
- Small exhibits around the competition venue where various objects of everyday life such as a bottle; a mobile telephone; a toy; automotive part; aerospace part are exhibited with an explanation how it is produced and the role of CNC milling machines;
- A person who has detailed knowledge about CNC milling explains our competition with samples and videos. (Using former completed projects and technical drawings and a video showing a dry machining process of one module.);
- Terminals nearby the Competitors workplace showing the CAM activity;
- Live web cam in the machine with projection to a big screen. E.g. GoPro Cameras.

11 Sustainability

11.1 Sustainability

This Skill Competition will focus on the sustainable practices below:

- Reduce the raw size from the material
- To improve sustainability, it makes sense if the tool box can be eliminated in the long run and all equipment is provided by the host.
- If the host organizes equipment that will lead to the tool box's reduction, this should be implemented in a timely manner, and should be announced at least 6 months before the competition, so that the candidates can prepare accordingly.