MANUFACTURING AND ENGINEERING TECHNOLOGY

Plastic Die Engineering

Technical Description

 TD43 v8.0 WSC2021

worldskills

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:

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Stefan Praschl
Board member – Competitions

Michael Fung
Board member – Competitions

1 Introduction

1.1 Name and description of the skill competition

1.1.1 The name of the skill competition is

Plastic Die Engineering

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

Plastic Die engineering is the mass production of plastic products of high quality at low cost. Plastic injection moulded components are used in telecommunications, medical, aerospace, and automobile industries, home appliances, office automation, entertainment, and electronics. Within this sector, plastic die technicians, otherwise known as mould makers, carry out a range of different duties which vary depending on the organisation they work for. Based on occupational data, mould makers must:

- Create and develop new tooling for plastic moulding dies using the specifications provided by separate design teams
- Plan the moulds initially by studying and interpreting the drawings or computer aided design (CAD) models supplied to them. They usually work with the design teams because they need to be familiar with each mould design concept, and with the CAD software used for making the designs. They study the dimensions and tolerances of each mould elements and ensure they are appropriate for the assembly and function of the mould. They also analyse the feasibility of the manufacture, given the available resources
- Set up equipment by interpreting the design and drawing of each mould's parts and the properties of the materials. Since much of the machining process uses computer numerical controlled (CNC) machines, they also must know how to operate CNC machines, and create programmes. They should be familiar with various mould polishing equipment and techniques. Once each mould is assembled and ready for testing, they conduct trials and prove each mould on an injection moulding machine. They must set up and control the moulding parameters in order to produce defect-free mouldings (plastic parts)
- Maintain and repair all equipment to ensure that each mould run is as required.

Plastic die technicians may also create prototype of products, jigs, and fixtures to facilitate production (machining, assembly, and inspection) etc.

Mould makers need good technical skills and dexterity to work with precision equipment and tools, as well as strong mathematical and problem-solving skills. To liaise with design teams and colleagues they require both formal and informal communication and interpersonal skills.

1.1.3 Number of Competitors per team

Plastic Die Engineering 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.

1.3 Associated documents

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

- WSI – Code of Ethics and Conduct
- WSI – Competition Rules
- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations.

2 The WorldSkills Occupational Standards (WSOS)

2.1 General notes on the WSOS

The WSOS 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/WSOS).

The skill competition is intended to reflect international best practice as described by the WSOS, and to the extent that it is able to. The Standard 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 Standard 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. This is often referred to as the "weighting". The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

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

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

2.2 WorldSkills Occupational Standards

Section		Relative importance (%)
1	**Work organization and management**	5

The individual needs to know and understand:

- Legislation and best practice for health and safety in the working environment
- Range of tools and their proper use in relation to Plastic Die Engineering
- Technical language and symbols used in plastic engineering design
- The importance of effective communications and inter-personal working relationships
- The importance of a customer focused attitude
- Applied mathematics, technical terms, and symbols
- IT systems and related professional CAD/CAM software
- CNC Machining centres, bench working and moulding machines
- Manual and CAM programming
- Cutting tool technology
- The importance of accruing knowledge and skills
- The role of providing innovative and feasible solutions to design, manufacturing, and moulding problems

The individual shall be able to:

- Effectively apply all current health and safety regulations in the workplace
- Proactively promote best practice in health and safety in the working environment
- Work independently on CNC machining centres
- Create manual and CAM programs for various types of machining
- Select suitable cutting parameters
- Select and set the most appropriate tools for the planned work
- Maintain all tools to ensure that they are in the best condition
- Communicate and collaborate effectively with colleagues, team members, and other professionals
- Engage with customers effectively, always prioritizing their needs
- Explain complex technical details to non-specialists
- Proactively engage in continuous professional development to promote excellence in the work and maintain expertise in current industrial practice
- Analyse the manufacturing feasibility
- Successfully apply mathematical principles to complex industrial scenarios
- Demonstrate high levels of critical thinking

Section		Relative importance (%)
2	**Interpretation of designs and drawings**	10

The individual needs to know and understand:

- The principles of technical drawings
- Symbols and features of both 2D and 3D drawings
- Computer Aided Design (CAD) software
- Currently recognized international design standards (ISO, ASME)
- Geometric Dimensioning and tolerancing methods
- Quality requirements
- The purposes and roles of innovative solutions
- Design For manufacturing (DFM) concepts
- Design for Assembly (DFA) concepts
- Design for maintainability (DfM) concepts,

The individual shall be able to:

- Interpret technical drawings and specifications
- Identify critical features
- Analyze manufacturability with the available resources
- Identify and prepare for potential assembly issues if any
- Identify and prepare for any maintenance issues that may arise during production
- Specify stock to be kept for different operations
- Plan the production of parts according to specifications

3	**Process planning**	5

The individual needs to know and understand:

- The importance of planning to improve efficiency
- Procedures to manufacture moulds with the available resources
- Machining operations and their sequences
- Method of clamping work pieces
- Choices of cutting tools and cutting parameters
- Machine and work piece setting
- Measuring tools and equipment
- Bench work and assembly techniques

The individual shall be able to:

- Identify and set different machining features
- Correctly clamp and set work pieces for machining or bench work
- Select correct cutting tools and machining strategies
- Make correct measurements

Section		Relative importance (%)
4	**Programming and setting up equipment**	20

The individual needs to know and understand:

- Programming in a logical sequence
- Different methods of programming (manual, Canned cycles, CAM etc.)
- Methods for transferring programs from computers to machine controllers in the case of CAM programming
- Methods for setting work pieces relative to machine co ordinates

The individual shall be able to:

- Select the best sequence for machining each specific work piece
- Program manually and in CAM software
- Transfer programs to machines
- Set work pieces and tools.

5	**Machining**	30

The individual needs to know and understand:

- The functions and features of Computer Aided Manufacturing (CAM)
- Settings for cutting conditions according to the mould material
- Settings for working procedures
- Settings for each piece of work and the way to measure it
- The importance of inspecting machines and tools

The individual shall be able to:

- Apply the principles and processes of Computer Aided Manufacturing (CAM)
- Set up and use machine centre input data into CNC machine controllers (tool offset, work offset, etc.)
- Create machining programs in software, and transfer to machine controllers
- Test the finished products and assess them for accuracy in accordance with the specified drawings
- Machine each part of the dies, taking account of each plastic product's requirements
- measure pieces of work accurately
- set offsets according to measured size
- achieve the required geometry and finish
- Fabricate all parts to commercial standards using:
- Machine centres
- Pin cut off grinders
- Drilling machines
- Bench grinders.

Section		Relative importance (%)
6	**Assembly**	**5**

The individual needs to know and understand:

- The purposes and methods of polishing components
- Standards (ANSI/SPI) currently used in the Plastics and Die Industry
- Ways to match the face between each core and cavity
- Processes to assemble moulds

The individual shall be able to:

- Use range of hand and power tools for assembly
- Polish components using polishing tools
- Drill components
- Apply the principles of pin cutting
- Apply the principles of surface contact
- Assemble components in preparation for testing.

Section		Relative importance (%)
7	**Try out of moulds**	**10**

The individual needs to know and understand:

- Setting up moulds on injection moulding machine for try out
- Settings and conditions for defects free products such as:
  - Pressure
  - Time
  - Speed
  - Temperature

The individual shall be able to:

- Change:
  - Injection pressures
  - Back pressures
  - Holding pressures
  - Clamping pressures
  - Injection times
  - Injection speeds
  - Ejection speeds
  - Melt temperatures
  - Strokes (metering, opening, ejection, etc.)
- Run machine in semi-automatic mode.

Section		Relative importance (%)
7	**Plastic Products**	**10**
	The individual needs to know and understand: • Types of defect and how to identify these defects in plastic products • The most frequent and common defects and their causes • Solutions for remedying defects in plastic products • Solutions for achieving specified product dimensions and finishes	

	The individual shall be able to:
	• Locate and identify defects in plastic products, for example:
	  • Weld lines
	  • Cracks
	  • Whitening
	  • Flow marks
	  • Burn marks
	  • Sinking marks
	  • Plastic material incompletely injected
	• Propose solutions for identified defects
	• Implement proposed solutions
	• Accurately measure the dimensions of products
	• Achieve product dimensions as in drawings or models
	• Check the condition of both the interiors and exteriors of products
	• Modify moulding parameters and develop the plastic products.	

9	**Maintenance and repair**	**5**
	The individual needs to know and understand: • The importance of injection mould maintenance • The importance of cleaning and repairs needed to keep moulds in good working order • Types of maintenance work required to improve the quality and longevity of moulds	
	The individual shall be able to: • Do preventative maintenance to avoid issues arising • Make repairs when problem arise.	
	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. The Test Project is the assessment vehicle for the skill competition, and therefore also follows the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

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

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors for quality assurance and 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 people 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 Rules for further details.

Experts and Independent Assessors 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)
- 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 The use of measurement and judgement

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

WorldSkills is committed to continuous improvement. This particularly applies to assessment. The SMT is expected to learn from past and alternative practice and build on the validity and quality of assessment and marking.

A— Product

- 10 samples from the automatic process is submitted for evaluation (Two samples for measurement and the remaining for Judgement)
- Main dimensions: feature sizes (marked with capital letters) less than 10 mm are with a tolerance of +/-0.05 mm and feature size more than 10 mm with a tolerance of +/-0.1 mm. They are selected at random by evaluation team when everyone has submitted the product for evaluation.
- Secondary dimensions: feature sizes (marked with small letters) more than 10 mm with a tolerance of +/-0.1 mm selected by evaluation team when everyone has submitted the product for evaluation
- Conformity to product forms, product layout, etc.
  - Arc, round, fillet and chamfer size (only visual inspection);
  - Position of features (only visual inspection);

- Surface quality (Experts visually inspect the product and looks for surface quality)
    - Ejector pin unevenness;
    - Burn mark;
    - Scratch at ejection;
    - Weld mark;
    - Machine mark;
    - Burr.

B—Machined parts

- Dimensions of core and cavity profiles; these dimensions are calculated based on the shrinkage of plastic material specified in the drawing issued to the competitor.
    - Main dimensions: Dimensions (marked with Capital letters) with a tolerance of +/-0.01 mm selected by marking team once everyone has completed the Test Project
    - Secondary dimensions: Dimensions (marked with Capital letters) with a tolerance of +/-0.02 mm selected by marking team once everyone has completed the Test Project
    - Dimensions of other plates: Dimensions of other parts are evaluates as per the dimensions and tolerance s specified in the drawing
    - Surface finish: Surface finish on moulding surface and other areas are checked on surface roughness tester required as per industry standards
- Use of material:
    - The Workshop Manager must prepare sufficient spare material for machining;
    - A Competitor has only one opportunity to request one piece of material per module;
    - There will be loss of marks for any additional material used.

C —Assembly and injection moulding

- Assembly conditions:
    - Assembly condition of the die will be checked for completeness of assembly, proper tightening of screws, ejector working conditions, and appearance of the total die excluding the product moulding area;
    - Ejector working conditions;
    - Bolt tightening;
    - Scratch on surface excluding the product area.
- Process:
    - Automatic moulding;
    - Teams of Experts must evaluate if an automatic moulding of the product is possible. Setting of the basic process parameters is the task of the Injection Moulding Machine Technician. If the Competitor makes a special request to the technician, the technician adjusts the parameters. Ten shots are taken to evaluate the process. For each shot, where the product falls without anybody pulling it out or kicking it off the ejector pins the Competitor gets one point.
    - A team of Experts assigned together with the Injection Moulding Machine Technician will evaluate the process;
    - The Competitor will select and submit any two samples from the lot for product evaluation by measurement and the submit the remaining eight parts for evaluation by Judgement.

4.10 Skill assessment procedures

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

Each Expert will form the member of a marking team of the Test Project.

Experts will be divided in to marking team allocating equal marking opportunities wherever possible. The composition of marking team will be decided by both CE and DCE with the aim of having a balance of new and experienced Experts in the team. The marking team will be decided on C-1.

The Skill Competition Manager is to assign the Test Project module design to Experts prior to the Competition. Proposed modules shall require 18-20 hours to complete.

The Experts will agree on the final Marking Scheme.

Dimensions on Mould and part will be checked by an external party on CMM.

- The Chief Expert will assign certain Experts to a supervisory role. These Experts will roam the floor to supervise the fairness of the Competition, to keep track of timetable and to assist Competitors if necessary. The other Experts, together with the Injection Moulding and CMM Technicians will be assigned to Marking Task Groups;
- Experts must NOT assemble a die. The Competitor delivers a completed die. If the die is not assembled, the Competitor will lose all the marks allotted for the process;
- The plastic products will be moulded by a qualified technician until the condition becomes stable and witnessed by two Experts and the Competitor who fabricated the die.

The Competitor can make a special request. for change of parameters and also can conduct repair work within the allotted time after injection process has begun by the technician to produce a complete product. Minor repair work on bench also will be permitted but drilling, pin cutting, or any other machining work will not be permitted.

Assessment of the die will be carried out only after injection moulding is completed.

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 applied knowledge, skills, and behaviours set out in each section of the WSOS.

The purpose of the Test Project is to provide full, balanced, and authentic opportunities for assessment and marking across the Standards, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme, and Standards 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, or affect the balance of marks within the Standards other than in the circumstances indicated by Section 2. 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. Section 2.1 refers.

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.

Most Test Projects (and Marking Schemes) are now designed and developed independently of the Experts. They are designed and developed either by the Skill Competition Manager, or an Independent Test Project Developer, normally from C-12 months. They are subject to independent review, verification, and validation. (Section 4.1 refers.)

The information provided below will be subject to what is known at the time of completing this Technical Description, and the requirement for confidentiality.

Please refer to the current version of the Competition Rules for further details.

5.2 Format/structure of the Test Project

The Test Project is in the form of engineering drawings and three-dimensional models of plastic products. Drawing file is provided in Autodesk Inventor either in first angle or third angle projection and only English version of the software is provided.

5.3 Test Project design requirements

- The Test Project drawings should conform to either first angle projection (ISO E) or third angle projection (ISO A) standards. These drawings must be available in digital format. Dimensioning and tolerancing will be interpreted as per ISO 1101 (R-2017) or ASME Y14.5 2018 standards only. This statement also should be added in all Test Project drawings;
- The drawing shall have as little text as possible,
- Items missing in standard inventor mould library shall be modelled and supplied to the competitor
- Models of the plastic products, which were produced with a die under same or similar conditions that the Competitors will face, should be provided;
- Marking sheets (completely filled out with all criteria, available in digital form in either MS Word or MS Excel) should be provided;
- The Test Project size for manufacturing must fit into the plates supplied by the sponsor;
- The base dimensions of core and cavity shall be about -140 mm x 140 mm;

- Ejector stroke shall be 20mm;
- The Test Project should not include any Hot Runner Technology or requirements;
- Family mould may be designed but sprue hole position must be as per standard housing;
- It must be possible to complete the Test Projects using only the equipment, tools, and tool holders specified in the Infrastructure List.
- Mould that is made should have cooling system (water line).
- Products of moulding should be able to be assembled (two cavity mould/for two separate products)

5.4 Test Project development

The Test Project MUST be submitted 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

Test Project for Manufacturing is developed by all Experts.

The Skill Competition Manager is to assign the Test Project module design to Experts prior to the Competition. Proposed modules shall require 18-20 hours to complete.

5.4.2 When is the Test Project developed

The Test Project/modules are developed according to the following timeline:

Time	Activity
Six (6) months prior to the Competition	Experts should submit one proposal for the manufacturing module to the Skill Competition Manager.
Five (5) months prior to the Competition	The Skill Competition Manger will post the submitted proposals on the WorldSkills Discussion Forum for other Experts to consider.

5.5 Test Project initial review and verification

The purpose of a Test Project is to create a challenge for Competitors which authentically represents working life for an outstanding practitioner in an identified occupation. By doing this, the Test Project will apply the Marking Scheme and fully represent the WSOS. In this way it is unique in its context, purpose, activities, and expectations,

To support Test Project design and development, a rigorous quality assurance and design process is in place (Competition Rules sections 10.6-10.7 refer.) Once approved by WorldSkills, the Independent Test Project Designer is expected to identify one or more independent, expert, and trusted individuals initially to review the Designer's ideas and plans, and subsequently to verify the Test Project, prior to validation.

A Skill Advisor will ensure and coordinate this arrangement, to guarantee the timeliness and thoroughness of both initial review, and verification, based on the risk analysis that underpins Section 10.7 of the Competition Rules.

5.6 Test Project validation

Test Projects are validated by the Experts who designed the selected Test Projects.

All Experts are required to confirm that the Test Projects satisfy the project design requirements and could be completed by the Competitors using the prescribed materials and equipment within the prescribed time.

5.7 Test Project selection

The Test Project/modules are selected by a vote of all Experts on the WorldSkills Discussion Forum.

- The vote is conducted two (2) months prior to the Competition;
- The Skill Competition Manager selects one of the best Test Projects which receives the highest votes for circulation

5.8 Test Project circulation

If applicable, the Test Project is circulated via the website as follows:

The Test Project/modules are circulated one (1) month prior to the competition.

5.9 Test Project coordination (preparation for Competition)

Coordination of the Test Project/modules is undertaken by the Skill Competition Manager.

5.10 Test Project change

The Independent Test Project Designer shall develop the 30% change as required by WorldSkills. This change is presented to the Experts and Competitors at the Competition.

5.11 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. 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 such items may include those for fault finding modules or modules not circulated.

The Competition Organizer will circulate the following information at least six (6) months prior to the Competition:

- Machine and control system to be used;
- Tool holder (e.g. DIN69871, BT40);
- Tool holder release bolt;
- Machine vice;
- CAM programming station, software version, PC keyboard;
- Machine control familiarization software.

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 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 Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- 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 six 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).

6.5 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

Topic/task	Best practice procedure
Test Project release	• Test Project is released as soon as the 30% changes are reviewed as per IL and accepted by all Experts on C-3
Translation of Test Project	• Only the test added by the Independent Test Project Designer is translated on C-3.
Tools for Interpreters	• Interpreters may use Dictionary, Internet, translation devices, etc.
Assessment	• All critical dimensions on mould and product developed by the Competitor are checked on CMM only and no modification are allowed on the CMM report. • Repeatability errors up to two microns during CMM inspection and three microns in manual inspection are permitted. • Experts will not be allowed to assist Competitors during mould testing.
Equipment failure	• If equipment or tools supplied by the Competition Organizer fail Competitors are allowed extra time to compensate for the time lost.
Others	• Competitors cannot carry out machining and bench work concurrently. Time saved in machining can be used for bench work, but time saved in bench work may not be used for machine work. • Competitors must advise the Expert on completion of the machine work phase. Under normal circumstances the Competitor will not be permitted to go back to machine work.

7 Skill-specific safety requirements

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

Task	Safety glasses with side protection	safety shoes with protective cap	sturdy shoes with closed toe and heel	tight fitting work clothes (long trousers	CUT Protection GLOVES (Without breakage)	Dust Mask
General PPE for safe areas			√			
Working on Computer			√			
Working on CNC machine	√ (only if no machine door)	√		√		
Working on Drilling machine	√	√		√	√	
Working on Pin cutter/pedestal grinder	√	√		√	√	√
Working on Injection moulding machine	√ (only if no machine door)	√		√	√	

Task	Safety glasses with side protection	safety shoes with protective cap	sturdy shoes with closed toe and heel	tight fitting work clothes (long trousers	CUT Protection GLOVES (Without breakage)	Dust Mask
Working with moving/rotating hand tools	√	√		√	√	
Polishing and Assembly work	√	√		√	√	

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 Management Team for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. 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 such items may include those for fault finding modules or modules not circulated.

At each Competition, the Skill Management Team must review and update the Infrastructure List in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions 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

The maximum external size of an individual toolbox in volume shall be 0.4 m³.

Maximum two toolboxes are permitted inside the competition workshop. Volume that is bigger than the regulation is removed from the competition workshop and 2.5 marks are reduced from Competitor's overall marks.

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

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

8.3 Materials, equipment, and tools supplied by Competitors

The Competitor should bring their own tools and equipment to ensure capabilities of designing and manufacturing the Test Project. These include the following.

Milling tools

Description	Photo
End mills Ø1—Ø16 (mm)	

Description	Photo
Ball end mills R1 – R6 mm	
Radius end mills R0.5 – R1 mm	
Dia 8.7mm long drill (150mm)	
1/8 NPT Tap	
1/8 NPT connector	
1/8 NPT Taper plug	
Taper reamer for sprue	

Description	Photo
Face mills and inserts	
Any kind of chamfering tools (45°)	
Machine reamers (Ø2-Ø8H7)	
Tools holder and collets	
Tool locking device	
Holder wrench	
Base master	
Point master	

Drilling

Description	Photo
Drill bits Ø1.8 - Ø10 (mm) (increments of 0.1 mm);	
Variety of centre drills;	
Variety of 90° countersinks;	
Counter bore	

Hand tools

Description	Photo
Tap wrenches;	
Hand reamers (Ø2-Ø8H7);	
Set of metric Allen wrenches (2 mm - 14 mm);	

Description	Photo
Files of any kind;	
Variety of honing (grinding) stones;	
Various polishing equipment;	
Any kind of hand tools (plastic hammer, wrenches, parallels, etc.) the Competitor sees fit for the milling and cut-off machine;	
Air grinder or electric grinder	

Measuring tools

Description	Photo
Calliper 160 mm;	
Outside micrometre set 0 mm - 100 mm;	

Description	Photo
Inside micrometer	
Depth micrometre set 0 mm - 100 mm;	
Dial indicator with stand;	
Block gauge set	

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

8.4 Materials, equipment, and tools supplied by Experts

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

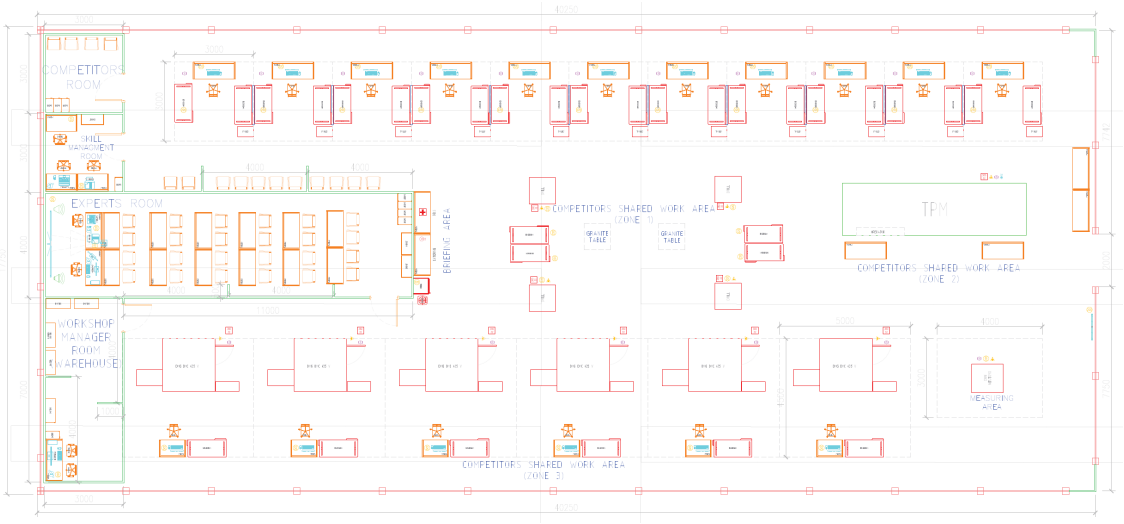
8.5 Materials and equipment prohibited in the skill area

Competitors and Experts are prohibited to bring any materials or equipment not listed in section 8.3 and section 8.4.

8.6 Proposed workshop and workstation layouts

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

Example workshop layout



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 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.

Topic/task	Skill-specific rule
Use of technology – USB, memory sticks	• Competitors are only allowed to use memory sticks provided by the Competition Organizer. No other memory sticks are to be inserted into the Competitor computers. If personal memory devices are brought into the workshop, they must be declared to the Chief Expert who will store in a locked cupboard for the duration of the Competition. These are returned at the end of competition on C4. • Memory sticks issued to the Competitor must be submitted to the Chief Expert at the end of each day for safe keeping and must not be taken out of the workshop. • Skill Competition Manager, Chief Expert, Deputy Chief Expert, Experts, and Interpreters are not allowed to bring personal memory devices into the workshop. If these devices are brought in, they must be locked in the personal lockers for the duration of the Competition.
Use of technology – personal laptops, tablets and mobile phones	• Skill Competition Manager, Chief Expert, Deputy Chief Expert, Competitors, Experts, and Interpreters are allowed to bring personal laptops, tablets, or mobile phones into the workshop but only use them in the Expert room. If these devices are brought, they must be locked in the personal locker when not in use until the end of competition on C4. Mobile phones can be removed at lunchtime and at the end of each day.
Use of technology – personal photo and video taking devices	• Skill Competition Manager, Chief Expert, Deputy Chief Expert, Competitors, Experts, and Interpreters are permitted to bring and use personal photo and video taking devices in the workshop but only at the conclusion of the competition on C4.
Templates, aids, etc.	• Competitors are not permitted to bring any templates into the workshop including in the Competitor toolbox. Competitors are not allowed to fabricate templates during the Competition. Standard design template is provided to them.

Topic/task	Skill-specific rule
Drawings, recording information	• Competitors are not permitted to use prepared reference material. Plain paper sheets are provided for rough work and it should not be taken out of the workshop. They may make their own data during familiarization or competition days in the sheet issued to them. • Chief Expert, Deputy Chief Expert, Experts, and Interpreters are not allowed to use prepared reference material. If creating rough work or data materials during the competition these must be left in the workshop until the end of C4.

10 Visitor and media engagement

Following is a list of possible ways to maximize visitor and media engagement:

- Try-a-Skill;
- Display screens;
- Test Project descriptions;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status.

Marketing and media resources:

- https://www.youtube.com/watch?annotation_id=annotation_304577357&feature=iv&src_vid=RMjtmsr3CqA&v=seZqq1qxW30
- https://www.youtube.com/watch?v=gi-XcsNM0AE
- https://www.youtube.com/watch?v=uEO_jDE5oQ8
- https://www.youtube.com/watch?v=xn2HgMjbKf4

11 Sustainability

This skill competition will focus on the sustainable practices below:

- Recycling;
- Use of “green” materials;
- Use of completed Test Projects after Competition.

12 References for industry consultation

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards 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 Occupational Standards 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.**oneto**nline.org/)

This WSOS (Section 2) appears to match most closely the occupation of Tool and Die Makers: https://www.onetonline.org/link/summary/51-4111.00

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 Occupational Standards in place for WorldSkills Shanghai 2021.

There were no responses to the request for feedback from industry and business.