

Technical Description

# Plastic Die Engineering

Manufacturing and Engineering Technology



  
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.

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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

Plastic Die Engineering

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

Plastic Die Engineers are engaged in the mass production of plastic products of high quality at low cost. This is achieved by producing a mould based on drawings created by a competent designer who understands design for manufacturing and assembly principles, having hands on injection moulding, mould making, plastic part design, and mould design software experiences.

The designing and processing of a mould is done with the help of CAD/CAM (Computer Aided Design/Computer Aided Machining) systems. Most of the machining is done on CNC (Computer Numerical Control) machining centres. The machined parts are then polished according to requirements and assembled as per drawing to keep them ready for trial. A completed mould will be then installed in an injection moulding machine. The raw plastic material is melted in the moulding machine and then injected into the mould, where it cools and solidifies into the final product.

This is a very rewarding profession. Plastic Die Engineers are increasingly in demand. An industrial market research consultancy specializing in plastic products and appliances, predicts that the world's use of commodity plastic will reach 510 million tons in 2020. Plastic Die Engineering is a fast-paced world which is highly creative and full of opportunities for skilled and talented people. It is an essential aspect of engineering because most plastic parts cannot be made without a die. Therefore, Plastic Die Engineers are a critical link in the overall plastic injection moulding process.

Light weight, availability of various designs, and cost reduction are the greatest advantages to industries. Since plastics are used in thousands of products that add comfort, convenience and safety to our lives the demand for plastic die engineering skills has significantly increased over the years. Plastic injection moulded components are used in telecommunications, medical, aerospace, and automobile industries, for home appliances, office automation, entertainment, and electronics. Thus the range of different fields of requirements provide many challenges, ranging from , designing an appropriate mould to programming for machining mould elements, working on machines, inspecting, polishing ,matching, assembling of parts ,moulding and trouble shooting of moulding defects for good mass production.

The skilled practitioner needs excellent levels of skill in numeracy, hand and machining skill, polishing, assembling, testing, and troubleshooting.

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

## 2 THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

### 2.1 GENERAL NOTES ON THE WSSS

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

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

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

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

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

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

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

## 2.2 WORLDSKILLS STANDARDS SPECIFICATION

SECTION		RELATIVE IMPORTANCE (%)
1	<b>Work organization and management</b>	5
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Legislation and best practice for health and safety in the working environment</li> <li>• Range of tools and their proper use in relation to Plastic Die Engineering</li> <li>• Technical language and symbols used in plastic engineering design</li> <li>• The importance of effective communications and inter-personal working relationships</li> <li>• Customer focused attitude</li> <li>• </li> <li>• Applied mathematics, technical terms and symbols</li> <li>• IT systems and related professional CAD/CAM software</li> <li>• CNC Machining centres, bench working and moulding machines</li> <li>• Manual and CAM programming</li> <li>• Cutting tool technology</li> <li>• The importance of accruing knowledge and skills</li> <li>• The role of providing innovative and feasible solutions to the design, manufacturing and moulding problems</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Effectively apply all current health and safety regulations in the work place</li> <li>• Proactively promote best practice in health and safety in the working environment</li> <li>• Work independently on CNC machining centres</li> <li>• Create manual and CAM programs for various types of machining</li> <li>• Select suitable cutting parameters</li> <li>• Select and set the most appropriate tools for the planned work</li> <li>• Maintain all tools to ensure that they are in the best condition</li> <li>• Communicate and collaborate effectively with colleagues, team members, and other professionals</li> <li>• Engage with customers effectively, always prioritizing their needs</li> <li>• Explain complex technical details to non-specialists</li> <li>• Proactively engage in continuous professional development to promote excellence in the work and maintain expertise in current industrial practice</li> <li>• Analyse the manufacturing feasibility</li> <li>• Successfully apply mathematical principles to complex industrial scenarios</li> <li>• Demonstrate high degrees of critical thinking</li> </ul>	

<b>2</b>	<b>Engineering drawing and Design</b>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The principles of technical drawings</li> <li>• Symbols and features of both 2D and 3D drawings</li> <li>• Computer Aided Design (CAD) software</li> <li>• Currently recognized international design standards (ISO, ASME)</li> <li>• The importance of accurate and clear presentation of designs</li> <li>• The potential for problems with drawings and their implications</li> <li>• The role of providing innovative solutions</li> <li>• Design For manufacturing (DFM) concept</li> <li>• Design for Assembly (DFA) concept</li> <li>• Design for maintainability</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Interpret technical drawings and specifications</li> <li>• Design in CAD software</li> <li>• Apply Geometric dimensioning and Tolerancing symbols as per ISO/ ASME standards</li> <li>• Design for economical manufacturability and ease of assembly</li> <li>• Create a design which can be easily maintained (or repaired) both economically and efficiently</li> <li>• Take design steps to minimize Time to Repair (TTR)</li> </ul>	
<b>3</b>	<b>Plastic material</b>	<b>5</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Working materials and their characteristics</li> <li>• Properties of plastic materials, for example:             <ul style="list-style-type: none"> <li>• Flow ability;</li> <li>• Heat deflection temperature;</li> <li>• Moulding temperature;</li> <li>• Stability;</li> </ul> </li> <li>• Percentage of shrinkage</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Specify the size and position of the gate</li> <li>• Specify the dimensions of core and cavity as per the shrinkage of material</li> <li>• Set up moulding temperature</li> <li>• Handle all materials safely</li> <li>• Select appropriate materials for a given job</li> </ul>	
<b>4</b>	<b>Mould design</b>	<b>20</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Principles and practice of 2D and 3D mould design</li> <li>• How to apply CAD/CAM systems for a range of solutions</li> <li>• Current ISO drawing standards</li> <li>• Specifications and fixtures of measuring equipment</li> <li>• Methods to split parting lines</li> <li>• Styles and types of layout</li> <li>• Set up for ejector pins</li> <li>• Set up for coolant line</li> <li>• Principles of low cost design</li> </ul>	

	<ul style="list-style-type: none"> <li>• Coating requirements for mould and component</li> <li>• Material selection for various mould elements</li> <li>• Heat treatment requirements</li> <li>• Design principles that ensure mass production capability and product life expectancy</li> <li>• Holes are easily produced in moulded component by providing core pins</li> <li>• Design requirements for easy maintenance of mould and repair work in case of failure</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Read and interpret drawings in both first and third angle projections</li> <li>• Interpret various geometrical tolerance/dimensioning and dimensional tolerances</li> <li>• Create technical engineering drawings that conform to international standards and clearly convey the details to the end user</li> <li>• Write reports to describe the concept of designing dies</li> <li>• Design moulds using 2D and 3D methods</li> <li>• Calculate shrinkage</li> <li>• Split parting lines, core and cavity</li> <li>• Design a position and size of a gate</li> <li>• Design a position and size of an ejector pin</li> <li>• Design a coolant line, position, and size coolant line</li> <li>• Apply principles that ensure mass production capability and maximize product life expectancy</li> <li>• Design easy manufacturing and assembly</li> <li>• Design for easy maintainability</li> </ul>	
<b>5</b>	<b>Machining</b>	<b>30</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Functions and features of Computer Aided Manufacturing (CAM)</li> <li>• Settings for cutting conditions according to the mould material</li> <li>• Settings for working procedures</li> <li>• Settings for a piece of work and the way to measure it</li> <li>• The importance of inspecting machines and tools</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Apply the principles and processes of Computer Aided Manufacturing (CAM)</li> <li>• Set up and use a machine centre</li> <li>• Position and do machining for ejector pins</li> <li>• Consider, plan and account for the proper size and layout of the injection points and ejector pins</li> <li>• Input data into the CNC machine controller (tool offset, work offset, etc.)</li> <li>• Machine each part of the die in consideration of the requirement of the plastic product measure a piece of work accurately</li> <li>• Fabricate parts to commercial standards using:             <ul style="list-style-type: none"> <li>• Machine centre;</li> <li>• Pin cut off grinder;</li> <li>• Drilling machine;</li> <li>• Bench grinder;</li> </ul> </li> <li>• Troubleshoot dies, find innovative solutions to complex problems</li> </ul>	



6	Assembly	5
	The individual needs to know and understand: <ul style="list-style-type: none"> <li>• The purpose and method of polishing a component</li> <li>• Standards (ANSI/SPI) currently used in Plastics and Die Industry</li> <li>• Ways to match the face between the core and cavity</li> <li>• Processes to assemble a mould</li> </ul>	
	The individual shall be able to: <ul style="list-style-type: none"> <li>• Polish components using polishing tool</li> <li>• Drill components</li> <li>• Apply the principles of pin cutting</li> <li>• Apply principles of surface contact</li> <li>• Assemble components in preparation for testing</li> </ul>	
7	Try out of mould	15
	The individual needs to know and understand: <ul style="list-style-type: none"> <li>• Setting up moulds on injection moulding machine for try out</li> <li>• Settings and conditions for defects free products such as:               <ul style="list-style-type: none"> <li>• Pressure;</li> <li>• Time;</li> <li>• Speed;</li> <li>• Temperature</li> </ul> </li> <li>• Distance</li> </ul>	
	The individual shall be able to: <ul style="list-style-type: none"> <li>• Change:               <ul style="list-style-type: none"> <li>• Injection pressure;</li> <li>• Back pressure;</li> <li>• Holding pressure;</li> <li>• Clamping pressure;</li> <li>• Injection time;</li> <li>• Injection speed;</li> <li>• Ejection speed;</li> <li>• Melt temperature;</li> <li>• Stroke (metering, opening, ejection, etc.)</li> </ul> </li> <li>• Run the machine in semi-automatic mode</li> </ul>	
8	Plastic Products	10
	The individual needs to know and understand: <ul style="list-style-type: none"> <li>• Types of defect and how to identify these defects in plastic products</li> <li>• Most likely defects and their causes</li> <li>• Solutions for remedying defects in plastic products</li> </ul>	
	The individual shall be able to: <ul style="list-style-type: none"> <li>• Locate and identify defects in plastic products, for example:               <ul style="list-style-type: none"> <li>• Weld line;</li> <li>• Crack;</li> <li>• Whitening;</li> <li>• Flow mark;</li> <li>• Burn mark;</li> <li>• Sinking mark;</li> <li>• Plastic material incompletely injected</li> </ul> </li> </ul>	

	<ul style="list-style-type: none"> <li>• Propose solutions for identified defects</li> <li>• Implement proposed solutions</li> <li style="padding-left: 20px;">Accurately measure the dimensions of a product</li> <li>• Check the condition on both the interior and exterior of a product</li> <li>• Modify and develop the plastic product</li> </ul>	
	<b>Total</b>	<b>100</b>

## 3 THE ASSESSMENT STRATEGY AND SPECIFICATION

### 3.1 GENERAL GUIDANCE

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

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

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

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

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

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

## 4 THE MARKING SCHEME

### 4.1 GENERAL GUIDANCE

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

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

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

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

The Marking Scheme and Test Project may be developed by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project must be approved by the whole Expert Jury prior to submission for independent quality assurance. The exception to this process is for those skill competitions which use an independent designer for the development of the Marking Scheme and Test Project. Please see the Rules for further details.

Experts and independent designers are required to submit their Marking Schemes and Test Projects for comment and provisional approval well in advance of completion, in order to avoid disappointment or setbacks at a late stage. They are also advised to work with the CIS Team at this intermediate stage, in order to take full advantage of the possibilities of the CIS.

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

### 4.2 ASSESSMENT CRITERIA

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

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

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

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

## 4.3 SUB CRITERIA

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form.

Each marking form (Sub Criterion) has a specified day on which it will be marked.

## 4.4 ASPECTS

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

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

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

	CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE	
	A	B	C	D	E	F	G	H				
STANDARDS SPECIFICATION SECTION	1	5.00							5.00	5.00	0.00	
	2		2.00				7.50		9.50	10.00	0.50	
	3							11.00	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

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

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

## 4.6 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, with a fourth to coordinate the marking and acting as a judge to prevent compatriot marking.

## 4.7 ASSESSMENT AND MARKING USING MEASUREMENT

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

## 4.8 THE USE OF MEASUREMENT AND JUDGEMENT

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

## 4.9 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

### A – Mould Design

- 3D model:
  - Presence of part features;
  - Shrinkage added;
  - Placement of component;
  - Size of the insert;
  - Parting surface;
  - Creation of sprue, runner and gate;
  - Ejector pin holes;
  - Assembling all elements;
  - Converting 3D into 2D.
- Drawings and Presentation:
  - Assembly drawing title block (title block should contain title, designed by, date, scale, sheet no. etc.)
  - Assembly drawing in isometric shaded view;
  - Assembly drawing part list (all the parts should be included);
  - Assembly drawing balloons (all the parts should be ballooned);
  - Top view (core half - all visible details);
  - Section view (assembly as per section);
  - Top view (Cavity half - all visible details);
  - Dimensions (as required);
  - Tolerances (GD &T as required);
  - Surface finish (as required);
  - Visual clarity.

### B – Machined parts (die)

- Main dimensions of die:
  - Main dimensions are specified in the drawing and known to Competitor;
  - Secondary dimensions;
  - Secondary dimensions are specified in the drawing and known to Competitor;
  - The dimensions are calculated and indicated on drawings by the Competitors themselves in consideration of shrinkage of the product;
  - For the shrinkage percentage of the plastic material, the value indicated on the data sheet must be known to the Competitors.

- 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 any two samples from the lot for product evaluation.
- Conformity to product forms product layout, etc.
  - Arc, round, fillet and chamfer size (only visual inspection);
  - Position of features (only visual inspection);
- Main dimensions
  - Main dimensions are specified on the product and known to the Competitors.
- Secondary dimensions
  - Secondary dimensions are specified on the product and known to the Competitors.
- 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.

## 4.10 SKILL ASSESSMENT PROCEDURES

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 where ever 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. Mould design in 4-6 hours and mould manufacturing in 10-14 hours.

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. Mould design in 4-6 hours and mould manufacturing in 10-14 hours.

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 Technician 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 after injection moulding.



## 5 THE TEST PROJECT

### 5.1 GENERAL NOTES

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

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

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

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

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

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

This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards Specification. Section 2.2 refers.

### 5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The Test Project will be in the form of engineering drawings and three-dimensional models of plastic products. Drawing file will be provided in Autodesk Inventor either in first angle or third angle projection and only English version of the software will be 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-2004) or ASME Y14.5 2009 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 Master Unit Die supplied by the sponsor;
- The base dimensions of the unit die shall be about 100 mm x 100 mm;
- Ejector stroke shall be 20 mm;
- Alternate design of the die also could be considered;
- The Test Project should not include any Hot Runner Technology or requirements;
- The plastic product for manufacturing must have a shape which enables moulding with a straight (horizontal) parting line and without a slider;
- 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 add cooling system (water line).
- Products of moulding should be able to be assembled (two cavity mould/for two separate products)
- Test Project that is made is allowed to use pin point gate, three plate mould, etc. (refer to industry standard).

## 5.4 TEST PROJECT DEVELOPMENT

The Test Project MUST be submitted using the templates provided by WorldSkills International ([www.worldskills.org/expertcentre](http://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 Mould Design is developed by an Independent Test Project Designer or Expert.

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. Mould design in 4-6 hours and mould manufacturing in 10-14 hours.

### 5.4.2 How and where is the Test Project or modules developed

The Test Project/modules are developed independently by the Experts.

### 5.4.3 When is the Test Project developed

The Test Project is developed six months before the Competition.

TIME	ACTIVITY
Six months prior to the Competition	Experts should submit one proposal for the manufacturing module to the Skill Competition Manager.
Five months prior to the Competition	The Skill Competition Manger will post the submitted proposals on the Discussion Forum for other Experts to consider.

## 5.5 TEST PROJECT VALIDATION

Test Projects will be 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.

## 5.6 TEST PROJECT SELECTION

The Test Project is selected by vote of Experts on the Discussion Forum.

- The vote will be conducted two months prior to the Competition;
- Only one of the best Test Projects which receives the highest votes in each module will be selected for circulation

## 5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

Only one Test Project which receives the highest votes in manufacturing module will be selected for circulation via WorldSkills International website one month before the Competition.

## 5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

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

## 5.9 TEST PROJECT CHANGE AT THE COMPETITION

The circulated Test Projects will be changed more than 30% by an independent Test Project Designer prior to the final selection at the competition site.

## 5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

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

The Competition Organizer will circulate the following information at least six months before 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](http://www.worldskills.org/competitorcentre)).

This information includes:

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

### 6.3 TEST PROJECTS [AND MARKING SCHEMES]

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

## 7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

- Polishing process is done without gloves but should wear safety protector such as safety glasses and mask;
- During machining process Competitors must wear safety glasses and safety shoes.

## 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](http://www.worldskills.org/infrastructure).

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

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts 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 COMPETITOR'S TOOLBOX

The maximum external size of an individual toolbox in volume shall be 0.4 m<sup>3</sup>. Maximum two toolboxes will be permitted inside the competition workshop. Volume that is bigger than the regulation will be removed from the competition workshop and 2.5 marks will be reduced from Competitor's overall marks.




### 8.3 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

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	 BULL NOSE
Face mills and inserts	
Any kind of chamfering tools (45°)	
Machine reamers (Ø2-Ø8H7)	


DESCRIPTION	PHOTO
Tools holder and collets	
Tool locking device	
Holder wrench	
Base master	
Point master	




## Drilling tools

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;	



DESCRIPTION	PHOTO
Air grinder or electric grinder	

### Measuring tools

DESCRIPTION	PHOTO
Calliper 160 mm;	
Outside micrometre set 0 mm - 100 mm;	
Inside micrometer	
Depth micrometre set 0 mm - 100 mm;	

DESCRIPTION	PHOTO
Dial indicator with stand;	
Block gauge set	

## 8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Not applicable.

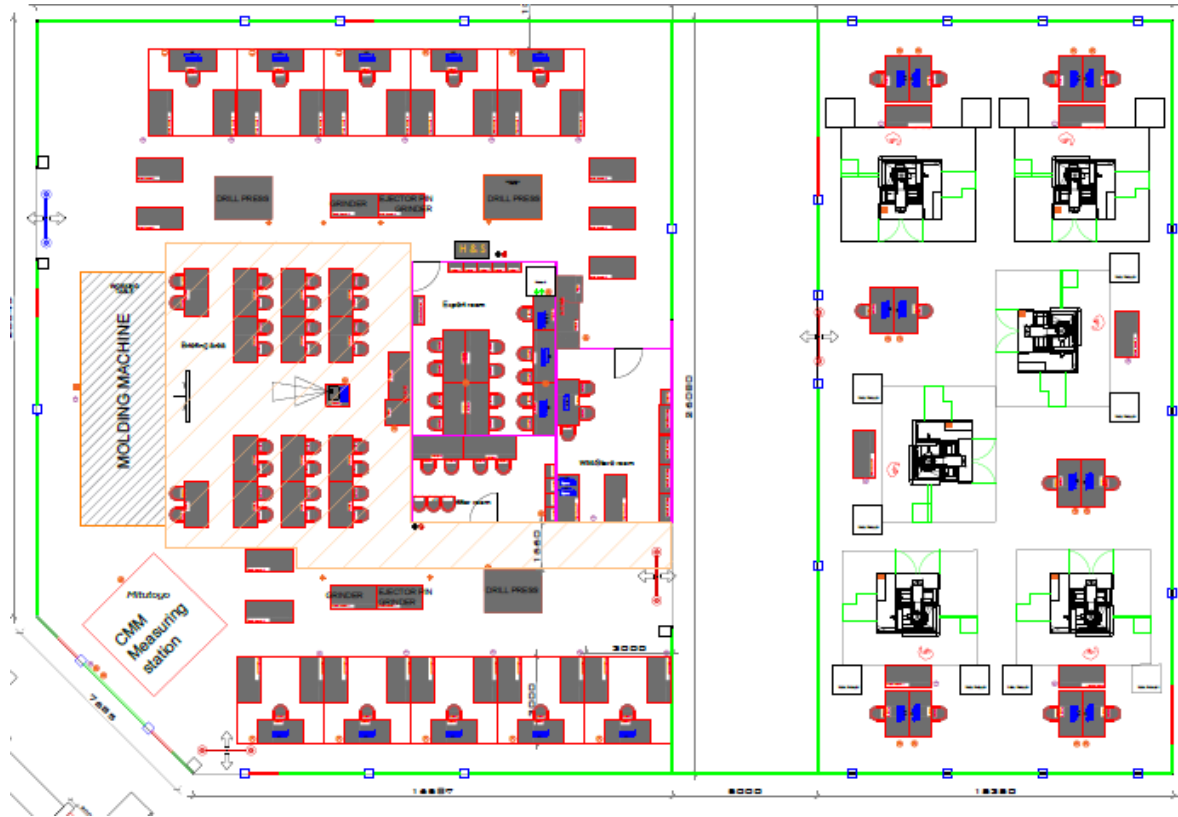
## 8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

Not applicable.

## 8.6 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

Workshop layouts from previous competitions are available at [www.worldskills.org/sitelayout](http://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 work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – USB, memory sticks	<ul style="list-style-type: none"> <li>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.</li> <li>Memory sticks or any other portable memory devices cannot be taken outside the workshop.</li> <li>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.</li> </ul>
Use of technology – personal laptops, tablets and mobile phones	<ul style="list-style-type: none"> <li>Competitors, Experts, and Interpreters are not allowed to bring personal laptops, tablets or mobile phones into the workshop.</li> </ul>
Use of technology – personal photo and video taking devices	<ul style="list-style-type: none"> <li>Competitors, Experts, and Interpreters are allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition only.</li> </ul>
Templates, aids, etc.	<ul style="list-style-type: none"> <li>Competitors are not permitted to bring any templates into the workshop including in the Competitor toolbox. Standard Design template will be provided only for manufacturing module.</li> </ul>
Drawings, recording information	<ul style="list-style-type: none"> <li>Competitors are not permitted to use prepared reference material. Plain paper sheet will be provided for rough work and it should not be taken out of workshop.</li> </ul>
Equipment failure	<ul style="list-style-type: none"> <li>If equipment or tools supplied by the Competition Organizer fail Competitors will be allowed extra time to compensate for the time lost.</li> </ul>
Health, Safety, and Environment	<ul style="list-style-type: none"> <li>Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.</li> </ul>
Assessment	<ul style="list-style-type: none"> <li>All critical dimensions on mould and product developed by the Competitor will be checked on CMM only and no modification will be allowed on the CMM report.</li> <li>Repeatability errors up to two microns during CMM inspection and three microns in manual inspection will be permitted.</li> <li>Experts will not be allowed to assist Competitors during mould testing.</li> </ul>

TOPIC/TASK	SKILL-SPECIFIC RULE
Other	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• Competitors should submit the solid model before proceeding to drafting and no modification will be permitted on model during drafting</li> </ul>

## 10 VISITOR AND MEDIA ENGAGEMENT

To maximize visitor and media engagement for this skill the following may be considered:

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

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

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

This WSSS (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 Standards Specification in place for WorldSkills Kazan 2019.

ORGANIZATION	CONTACT NAME
Gedee Technical Training Institute (GTTI), India	Ramachandran. T. P., Senior Counsellor