Technical Description

Mechanical Engineering Design – CAD

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.

The Technical Description consists of the following:

Effective 12.10.16

Stefan Praschl
Chair of the Competitions Committee

Michael Fung
Vice Chair of the Competitions Committee

1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

Mechanical Engineering CAD

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

Computer aided design is the use of computer systems to assist in the creation, modification, analysis, or optimization of an engineering design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communication through documentation, and create a database for manufacturing. CAD output is often in the form of electronic files for print, manufacturing or other manufacturing processes.

The technical and engineering drawings and images must convey information such as materials, processes, dimensions and tolerances according to application-specific conventions. CAD may be used to design curves and figures in two-dimensional (2D) space or curves, surfaces and solids in three-dimensional (3D) space. CAD is also used to produce computer animation for the special effects used in, for example, advertising and technical manuals.

CAD is an important industrial art and is the way projects come true. It is extensively used in many applications, including automotive, ship building and aerospace industries, and in industrial design. The CAD process and outputs are essential to successful solutions for engineering and manufacturing problems.

CAD software helps us explore ideas, visualize concepts through photorealistic renderings and movies and simulates how the design project will perform in the real world.

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).

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 not be separate tests of knowledge and understanding.

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. 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.

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2.2 **WORLDSKILLS STANDARDS SPECIFICATION**

SECTION		RELATIVE IMPORTANCE (%)
1	**Work organization and management**	15
	The individual needs to know and understand: • The various purposes and uses for CAD designs • Current internationally recognized standards (ISO) • Standards currently used and recognized by industry • Health and safety legislation and best practice including specific safety precautions when using a visual display unit (VDU) and in a work station environment • Relevant theory and applications of mathematics, physics, and geometry • Technical terminology and symbols • Recognized IT systems and related professional design software • The importance of accurate and clear presentation of designs to potential users • The importance of effective communications and inter-personal skills between co-workers, clients and other related professionals • The importance of maintaining knowledge and skill in new and developing technologies • The role of providing innovative and creative solutions to technical and design problems and challenges	

The individual shall be able to:
- Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry
- Apply and promote health and safety legislation and best practice in the workplace
- Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects
- Access and recognize standard component and symbol libraries
- Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings
- Use recognized IT systems and related professional design software to consistently produce high quality designs and interpretations
- Deal with systems problems such as error messages received, peripherals which do not respond as expected, and obvious faults with equipment or connecting leads
- Produce work that consistently meets high standards of accuracy and clarity in the design and presentation of designs to potential users
- Demonstrate effective communications and inter-personal skills between co-workers, clients, and other related professionals to ensure that the CAD process meets requirements
- Describe to clients and other professionals the role and purposes for CAD designs
- Explain complex technical images to experts and non-experts, highlighting key elements
- Maintain proactive continuous professional development in order to maintain current knowledge and skill in new and developing technologies and practices
- Provide and apply innovative and creative solutions to technical and design problems and challenges
  Visualize the desired product in order to fulfil the client's brief accurately

2	Materials, software, and hardware	15

The individual needs to know and understand:
- Computer operating systems to be able to use and manage computer files and software correctly
- Peripheral devices used in the CAD process
- Specific specialist technical operations within design software
- The range, types and uses of specialist product available to support and facilitate the CAD process
- The production process for designs
- The limitations of design software
- Formats and resolutions
- The use of plotters and printers

	The individual shall be able to: • Power up the equipment and activate the appropriate modelling software • Set up and check peripheral devices such as keyboard, mouse, 3D mouse, plotter, and printer • Use computer operating systems and specialist software to create and manage and store files proficiently • Select correct drawing packages from an on-screen menu or graphical equivalent • Use various techniques for accessing and using CAD software such as a mouse, menu, or tool bar • Configure the parameters of the software • Plan the production process effectively to produce efficient work processes • Use plotters and printers to print and plot work		
3	**3D modelling and creation of animations**	**30**	
	The individual needs to know and understand: • Programmes in order to be able to configure the parameters of the software • Computer operating systems in order to use and manage computer files and software • Mechanical systems and their functionality • Principles of technical drawing • How a component is assembled • How to demonstrate the working of an image		
	The individual shall be able to: • Model components, optimizing the constructive solid geometry • Create families of components • Ascribe characteristics to the materials (density) • Ascribe colours and textures to the components • Produce assemblies from 3D models of components • Structure assemblies (sub-assemblies) • Review base information to plan work effectively • Access information from data files • Model and assemble base components of project pieces • Estimate approximate values for any missing dimensions • Assemble modelled parts into sub-assemblies as required • Apply graphics decals such as logos as required onto images • Create functions relative to the operation of the system being designed using industry programmes • Create animations that demonstrate how different parts work or are assembled • Save work for future access		

4	**Create photo rendered images (2D)**	5
	The individual needs to know and understand: • The use of lighting, scenes and decals to produce photo rendered images	
	The individual shall be able to: • Save and label images to access for further use • Interpret source information and accurately apply to the computer generated images • Apply material properties using information supplied from source drawings • Create photo rendered images of components or assemblies • Adjust colours, shading, backgrounds and camera angles to highlight key images • Use camera settings to show better angles of the project • Print completed images for presentation purposes	
5	**Reverse engineering of physical models**	10

	The individual needs to know and understand:
	• Materials and processes for obtaining unprocessed work pieces:
	
	   • Castings
	   • Welding
	   • Machining
	   • Simulation
	
	• The process to transfer a real object to a 3D image and then to a technical drawing	

	The individual shall be able to: • Determine dimensions on physical parts by using industry accepted instruments • Create freehand sketches • Use measuring instruments to produce accurate replicas	
6	**Technical drawing and measuring**	25
	The individual needs to know and understand: • Working drawings in ISO standard together with any written instruction • Standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard • Rules of technical drawing and the prevailing latest ISO standard to govern these rules • The use of manuals, tables, list of standards, and product catalogues	

	The individual shall be able to: • Generate working drawings in ISO standard together with any written instructions • Apply standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard • Apply the rules of technical drawing and the prevailing latest ISO standard to govern these rules • Use manuals, tables, lists of standards, and product catalogues • Insert written information such as explanation balloons and parts lists with more than one column using annotation styles that meet ISO standards • Create 2D detail technical drawings • Create exploded isometric views	
	Total	**100**

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3 THE ASSESSMENT STRATEGY AND SPECIFICATION

3.1 GENERAL GUIDANCE

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

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

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

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

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

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

4 THE MARKING SCHEME

4.1 GENERAL GUIDANCE

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

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

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

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

The Marking Scheme and Test Project may be developed externally by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project designed externally 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 external designer for the development of the Marking Scheme and Test Project where the final versions of the Marking Scheme and Test Project are quality approved and quality assured by the Skill Competition Manager.

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

In all cases the complete and approved 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. The Skill Competition Manager is responsible for this process.

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 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).

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 A within that Assessment Criterion.

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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.

Each marking form (Sub Criterion) contains Aspects to be assessed and marked by measurement or judgement. Some Sub Criteria have Aspects marked by both measurement and judgement, in which case there is a marking form for each.

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, and appear on the appropriate marking form.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it and a reference to the section of the skill as set out in the Standards Specification.

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			2.75	1.00	1.25	0.25	1.00		6.25	6.00	0.25
	2		4.25			2.00		0.50	1.00	7.75	6.00	1.75
	3	11.00	9.75							20.75	22.00	1.25
	4			10.25	11.00					21.25	22.00	0.75
	5					9.50	10.00	1.50		21.00	22.00	1.00
	6					2.00		7.00	14.00	23.00	22.00	1.00
TOTAL MARKS		11.00	14.00	13.00	12.00	14.75	10.25	10.00	15.00	100.00	100.00	6.00

4.5 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
- 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 acting as a judge where required to prevent compatriot assessment.

4.6 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.

4.7 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.

4.8 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

This Skill Competition is classed as "fault finding" on all days, therefore no Expert and Competitor communication during the competition time including breaks and lunch period will be allowed.

Module one - Mechanical Assemblies and Detail Drawing for Manufacture

- Part Modelling;
- Assembly Modelling;
- Dimensioning including GDT;
- Drawing Views and Presentation (part judgement);

Module two – Mechanical Fabrication

- Sheet Metal Parts and Assemblies;
- Frame Parts and Assemblies;
- Fabrication Drawing Details;
- Drawing Views and Presentation (part judgement).

Module three – Mechanical Design Challenge

- Fulfilment of the Design Brief (part judgement);
- Physical Simulation (part judgement);
- Exploded view (simulation) (part judgement);
- Photo rendering (part judgement).

Module four – Reverse Engineering from a Physical Model

- Presence of part features;
- Accuracy of dimensions;
- Tolerances;
- Surface Texture;
- Presentation (judgement).

4.9 SKILL ASSESSMENT PROCEDURES

The Chief Expert will divide the Experts into four groups. They will make sure to have Experts with WorldSkills experience and first Competition Experts in the same group.

Each group will be responsible to mark every aspect in one of the four Test Project modules.

Each Expert will mark all the aspects in the day that their group is responsible.

Each Expert will mark exactly 25% of the total marks assessed where possible.

At the end of each day the marks will be entered into the CIS.

Blind marking will be applied whenever possible.

There are no special processes to be followed during marking.

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 and balanced 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.

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 is a series of four standalone modules.

Skills that could be tested in the different modules could cover:

- Sheet metal parts;
- Frame structures and assemblies;
- Welded parts and assemblies;
- Mechanical parts and assemblies;
- Detail drawing;
- Functional animation and photo rendering;
- Reverse engineering from a physical model;
- Modification of a product to fulfil and design brief;
- 3D printing

A combination of the above skills is allowed in each module but different competencies must be tested in each module

5.3 TEST PROJECT DESIGN REQUIREMENTS

The Competition is divided into four modules covering the following categories:

Day one (six hours) – Mechanical assemblies and detail drawing for manufacture:

Data:

- Finished drawings of components or assemblies;
- 3D models of components or assemblies;
- Nomenclature;
- All necessary additional information.

Work requested:

- To produce models of components from detail drawings;
- To produce an assembly;
- To produce detail drawing(s) for manufacture;
- To input components from Inventor Content Centre.

Results expected:

- Part and Assembly file(s);
- Assembly drawing(s);
- Detail drawings for manufacture;
- Nomenclature;
- Exploded view(s).
- One animation showing physical simulation in file format .avi;

Day two (six hours) – Mechanical Fabrication:

Data:
- Finished drawings of components;
- 3D models of components or assemblies;
- Nomenclature;
- All necessary additional information.

Work requested:

- To produce sheet metal parts and assemblies;
- To produce metal frame parts and assemblies using Autodesk Inventor Frame Generator;
- To add welded connections to parts and assemblies;
- To add bolted connections to parts and assemblies;
- To produce sheet metal and welding detail drawings.
- One animation showing full exploded or collapsing view sequence in file format .avi;

Results expected:

- Part and Assembly file(s);
- Assembly drawing(s);
- Detail drawings for manufacture;
- Nomenclature.

Day three (six hours) – Mechanical Design Challenge:

Data:

- Assemblies (3D models);
- Layout (assemblies and components);
- Technical specifications for the design change to be applied;
- Design brief;
- All necessary additional information.

Work requested:

- Produce functional assembly(s) from given data;
- Implement the design change;
- Autodesk Inventor Design Accelerator may be used to generate parts and assemblies;
- Produce assembly drawing(s) of design change;
- Produce exploded views;
- Produce physical simulations using Autodesk Inventor Studio or Autodesk Showcase;
- Produce photo rendered images using Autodesk Inventor Studio or Autodesk Showcase.

Results expected:

- Modified files (components and assemblies);
- Assembly drawing of design change;
- One Animation showing full exploded and collapsing view sequence and physical simulation of design change in file format .avi;
- Photo Rendered images of design change up to a maximum of A3 size;
- Nomenclature;
- 3D printed parts as solution

Day four (four hours) – Reverse Engineering from a Physical Model:

Data:

- Physical component(s) and assembly(ies);
- File of parts and assemblies;
- All the necessary additional information.

Work requested:

- Making files and layout from dimensions taken from a physical component;
- The scaled drawing will be produced using measuring instruments in Appendix one Tool List;
- The use of systems enabling the memorization of scaled drawings or shapes is prohibited (Photographs, malleable putty, ink pad, etc.);
- The Competitor may produce sketches on paper which will serve as the basis for producing the 3D modelling of the components or assemblies;
- The physical component(s) will be given to the Competitors for two hours and then confiscated. The Competitor will then continue his task on the basis of the sketches and information collected previously.
- The use of the computer is allowed during all the competition time.
- Results expected:
- 3D models of components or assemblies;
- 3D Annotation;
- Manufacturing drawing(s) of components or assemblies.

Output format:

Use of Autodesk Inventor Professional and/or Autodesk Showcase. The version will be determined by the Skill Competition Manager six months before the Competition.

- Drawing plotted on sizes A1 and smaller;
- Charts, table and documents printed by laser printers on paper sizes A3;
- Screenshots, rendering on colour printer to a maximum size of A3;
- Files, components, assemblies, etc. according to the instructions for the test;
- During the competition, each Competitor is allowed no more than two checking prints of each drawing. The final printing will take place after the end of each competition day time;
- PDF prints may be asked to reduce the paper waste;
- Day one: minimum three detail drawings and one assembly drawing; maximum two assembly drawings;
- Day one and day three: checking/marking the functionality is allowed with 3-D printing parts;
- Maximum three videos over all four days (note: a movement has to be recognisable to be validated);
- Maximum one image (sheet/file) each day (note: not only a background-screen).

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

The Test Project is developed by an external enterprise (possibly Autodesk).

5.4.2 How and where is the Test Project or modules developed

The external enterprise is to produce five Test Projects (Modules), four to use in the Competition and one more as a backup plan, including the marking scheme.

The Test Project must be developed in Autodesk Inventor, and all files must come along with the Test Project.

All the physical models for Module four (one for each Competitor), must be provided by the external enterprise to WorldSkills International, one month before Competition.

The presence of a Technical/Support Team from Autodesk and from IT Management, during all pre-competition and Competition period is mandatory.

All Test Project modules have to be fully checked by the Test Project designer and/or a second person from the external enterprise.

The presence of the Test Project designer is mandatory during all pre-competition and Competition period

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
Six (6) months before the current Competition	The Test Project is to be developed.
One (1) month before the Competition	The Test Project must be submitted to WorldSkills International for validation.

5.5 TEST PROJECT VALIDATION

At the Competition all Experts will be divided into four groups. Each group will be given the task to verify the validity of one the finally selected Test Projects. The group will be required to:

- Verify that all documents are present;
- Verify that Test Project is within the design criteria;
- Ensure that the Test Project can be completed within the time frame;
- Ensure that proposed marking aspects are adequate;
- Verify if there are two versions of drawings, first angle, and second angle projection method;
- Verify if there's a marking scheme version to be given to the Competitors;
- If, after examination, the selected Test Project is found incomplete or unfeasible, it shall be discarded and replaced with the backup Test Project.

5.6 TEST PROJECT SELECTION

Not applicable.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The Test Project is not circulated.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

The Skill Competition Manager and the Director of Skills Competition.

5.9 TEST PROJECT CHANGE AT THE COMPETITION

All necessary changes will be made by the Test Project producer based on each team of Experts' feedback.

5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

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

Not applicable.

6 SKILL MANAGEMENT AND COMMUNICATION

6.1 DISCUSSION FORUM

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

6.2 COMPETITOR INFORMATION

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

This information includes:

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

6.3 TEST PROJECTS [AND MARKING SCHEMES]

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

6.4 DAY-TO-DAY MANAGEMENT

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

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

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8 MATERIALS AND EQUIPMENT

8.1 INFRASTRUCTURE LIST

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

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

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

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

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

8.2 COMPETITOR'S TOOLBOX

The maximum toolbox size is 800 mm x 800 mm x 500 mm.

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

- Compendium of standards;
- Technical manuals;
- Instruments for freehand sketching;
- Measuring instruments (see appendix one Tool List);
- The Competition Organizer must supply identical tools during the Competition for the Experts;
- Personal keyboard and mouse (including drivers), if different than the ones supplied by Host Member;
- "Space Mouse" (3D Mouse) is allowed. Different electronic equipment must be presented to the Expert team for validation.

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Not applicable.

## 8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

All materials and equipment brought by Competitors will have to be presented to the Experts. The Jury shall rule out any items brought to the Competition that are not considered normal Engineering Drawing and CAD related tools and equipment, that will give any Competitor an unfair advantage.

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

Example workshop layout:
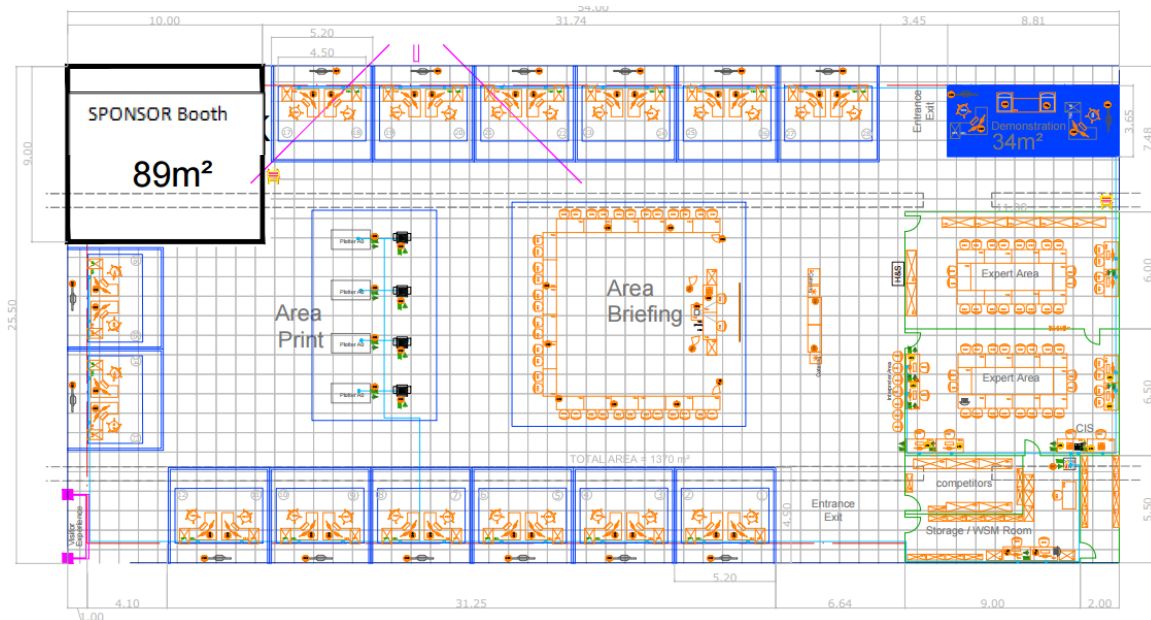
9 SKILL-SPECIFIC RULES

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 work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – USB, memory sticks	• No external memory devices are to be connected to the competition computer unless under the supervision of the Chief Expert and Deputy Chief Expert. • Competitors are not allowed to load any digital data to their competition computers.
Use of technology – personal laptops, tablets and mobile phones	• Experts and Interpreters are allowed to use personal laptops, tablets and mobile phones in the Expert room only. • Competitors are not allowed to bring personal laptops, tablets or mobile phones into the workshop. • Wireless Headphones are not allowed.
Use of technology – personal photo and video taking devices	• During module three the use of personal photo and video taking devices is forbidden in the workshop.
Communication and contact between compatriot Expert and Competitor	• No communication during breaks or lunch time between Expert/Interpreter and Competitor. • Competitor and compatriot Expert/Interpreter cannot be outside the competition area at same time unless is approved by CE.
Health, Safety, and Environment	• Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.

10 VISITOR AND MEDIA ENGAGEMENT

Below is a list of possible ways to maximize visitor and media engagement for this skill:

- Try a trade;
- Display screens;
- Test Project descriptions;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status;
- 3D Printing;
- Sponsors booth.

11 SUSTAINABILITY

This skill competition will focus on the sustainable practices below:

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

12 REFERENCES FOR INDUSTRY CONSULTATION

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

In addition, the career exploration and job analysis database, O*NET OnLine (www.**oneto**nline.org/), is used as a reference to all occupations represented at the WorldSkills Competition.

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 Abu Dhabi 2017.

ORGANIZATION	CONTACT NAME
Autodesk	Matthew Bell, Secondary Education Manager for Europe
Voith Paper Máquinas e Equipamentos Ltda.	Guilherme Custódio de Araújo, Mechanical Designer

13 APPENDICES

13.1 APPENDIX ONE – TOOL LIST

Vernier/Dial/ Digital Caliper (0-150mm or 0-200mm)

Vernier/Dial Digital Offset Centerline Caliper

Digital or Universal Protractor

Radius Gages (0.4 to 25mm)

External Metric Thread Pitch Gage (0.35 to 6mm)

Internal Metric Thread Pitch Gage (0.35 to 6mm)

4 sizes in this range has to be define 6 months for C1

Use of screws/thread plugs is allowed

Surface comparator gauges (Ra) (not mandatory)

Metallic Ruler (0-300mm)

Vernier/Dial/ Digital Depth Gage Caliper (0-150mm or 0-200mm)

13.2 APPENDIX TWO – CAD SOFTWARE (AUTODESK INVENTOR) BASE FUNCTIONALITY LIST

After installation of the following file, all listed functionalities will be linked to his own explanation.
Local installation file:

http://download.autodesk.com/us/support/files/inventor_2016_help/Autodesk_Inventor_2016_Help.exe

Online support:
http://help.autodesk.com/view/INVNTOR/2016/ENU/

- Fundamentals
  - File types;
  - Parts;
  - Features;
  - Assemblies;
  - Drawings;
  - Publish Designs;
  - Manage Data;
  - Print Designs;
  - Styles and Style Libraries

- Work Environment

    - Application Options settings;
    - Configure Default Templates;
    - Document Settings;
    - Measurement units;
    - Projects;
    - Command Alias input and behaviour;
    - Autodesk Exchange App Manager;
    - Custom command aliases;
    - Custom shortcut keys;
    - Customize info tips in Inventor

- Parts

    - 2D sketches;
    - 3D sketches;
    - Dimensions;
    - Constraints;
    - Work geometry and work features;
    - Part modelling overview;
    - Part features;
    - Plastic Features;
    - I-Features and iParts;
    - Part faces and bodies;
    - Solid modelling;
    - Representations;
    - Part Analysis;
    - Repair Environment;
    - Construction Environment;
    - Sheet metal parts

- Assemblies
    - Build assemblies;
    - Bills of materials:

        - Bills of materials overview;
        - Manage item numbers in bills of materials;
        - Structure of bills of materials;
        - Bill of Materials Editor;
        - Parts lists and BOMs in iAssemblies

- Representations
- Functional design
  - Design Accelerator
    - Bolted Connection;
    - Shaft;
    - Involute Splines;
    - Parallel Splines;
    - Key Connection;
    - Disc Cam;
    - Linear Cam;
    - Spur Gears;
    - Bevel Gears;
    - Worm Gears;
    - Bearing;
    - V-Belts;
    - Synchronous Belts;
    - Roller Chains;
    - Clevis Pin;
    - Joint Pin;
    - Secure Pin;
    - Cross Pin;
    - Radial Pin;
    - O-ring
  - Component Generators
    - Bolted Connection Component Generator;
    - Shaft Component Generator;
    - Parallel Splines Component Generator;
    - Involute Splines Component Generator;
    - Parallel Key Connection Generator;
    - Cam Component Generators;
    - Spur Gears Component Generator;
    - Bevel Gears Component Generator;
    - Worm Gears Component Generator;
    - Bearing Component Generator;
    - Plain Bearing Calculator;
    - Compression Spring Component Generator;
    - Extension Spring Component Generator;
    - Torsion Spring Component Generator;
    - Belleville Spring Component Generator;
    - V-Belts Component Generator;
    - Synchronous Belts Component Generator;
    - Roller Chains Generator;
    - Clevis Pin Component Generator;
    - Pin Component Generators;
    - O-Ring Component Generator
  - Calculators;

- Content Centre:
  - Configuration of Content Centre libraries;
  - Manage libraries on the server;
  - Migrate or synchronize user libraries;
  - Navigate in Content Centre;
  - Search in Content Centre;
  - Content Centre Consumer;
  - Auto Drop;
  - Refresh Standard Components;
  - Content Centre Editor;
  - Publish parts and features in Content Centre
- Build structural frames with Frame Generator
  - Frame Generator;
  - Apply or Modify End Treatments;
  - BOMs and Cut Lists;
  - Structural Shape Authoring;
  - Tips for generating frames;
  - Frame Generator browser
- Weldments;
- Weldments environment
  - Templates for weldments;
  - Strategies for designing weldments;
  - Weld bead feature types;
  - Weld feature groups;
  - Welding symbols on models
- Drawings
  - Create drawing views
    - Develop drawings for large assemblies;
    - Design view representations in drawing files;
    - Drawing views;
    - Alignment, orientation, and rotation of drawing views;
    - Sketches in drawings;
    - Project geometry to drawing sketches;
    - Section views;
    - Detail Views;
    - Overlay Views;
    - Break Operations;
    - Crop Operations;
    - Slice Operations;
    - Create drawing views of surfaces;

- Drawing annotations
    - Suppressed annotations;
    - Dimensions in drawings;
    - Centre lines and centre marks;
    - Symbols, sketched symbols, and blocks;
    - Tables;
    - Hole notes;
    - Hole tables;
    - Balloons;
    - Parts lists;
    - Text in drawings;
    - Text in drawing sketches;
    - Weld annotations in drawings;
    - Revision tables and revision tags;
    - Sheet metal annotations in drawings;
- Exploded views and presentations
- Visualization
    - Render and animate with Inventor Studio
        - Studio browser;
        - Styles for rendering;
        - Rendering Images;
        - Animating in Studio