

Technical Description

# Construction Metal Work

Manufacturing and Engineering Technology



WorldSkills International, by a resolution of the Competitions Committee and in accordance with the Constitution, the Standing Orders and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

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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

Construction Metal Work

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

Construction metalworking is the assembly and installation of steel structures, vessels and components that encompass the food & dairy, pharmaceutical & chemical industries, architectural engineering and structural steel work for buildings and bridges. Very high standards of finish and quality are expected from the construction metalworker as food and pharmaceutical products are transported and produced from steel components that a construction metalworker would assemble. High-rise buildings, stadiums and bridges are erected using the skills of the construction metalworker along with cutting edge architectural designs that affect the modern landscape for innovative building designs.

The skills required for construction metalworking involve;

- A thorough knowledge and understanding of safe working practices, personal protection equipment and the hazards and practices associated with the construction metalworking industry.
- Interpretation of engineering drawings.
- Knowledge of mathematical calculations, geometrical construction techniques and computer-aided design and drafting software applications.
- A comprehensive knowledge of a range of industrial cutting and forming processes to suit a range of steels and alloys including low carbon steel, stainless steel, alloy steels, aluminium alloys and also working with different tube & pipe standards.
- Shaping and forming these steel components with the aid of thermal processes and a range of machinery used in cutting, bending and rolling metal plate
- Using modern thermal cutting processes such as plasma, laser and waterjet cutting techniques.
- Applying a range of welding processes such as Manual Metal Arc welding, TIG/TAG (Tungsten Inert Gas & Tungsten Active Gas) welding, MIG/MAG (Metal Inert Gas & Metal Active Gas) welding to assemble and join materials into structures and products.

Work organization & self-management, working precisely and accurately, concentration, attention to detail, communication and interpersonal skills, problem solving, innovation and creativity, are the universal attributes of the construction metal worker.

Construction metalworkers are highly skilled individuals who are able to work autonomously, contribute to a technical team, take personal responsibility for completing projects to approved quality standards in a timely manner, and interact effectively with colleagues and customers in an industrial setting. Every step in the process matters and mistakes are largely irreversible and very costly.

With the international mobility of people, construction metalworkers face rapidly expanding opportunities and challenges. For talented construction metalworkers, there are many commercial and international opportunities, which carry with them the need to understand and work with diverse cultures and trends.

1.1.3 Number of Competitors per team

Construction Metal Work 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>• The standards and regulations relating to health and safety, security, and hygiene within the construction metal industry</li> <li>• The precautions and methods of operation for common hand tools</li> <li>• The precautions for the safe use, maintenance, and adjustment of mechanical and thermal cutting equipment</li> <li>• The safe use, adjustment, and maintenance of mechanical and hand bending and forming equipment</li> <li>• The requirements and possibilities for environmental management and sustainability within the industry</li> <li>• The selection, use, and maintenance of the range of Personal Protective Equipment used in the construction metalwork industry</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Work safely with regard to self and others</li> <li>• Maintain a safe and clean working environment</li> <li>• Use hand and power tools safely</li> <li>• Use and adjust thermal and mechanical cutting and shearing equipment safely</li> <li>• Use and adjust hand and mechanical bending and forming equipment</li> <li>• Carry out work with consideration to the environmental and sustainability issues relating to the industry</li> <li>• Select and use appropriately the relevant personal protective equipment appropriate for the task</li> </ul>	
2	<b>Communication and interpersonal skills</b>	5
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The roles and requirements of customers, architects and design engineers, and related tradespersons, and effective methods of communication</li> <li>• Detailed instructions from customers, architects, design engineers, and Engineering Supervisors.</li> <li>• Non-verbal communication such as drawings, guidelines, international standards, etc.</li> <li>• The importance of good team work</li> </ul>	

	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Interpret and implement the customer's brief</li> <li>• Clarify any possible misunderstanding in the drawing by asking the relevant questions</li> <li>• Read and use all necessary manuals, drawings, guidelines, etc. to achieve a good result of the work</li> <li>• Work effectively as a member of a team</li> </ul>	
<b>3</b>	<b>Marking out techniques</b>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• First and third angle orthographic projection</li> <li>• Drawing and welding symbols used on engineering drawings</li> <li>• ISO standard numbers</li> <li>• Mathematical calculation and unit translation</li> <li>• Geometrical development methods and practice</li> <li>• The selection, use, and maintenance of measuring and checking equipment</li> <li>• The differences between a cutting list and a material list</li> <li>• The techniques of flat pattern development</li> <li>• Structural joint connection types</li> <li>• Methods of interpreting and using information and instructions for production</li> <li>• Tolerances and their relationship to accuracy</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Interpret engineering drawings and symbols</li> <li>• Perform standard mathematical calculations including areas, volumes, and unit conversion</li> <li>• Select and use measuring equipment</li> <li>• Prepare a comprehensive materials list</li> <li>• Develop and cut patterns using parallel, radial, and triangulation methods</li> <li>• Mark out, form, and assemble construction joint connections</li> <li>• Carry out cutting and assembly using production instructions to given tolerances</li> </ul>	
<b>4</b>	<b>Cutting techniques</b>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The selection, use, and maintenance of mechanical equipment used such as shears, corner shears, guillotine, saws, and grinders</li> <li>• Processes for cutting/grinding materials to given tolerances</li> <li>• The selection and use of thermal cutting equipment to include Oxy-Acetylene torch, cutting wheels, guides and circle cutters</li> <li>• The techniques for punching, countersinking, drilling, tapping, and reaming holes in a variety of metals and non-ferrous materials</li> </ul>	

	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Use power tools and mechanical methods to cut/shear materials to given tolerances</li> <li>• Use thermal cutting equipment to cut low carbon steels using manual cutting wheels, straight edges, and circle cutters and guides</li> <li>• Use hand and power tools to cut, punch, drill, countersink, tap, and ream holes in a variety of metals</li> </ul>	
<b>5</b>	<b>Forming techniques</b>	<b>15</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The adjustment and operation of manual or mechanical forming machines</li> <li>• The adjustment and operation of brake presses</li> <li>• The adjustment and operation of pinch and pyramid rolls</li> <li>• The selection, adjustment and maintenance of oxy-acetylene gas heating equipment</li> <li>• The adjustment and operation of flat bar benders</li> <li>• The adjustment and operation of manual and mechanical folders</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Use manual or mechanical forming machines to cold form metals</li> <li>• Adjust and use oxy/acetylene equipment to hot form plate and section</li> <li>• Bend low carbon steels using a flat bar bender</li> <li>• Use manual or mechanical break presses or folders to shape low carbon steels, stainless steels, aluminium, and alloys</li> <li>• Use pinch and pyramid rolls to produce required shapes</li> <li>• Use a mechanical brake press or folder to produce straight bends to any angle</li> </ul>	
<b>6</b>	<b>Assembly and finishing techniques</b>	<b>35</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Assembly techniques and symbols used in engineering drawings and project descriptions</li> <li>• The use of hand and power tools for assembly</li> <li>• The types, selection and operation of pivot and locking devices in common use</li> <li>• The range of mechanical fastenings used in the construction metalwork industry including:           <ul style="list-style-type: none"> <li>• Rivets;</li> <li>• Nuts and bolts;</li> <li>• Locking and flat washers;</li> <li>• Screws;</li> <li>• Manufacturers mechanical fasteners</li> </ul> </li> <li>• The range of edge, surface and joint finishes available</li> <li>• The range of tools used to achieve required finishes</li> <li>• The use of standard techniques for checking dimensional stability</li> </ul>	

	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Use correct assembly skills as required</li> <li>• Select and use hand and power tools for assembly</li> <li>• Construct moving pivots and locking devices as required</li> <li>• Select and place and fix mechanical fittings as required for assemble</li> <li>• Finish project edges, surfaces and joints as required using hand and power tools to include:           <ul style="list-style-type: none"> <li>• Files;</li> <li>• Wire brushes;</li> <li>• Abrasives;</li> <li>• Deburring tools</li> </ul> </li> <li>• Use non-chemical weld cleaning techniques</li> <li>• Check structures for accuracy, square, and flatness</li> </ul>	
<b>7</b>	<b>Welding and joining techniques</b>	<b>20</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The selection and use of Welding processes including:           <ul style="list-style-type: none"> <li>• Manual metal arc welding (111);</li> <li>• Gas metal arc welding (135);</li> <li>• Gas Tungsten arc welding (141)</li> </ul> </li> <li>• The range of welding consumables available, their selection, and storage</li> <li>• Polarities adopted for welding processes</li> <li>• Preparation techniques prior to welding</li> <li>• Weld faults and rectification</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Select, adjust and use manual metal arc welding equipment to produce welded joints in steel</li> <li>• Select, adjust and use manual metal arc welding equipment to produce joints in low carbon steel and stainless steels</li> <li>• Select, adjust and use gas metal arc welding equipment to produce joints in low carbon steel and stainless steels</li> <li>• Select, adjust and use gas tungsten arc welding equipment to produce joints in stainless steels, aluminium and aluminium alloys with no need for weld penetration.</li> <li>• Select welding consumables to suit position, weld polarity and type of material:           <ul style="list-style-type: none"> <li>• MMAW (111) Carbon steel - E6013, S/S-E304L, E309L</li> <li>• GMAW (135) Carbon steel - E70S6</li> <li>• GTAW (141) Carbon steel - ER70S2, S/S – E304L, E308L and Aluminium welding</li> </ul> </li> <li>• Remove surface contamination and prepare joint for welding regarding, type, and material thickness</li> <li>• Interpret weld position standards to ISO standards (Sys A)           <ul style="list-style-type: none"> <li>• PA/1G</li> <li>• PB/2F</li> </ul> </li> <li>• Identify and repair weld faults</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 a whole must reflect the weightings in the Standards Specification.

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

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

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

## 4.3 SUB CRITERIA

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

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

## 4.4 ASPECTS

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

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

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

	CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE	
	A	B	C	D	E	F	G	H				
STANDARDS SPECIFICATION SECTION	1	5.00								5.00	5.00	0.00
	2		2.00					7.50		9.50	10.00	0.50
	3								11.00	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, in all circumstances. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (See 4.6.)

## 4.6 ASSESSMENT AND MARKING USING JUDGEMENT

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

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts or separate guidance notes)
- the 0-3 scale to indicate:
  - 0: 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

The tolerance ranges for primary, secondary, and technical perfection shall be in the range of +/- 0.59 mm to 4.09 mm

### A – Primary dimensions

- Measurements taken in various positions;
- Marks awarded for primary dimensions should be allocated to parts/module according to the degree of difficulty to achieve an assembly.
  - Function of a part or module
  - Bending/folding of various grades of sheet & plate in a range of thicknesses
- If round pipes are included in the measurements, tolerance will be 0.84 mm.

### B – Secondary dimensions

- Measurements taken in various positions;
- Marks awarded for secondary dimensions should be allocated to parts/module according to the degree of difficulty to achieve an assembly. For example:
- If round pipes are included in the measurements, Tolerance will be 0.84 mm.

### C – Technical perfection

- Squareness;
- Parallelism;
- Flatness;

### D – Welding Symbols

- Welding completed as per number of the welds stated as for the process

### E – Drilling

- Quality of drilling
- Tolerance to be determined on the Discussion Forum minimum six weeks prior to the Competition. The hole size will be checked with a drill shank. Example: for a hole size of  $\text{Ø}12.2$  mm with a tolerance of 0.2 mm,  $\text{Ø}12.3$  is correct, but it should not be greater than  $\text{Ø}12.4$ .

### F – Use of materials

### G – Function

- Assessment depends on the Test Project

#### H – Bending, forming, and rolling

- Parts formed not have a tolerance of less than 1.09 mm.

#### I – Welding

- Quality of welding

#### J – Flame cutting

- Thermal Cutting on the Test Project:

#### K - General impression

- Fabrication symmetry (position and orientation of parts) and joint alignment (visual consideration not included in any other previous criteria). Finished module is free from burrs, sharp edges and work marks.
- Pipe measurement are included for height and widths, etc.

## 4.10 SKILL ASSESSMENT PROCEDURES

- The Experts decide together on the Test Project, the marking criteria and the dimensional tolerances and they prepare the material list;
- The Experts are responsible for the work timetable – start, end, lunch time, etc. The Experts create a project working timetable which will be delivered to all Experts and Competitors;
- The Experts will be divided into marking groups to deal with different sections of the marking criteria.

Note: If the Test Project will be developed by an external designer, he will also develop the marking criteria's, dimensional tolerances, and material list according to the TD. Also he is responsible for the work timetable – start, end, lunchtime, etc. He has to create a project working timetable which will be delivered to all Experts and Competitors.

- The Experts agree that a majority vote is needed to:
- Change scoring system (within limits specified in the Technical Description);
- Change competition sequence or content;
- Agree on a solution for disputes concerning points awarded etc.
- All Experts make the judgement marking together;
- Every modular judging has to be closed (judgement and measurement) before a result will be public.

Measurement tolerance examples:

MEASUREMENT	TOLERANCE	NO	YES	YES	NO
100	± 1.09	101.10	101.09	98.91	98.90
100	± 0.59	100.60	100.59	99.41	99.40

- To mark the Test Project, the official measuring equipment will be used.
- All measurement equipment must be set at 0.0 before assessment begins;
- The Competitors are free to use the official measuring equipment to check/verify with their own measuring equipment.

## 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 is assessed in stages.

### 5.3 TEST PROJECT DESIGN REQUIREMENTS

The following design requirements must be met when developing the Test Project:

- The Test Project design has to be carried out with the material as outlined below;
- Project elements must be possible to construct using the supplied tools and equipment;
- The instructions for the Competitors must be delivered with the Objective and Subjective marking forms including the assessment criteria;
- Guideline for the weight of the Test Project
  - Single piece <30 kg
  - The whole Test Project <50 kg
- Special equipment for building the Test Project must be especially marked before a Test Project proposal will be considered;
- Be based on modern practices of construction steel work and construction metal work;
- Be a CAD drawing to ISO-standard supplied on disk (DXF, DWG) and in paper copy;
- The drawings of the Test Project have to be available in 1<sup>st</sup> and 3<sup>rd</sup> angle projection method;
- Whole numbers are to be used on drawing dimensions except extruded/rolled sections;
- Contain a detail material list;
- Be self-explanatory requiring a minimum of translation;
- Welding symbols are according to ISO-Standard 2553 – System A;
- Size of welds is for MMAW (111)=z4, GMAW (135) =z5 and for GTAW (141) =z2 to z4;
- Maximum percentage of flame cut parts is 15%.

Materials to be considered when designing the Test Project include:

- Pickled steel sheet with thickness from 4 mm to 12 mm, rolled steel sections (carrier profiles, L-shaped bars, T-bars, flat bars), welded tubes, seamless tubes, screws and nuts, all in shapes and sizes to ISO-standards, where possible;
- Stainless steel sheet 2B, thickness 2 mm to 3 mm and sections;
- Aluminium sheet, thickness 3-4 mm;
- Use electrodes for GMAW (135) Ø0.8 mm–1.0 mm, GTAW (141) Ø1.6 mm – 2.4 mm and MMAW (111) Ø2.5 mm - Ø3.2 mm.

## 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

The Test Project/modules are developed by an Independent Test Project Designer according to the Technical Description.

The independent designer shall ideally be from a non-participating country or region. All Experts including the CE and DCE have no information about the Test Project until it is presented on C1. The planning time for the Competitors is four hours.

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

The Test Project/modules are developed by an Independent Designer.

### 5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At the Competition	The Test Project drawings are presented to the Competitors on C1. The Test Project will be presented to the Experts at the same time as the Competitors.

## 5.5 TEST PROJECT VALIDATION

The Independent Test Project Designer ensures that the task can be completed in the prescribed 18 hours. This is done prior to the current Competition.

## 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 prior to the Competition.

## 5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

Coordination of the Test Project will be undertaken by the Director of Skills Competition

## 5.9 TEST PROJECT CHANGE AT THE COMPETITION

There is no requirement for the Test Project to be changed at the Competition as it is not circulated.

## 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 developer of the Test Project has to inform if specific material or manufacturer specifications are required to allow the Competitor to complete the Test Project.

## 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 Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre ([www.worldskills.org/expertcentre](http://www.worldskills.org/expertcentre)).

## 7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

All Competitors must use safety glasses when using any hand, power or machine tools, or equipment likely to cause or create chips or fragments that may injure the eyes.

Competitors must wear puncture-resistant safety shoes.

Competitors must use protective gloves, welding helmet or shield and wear closed and no flammable clothes for welding.

For working with rotate machine (example drilling machine, etc.) it is forbidden to use gloves. Long hair must be securely tied back and covered with a hair net.

## 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 the toolbox in volume is max. 4 m<sup>3</sup>. This size should not include the outside packing used to transport the toolbox. Not more than three toolboxes are allowed for each Competitor.

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

Competitors may bring the following tools:

- One analogue or digital height gauge 1000 mm or height gauge 600 mm combined with prism/clamping block 400 mm, to measure a height of 1000 mm;
- One feeler gauge;
- One steel measuring tape;
- Two steel measure (500/1000);
- One guide (600 mm);
- One calliper (600 mm);
- One cross-chisel;
- One set square;
- One set drawing tools;
- One marking gauge;
- One steel hammer (500/100 gr.);
- One plastic hammer;
- One angle;
- Braces for vice;
- One cutter;
- One pointer;
- One protractor;

- One lighter;
- One welding helmet;
- One wire brush;
- Four clamps 100 to 500 mm;
- One saw;
- One roll fork key;
- One countersink set;
- Two screw drivers (middle and big);
- One set button die;
- One set twist drill up to 13 mm (in steps of 0.5 mm);
- One scraping tool;
- One screw cutting die;
- Six spare blades for metal saw;
- Four disc grinders;
- One set tap drills M4/M5/M6/M8/M10/M12;
- One grinding machine;
- One reamer;
- One electrical adapter;
- One set files (ever two pieces flat, round and square);
- One working clothes;
- marking-off scribes (or magic markers);
- Safety goggles;
- Two cleaning tissues;
- One ear protection;
- Safety shoes;
- One leather hammer;
- One hand drilling machine;
- One steel compass;
- One scribe;
- One flame cutting torch and hose with connection tools with flashback.
- The connection sizes for the flame cutting torch and hoses shall be listed on the IL at a minimum of 12 months prior to the start of the Competition.

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

Not applicable.

## 8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

Surface tables brought by Competitors cannot be used. They must use the surface tables as supplied by the Competition Organizer.

For all mechanical cutting the back gauge is forbidden, if the machine cutting-line-shadow is perfect. However, if the machine cutting-line-shadow is not perfect, the back gauge can be used. This will be instructed in the fabrication instructions on every competition.

Using back gauge for bending is ok.

The majority of Experts decide before the Competition starts which materials and equipment are prohibited. If some possibly prohibited tools are found on the first Competition day, the Experts inform the Chief Expert and the compatriot Expert.

If the Experts find some defined prohibited material in the toolbox after the first Competition day, the Competitor will lose five marks.

The Experts vote on the Discussion Forum one month prior to the Competition which tools are prohibited for using at the Competition.

For Familiarization Day all Competitors are to be supplied samples of the Test Project material.

This material will be itemized on the Infrastructure List in terms of size and quantity

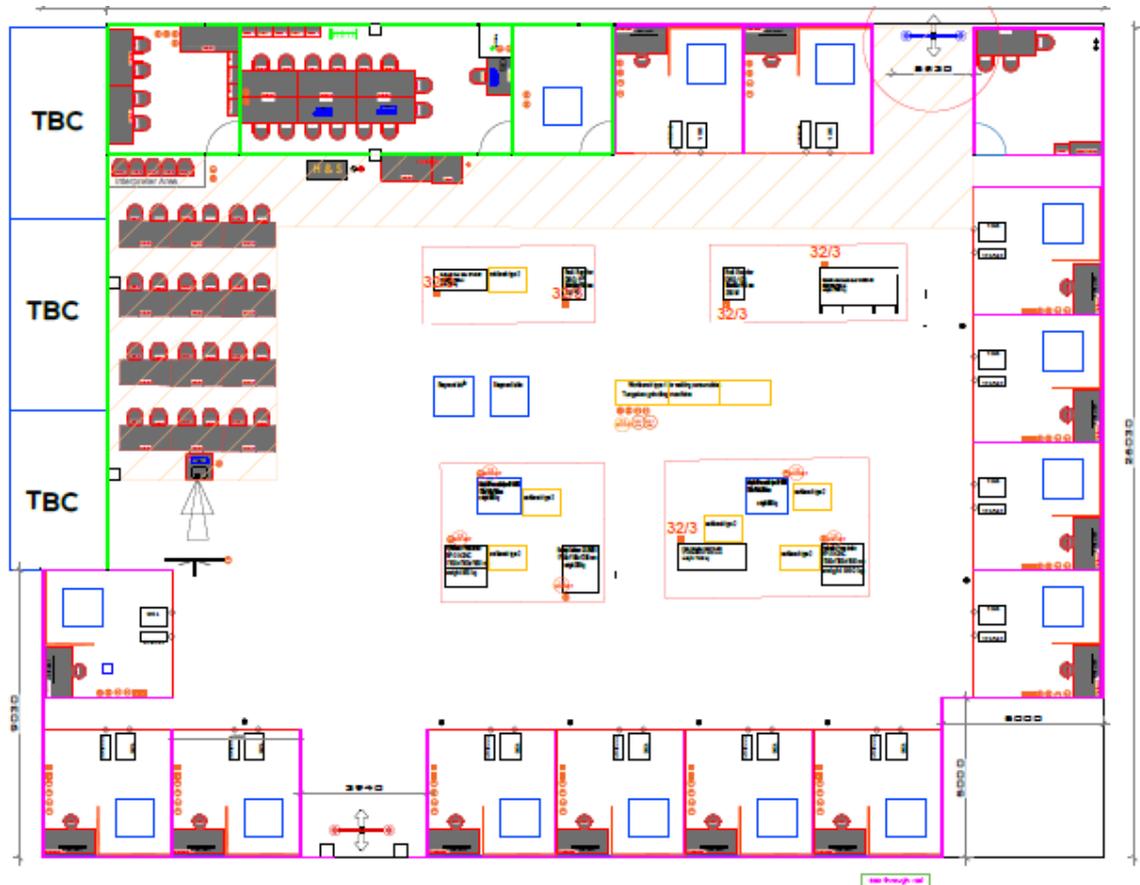
## 8.6 CONSTRUCTION STEEL MATERIAL LIST

DESCRIPTION	THICKNESS	SIZE	QTY	GRADE
Stainless Steel Sheet	3mm	600x900mm	18	304 2B Finish
Mild Steel plate	5mm	750x800mm	18	250 Mpa finish
Mild Steel plate	5mm	1200x200mm	18	250 Mpa finish
Mild Steel plate	6mm	500x600mm	18	250 Mpa finish
Mild Steel plate	10mm	300x600mm	18	250 Mpa finish
Mild Steel Pipe	25NB med wall	1200	18	250 Mpa finish
Mild Steel Flat Bar	25x5mm	3000mm	18	250 Mpa finish
Bright Bar	12mm	1000mm	18	
M12 Zinc cap Head Bolt	M12 x 1.75	20mm	100	Zinc or stainless

## 8.7 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 – personal laptops, tablets, and mobile phones	<ul style="list-style-type: none"> <li>• Experts and Interpreters are allowed to use personal laptops in the Expert room only.</li> <li>• Competitors are not allowed to bring personal laptops, tablets or mobile phones into the workshop.</li> <li>• Competitors are allowed to have electronic calculators only.</li> </ul>
Use of technology – personal photo and video taking devices	<ul style="list-style-type: none"> <li>• Competitors are not allowed to bring any type of other personal photo and video taking devices into the workshop.</li> </ul>
Tools/infrastructure	<ul style="list-style-type: none"> <li>• Competitors are not permitted to bring special tools into the workshop including in the Competitor toolbox, this includes electrodes used for all welding processes.</li> <li>• Definition of special tools will occur after discussion and decision of the majority of all Experts at the competition.</li> </ul>
Templates, aids, etc.	<ul style="list-style-type: none"> <li>• Competitors are not permitted to bring any templates or practical aides into the workshop including in the Competitor toolbox.</li> </ul>
Drawings, recording information	<ul style="list-style-type: none"> <li>• Competitors, Experts, and Interpreters are not permitted to bring any CAD-drawings or prepared precise pencil drawings into the workshop.</li> <li>• Experts are not permitted to record the marks of Competitors on any paper or digital device apart from the official marking forms.</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>
Test Project	<ul style="list-style-type: none"> <li>• Competitors, Experts, and Interpreters are not permitted to take Test Project drawings out of the workshop after distribution on C1 until the conclusion of the Competition.</li> </ul>
Material	<ul style="list-style-type: none"> <li>• Competitors must complete the Test Project with the material supplied on C1, no other material will be supplied.</li> </ul>

## 10 VISITOR AND MEDIA ENGAGEMENT

The following list provides examples of how it is intended to maximize visitor and media engagement for this skill competition:

- Display screens;
- Test Project descriptions;
- Competitor profiles;
- Career opportunities;
- Attractions for visitors;
- 3D-Projection of the actual Test Project;
- Model of the Test Project (optional)

## 11 SUSTAINABILITY

This skill competition will focus on the sustainable practices below:

- All material can be recycled

## 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 most closely to relate to *Structural Metal Fabricators and Fitters*:  
<https://www.onetonline.org/link/summary/51-2041.00>

The links also enable adjacent occupations to be reviewed.