TECHNICAL DESCRIPTION

CONSTRUCTION METAL WORK

TD42 v4.0 – WSC2013

WorldSkills International, by a resolution of the Technical 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 11.10.11

John Shiel
Chair Technical Committee

Stefan Praschl
Vice Chair Technical Committee

1. INTRODUCTION

1.1 Name and description of skill

1.1.1 The name of the skill is

Construction Metal Work

1.1.2 Description of skill

Construction metal work covers the construction of steel structures, their erection and assembly, maintenance and repair and general metal and welding fabrications for a lot of works in industry and privacy. Main areas are general steel work, construction metal work, welding techniques and fitting works.

1.2 Scope of application

1.2.1 Every Expert and Competitor must know this Technical Description.

1.2.2 In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

1.3 Associated documents

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

- WSI - Competition Rules
- WSI - Online resources as indicated in this document
- Host Country - Health and Safety regulations

2. COMPETENCY AND SCOPE OF WORK

The Competition is a demonstration and assessment of the competencies associated with this skill. The Test Project consists of practical work only.

2.1 Competency specification

Working Environment

Knowledge and understanding of working environment:

- Comprehend and comply with the standards and laws relating to safety, security and hygiene in the metal construction and welding industry
- Describe the various items of personal protective equipment required for any given situation (PPE)
- Describe the precautions for the safe use of hand and power tools
- Describe the precautions for the safe use of mechanically and thermal cutting equipment
- Describe the precautions for the safe use of mechanically and hand operated bending and forming equipment
- Describe the possibilities for sustainability in the metal construction welding and industry

Competitors shall be able to:

- Become familiar with the host country‘s Health and Safety Regulations documentation
- Display the safe and proper use of all equipment used in the construction and welding industry
- Identify and use the appropriate personal protective equipment
- Separate trash and different metals for recycling
- Work carefully within their work/competition environment

Marking out techniques

Knowledge and understanding of marking out techniques:

- Be familiar with various types of technical drawing used in the metal construction industry
- Understand basic calculations used in the metal construction industry
- Be aware of various measuring methods used, for example:- rulers, tapes, height gauges and callipers
- Identify the difference between a material list and cutting list
- Be familiar with the various types of methods used for flat pattern development, for example, parallel line, radial line triangulations development methods.
- Be familiar structural type joint connections
- Identify and use the various production instructions

Competitors shall be able to:

- Read and interpret technical drawings
- Perform basic calculations
- Perform measuring techniques
- Prepare a material list
- Prepare a cutting list
- Be able to develop a pattern using Parallel line, radial line or triangulation development techniques
- Be able to use different type of structural joint connections
- Identify and use the correct production instructions

Cutting techniques

Knowledge and understanding of cutting techniques:

- Understand how to cut/grind various materials to specified tolerances using mechanical machinery such as, shears, corner shears, saws and grinding
- Have the knowledge to manually thermal cut low carbon steel to specified tolerances using cutting wheels, circle cutters and guides
- Have the knowledge to drill, tap, ream, countersink and punch holes to various sizes and tolerances on various materials

Competitors shall be able to:

- Be able to cut various materials to specified tolerances using mechanical machinery such as, shears, corner shears and saws
- Be able to manually thermal cut low carbon steel to specified tolerances using manual cutting wheels, circle cutters and guides
- Be able to drill, tap, ream, countersink and punch holes to different sizes and tolerances on various materials

Forming techniques

Knowledge and understanding of forming techniques:

- Understand the skills to cold form using mechanical or manual plate rolls
- Understand the skill to hot bend low carbon steel using oxygen and acetylene gas heating equipment
- Have the knowledge to use a flat bar bender to bend low carbon steel
- Understand the skills required to bend various materials using a mechanical break press or hand folder

Competitors shall be able to:

- Demonstrate the skills to cold form using mechanical or manual plate rolls
- Demonstrate the skill to hot bend low carbon steel using oxygen and acetylene gas heating equipment
- Be able to use a flat bar bender to bend low carbon steel
- Demonstrate the skills required to bend various materials using a mechanical break press or hand folder

Assembly techniques

Knowledge and understanding of assembly techniques:

- Understand and use the appropriate assembly techniques required for the project
- Have the knowledge to be able to assemble project as per drawing specifications and tolerances

NOTE: The finish project will include a manual moving and lockable part as per project drawing specifications

Competitors shall be able to:

- Demonstrate the assemble skills required to build the project to the drawing specifications and tolerances
- Assemble the project with the required movable and lockable part as per project drawing specifications

Welding and joining techniques

Knowledge and understanding of welding and joining techniques:-

- Have the knowledge to competently use the following welding process, for example: (111) manual metal arc welding, (135) gas metal arc welding, (141) gas tungsten arc welding
- Understand the appropriate bolting technique required for the project
- Understand the appropriate screwing technique required for the project

Competitors shall be able to:

- Set-up welding equipment in accordance with manufactures specifications
- Select the required welding process as required, for example:
  - for Aluminium and stainless steels only use (141) gas tungsten arc welding
- Demonstrate the correct methods used to bolt or screw the project together

Finishing techniques

Knowledge and understanding of correct finishing techniques:

- Have the knowledge on edge cleaning of the project with a file, wire brushing, grinding paper and de-burring of holes and edges
- Have the knowledge on weld cleaning, wire brushing, chipping

NOTE: Excessive cleaning and polishing of the project is NOT allowed and NO chemical agents are allowed to enhance the finished project

Competitors shall be able to:

- Demonstrate appropriate edge cleaning and de-burring of edges and holes methods
- Demonstrate appropriate weld cleaning techniques

NOTE: Computer-drawing are prohibited in the competition work area, rough drawings are allowed, ONLY in the competitors work area, during the competition.

2.2 Theoretical knowledge

2.2.1 Theoretical knowledge is required but not tested explicitly.

2.2.2 Knowledge of rules and regulations is not examined.

2.3 Practical work

The Competitor has to carry out, independently and alone, the following tasks:

- Make a simple structure with material as defined in section 3.2 in accordance with detailed drawings, using the appropriate machines, tools and techniques.

The following technical skills are required:

Checking and mark out phase

- Checking that the dimensions of the materials are in accordance with the material list and the drawings.
- All developments must be drawn on special sheets supplied by shop master and submitted before completing the practical element of the exercise.
- Being thoroughly familiar with the properties of materials for use
- Marking, centring

Cutting, forming and assembling phase

- Building of steel constructions, general skills of welding
- Grinding, to bevel and burr of the material
- Sawing, shearing (75%) and flame cutting (25%) all materials
- Drilling, countersinking, grating, tapping, to screw
- Cold bending with rolls or press break, hot bending, smoothing, rolling and hot- and cold straightening

Welding and joining phase

- Welding processes 111 (15%), 135 (55%) and 141 (30%)
- Aluminium and stainless steel will be welded only 141

Final assembly phase

- Adjusting and assembling parts manufactured according to the drawing, to obtain necessary form, function and technical precision.

Finishing and cleaning phase

- Scrubbing and cleaning the surface with tools (files, chisels, and wire brushes (manual and with aid of electric machines)

3. THE TEST PROJECT

3.1 Format / structure of the Test Project

Test Project assessed in stages

3.2 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 pieces < 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
- Contain a detail material list
- Be self explanatory requiring a minimum of translation
- Welding symbols are according to ISO-Standard 2553
- Size of welds is for 111=z4, 135=z5 and for 141=z2 to z4
- Whole numbers are to be used on drawing dimensions except extruded/rolled sections

Materials to be considered when designing the Test Project include:

- Pickled steel sheet with thickness from 4-12mm, 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 2-3mm and sections
- Aluminium sheet, thickness 2-4mm
- Use electrodes for 135 diam. 0.8mm–1.0mm, 141 diam. 1.6mm–2.4mm and 111 diam. 2.5mm-3.2mm.

3.3 Test Project development

The Test Project MUST be submitted using the templates provided by WorldSkills International (http://www.worldskills.org/competitionpreparation). Use the Word template for text documents and DWG template for drawings.

3.3.1 Who develops the Test Project / modules

The Test Project / modules are developed by:

Every Expert has to create a Test Project proposal for the next Competition.

3.3.2 How and where is the Test Project / modules developed

The Test Project / modules are developed independently by every Expert

3.3.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

Time	Activity
At the previous Competition	The Test Project is developed and proposed by the Experts. The proposed Test Projects are shortlisted to 2 projects by vote of the Experts.
After the previous Competition	The shortlisted Test Projects are immediately circulated on the WSI website.
3 months prior to the Competition	The Test Project to be used at the Competition is selected from the 2 shortlisted projects by vote of the Experts.
At the Competition	30% change is made to the Test Project.

(NOTE FROM WSI: Two Test Projects were shortlisted at WSC2011for WSC2013 – CH and IE. Due to time pressures by the CH Expert and concerns from the CE and DCE that the CH project is too European centric it has now been withdrawn. The IE project will be the selected project for WSC2013. The drawings will be developed and circulated on the WSI website on June 1, 2012.)

3.4 Test Project marking scheme

Each Test Project must be accompanied by a marking scheme proposal based on the assessment criteria defined in Section 5.

3.4.1 The marking scheme proposal is developed by the person(s) developing the Test Project. The detailed and final marking scheme is developed and agreed by all Experts at the Competition.

3.4.2 Marking schemes should be entered into the CIS prior to the Competition.

3.5 Test Project validation

The Chief Expert ensures that the task can be completed in the prescribed 22 hours. This is done prior to the current Competition.

3.6 Test Project selection

The Test Project is selected as follows:

Proposed Test Projects are shortlisted to two by vote of Experts at the previous Competition.

3 months before the Competition these shortlisted Test Projects are voted on by the Experts to select the project to be used at the Competition.

3.7 Test Project circulation

The Test Project is circulated via WorldSkills International website as follows:

Immediately after the previous Competition the shortlisted Test Projects are circulated.

The Test Project will be circulated as an AutoCAD drawing in .dwg format.

3.8 Test Project coordination (preparation for Competition)

Coordination of the Test Project will be undertaken by:

Chief Expert however the Expert who developed the Test Project is responsible for the material list.

3.9 Test Project change at the Competition

30% of the Test Project will be changed at the Competition. All changes, which will reduce the time, are not included in this 30% change. If it is necessary to reduce the Test Project, it should be done at the beginning. After this the Experts will make 30% changes to the reduced Test Project.

The changes will be made as follows:

- 15% change in the Test Project is implemented by defining the final marking scheme (see point 3.4.1)
- The other 15% change will be implemented by changing 15% of all positions of the Test Project.

3.10 Material or manufacturer specifications

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.

4. SKILL MANAGEMENT AND COMMUNICATION

4.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration and decision making regarding the skill must take place on the skill-specific Discussion Forum (http://www.worldskills.org/forums). All 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 moderator for this forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

4.2 Competitor information

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

This information includes:

- Competition Rules
- Technical Descriptions
- Test Projects
- Other Competition-related information

4.3 Test Projects

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

4.4 Day-to-day management

The day-to-day management 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 finalised at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (http://www.worldskills.org/expertcentre).

5. ASSESSMENT

This section describes how the Experts will assess the Test Project / modules. It also specifies the assessment specifications and procedures and requirements for marking.

5.1 Assessment criteria

This section defines the assessment criteria and the number of marks (subjective and objective) awarded. The number of the different marks can move. The total number of marks for all assessment criteria must be 100.

Section	Criterion	Marks		
		Subjective (if applicable)	Objective	Total
A	Primary dimensions	0	37	37
B	Secondary dimensions	0	25	25
C	Technical perfection	0	15	15
D	Welding	4	0	4
E	Welding symbols	0	3	3
F	Drilling and bending	0	4	4
G	Use of material	0	4	4
H	General impression/function	3	3	6
I	flame cutting	0	2	2
	Total =	7	93	**100**

5.2 Subjective marking

Scores are awarded on a scale of 1 to 10

5.3 Skill assessment specification

A – Primary dimensions
- Measurements taken in various positions
- Tolerance will be 0.5 mm
- If round pipes are included in the measurments, Tolerance will be 0.75 mm

B – Secondary dimensions
- Measurements taking in various positions
- Tolerance will be 1 or 1.5 mm (Everything of material)
- If round pipes are included in the measurments, Tolerance will be 0.75 mm

C – Technical perfection
- Squareness
- Parallelism
- Flatness
- Tolerance will be 0.5, 0.75 or 1 mm

D – Welding
- Quality of welding

E – Drilling and bending
- Quality of drilling
- Quality of bending

F – Use of materials

G - General impression/function
- General appearance
- Function

Pipe measurement included for height and widths etc.

5.4 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.

- 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 subjective marking together.

- Every modular judging has to be closed (subjective and objective) before a result will be public.

Measurement tolerance examples

Measurement	Tolerance	No	Yes	Yes	No
100	± 1	101.01	101.00	99.00	98.99
100	± 0.5	100.51	100.50	99.50	99.49

- The measuring equipment that the competitor uses to complete the Test Project, will be this used to mark the project. However, if a dimension is disputed or not viewed accurately, the official measuring equipment will be used to resolve these issues.
- All measurment equipment must be set at 0.0 before assessment begins.
- The competitor is free to use the official measuring equipment to check/verify with his/her own measuring equipment.

6. SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to Host Country Health & Safety documentation for Host Country 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.

7. MATERIALS & EQUIPMENT

7.1 Infrastructure List

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

The Infrastructure List is online (http://www.worldskills.org/infrastructure/).

The Infrastructure List specifies the items & quantities requested by the Experts for the next Competition. The Competition Organiser will progressively update the Infrastructure List specifying the actual quantity, type, brand/model of the items. Items supplied by the Competition Organiser 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 Technical Director 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.

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

Competitors may bring the following tools in one or two tool boxes as a minimum:

- 1 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
- 1 feeler gauge
- 1 steel measuring tape
- 2 steel measure (500/1000)
- 1 guide (600 mm)
- 1 caliper (600 mm)
- 1 cross-chisel
- 1 set square
- 1 set drawing tools
- 1 marking gauge
- 1 steel hammer (500/100 gr.)
- 1 plastic hammer
- 1 angle
- braces for vice
- 1 cutter
- 1 pointer
- 1 protractor
- 1 lighter
- 1 welding helmet
- 1 wire brush
- 4 clamps 100 bis 500 mm
- 1 saw
- 1 roll fork key
- 1 countersink set
- 2 scew drivers (middle and big)
- 1 set button die
- 1 set twist drill up to 13 mm (in steps of 0.5 mm)
- 1 scraping tool
- 1 screw cutting die
- 6 spare blades for metal saw
- 4 disc grinder
- 1 set tap drills M4/M5/M6/M8/M10/M12
- 1 grinding machine
- 1 reamer
- 1 electrical adapter
- 1 Set files (ever 2 pieces flat, round and square)
- 1 working clothes
- marking-off scribes (or magic markers)
- safety goggles
- 2 cleaning tissues
- 1 ear protection
- safety shoes
- 1 leather hammer
- 1 hand drilling machine
- 1 steel compass
- 1 scriber
- 1 flame cutting torch and hose with connection tools with flashback

7.3 Materials, equipment and tools supplied by Experts

Not applicable

7.4 Materials & equipment prohibited in the skill area

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

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 fabricaton 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 5 marks.

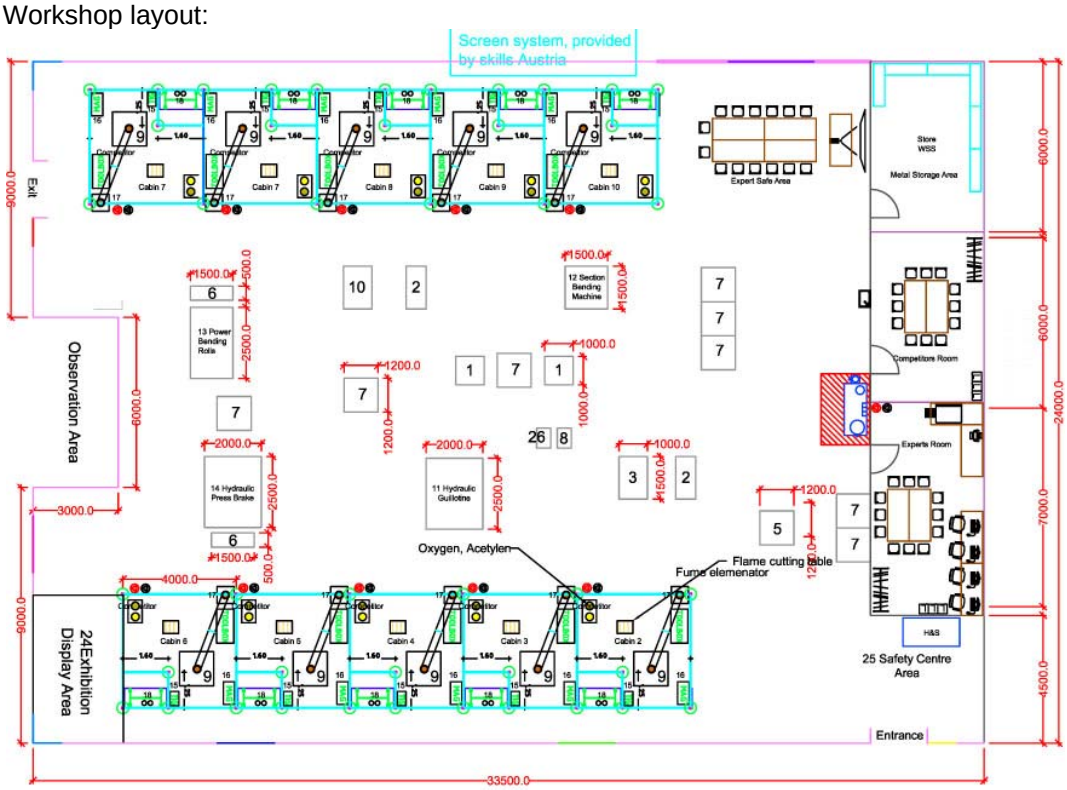
The Experts vote on the Discussion Forum 1 month prior to the Competition which tools are prohibited for using at the Competition.

For Familiarisation Day all Competitors are to be supplied samples of the Test Project material. This material will be itemised on the Infrastructure List in terms of size and quantity.

7.5 Proposed workshop and workstation layouts

Workshop layouts from London are available at:
http://www.worldskills.org/index.php?option=com_halls&Itemid=540

Workshop layout:



8. MARKETING THE SKILL TO VISITORS AND MEDIA

8.1 Maximising visitor and media engagement

The following list provides examples of how it is intended to maximise visitor and media engagement for this skill.

- Display screens
- Test Project descriptions
- Competitor profiles
- Career opportunities
- Attractions for visitors

8.2 Sustainability

- All material can be recycled