

Technical Description

# Plumbing and Heating

Construction and Building 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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Effective 22.08.18



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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

Plumbing and Heating

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

A plumbing and heating technician works on commercial, residential, agricultural, and industrial projects. There is a direct relationship between the nature and quality of the product required and the payment made by the customer. Therefore, the practitioner has a continuing responsibility to work professionally in order to meet the requirements of the customer and thus maintain and grow the business. Plumbing and heating is closely associated with other parts of the construction industry, and with the many products that support it, normally for commercial purposes.

The plumbing and heating technician works internally and externally, including the homes of customers and on small and major projects. He or she will plan and design, select and install, commission, de-commissioning, test, report, maintain, fault find, and repair systems to a high standard. Work organization and self-management, communication and interpersonal skills, problem solving, flexibility, and a deep body of knowledge are the universal attributes of the outstanding practitioner.

Whether the plumbing and heating technician is working alone or in a team, the individual takes on a high level of personal responsibility and autonomy. From working to provide a safe and reliable plumbing and heating service, in accordance with relevant standards, through to diagnosing malfunctions, and commissioning plumbing and heating systems and components, precision, accuracy and attention to detail every step in the process matters and mistakes are largely irreversible, costly, and potentially life threatening.

With the international mobility of people, the plumbing and heating technician face rapidly expanding opportunities and challenges. For the talented practitioner there are many commercial and international opportunities; however, they carry with them the need to understand and work with diverse needs, cultures, and trends. The diversity of skills associated with plumbing and heating is therefore likely to expand.

1.1.3 Number of Competitors per team

Plumbing and Heating 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>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The purposes, uses, maintenance, and care of all equipment, together with their safety implications</li> <li>• The purposes, uses, care, and potential risks associated with materials and chemicals</li> <li>• The purposes and uses of manufacturers' specifications and drawings</li> <li>• How to search for specific and non-specific information, specifications, and guidance to complete a task</li> <li>• The time available and associated with each activity</li> <li>• The parameters within which activities need to be scheduled</li> <li>• The health and safety standards applying at any one time</li> <li>• The use of new technologies as a work aid. Technologies used must be readily available and relatively easy to be operated.</li> <li>• Principles and their application to good housekeeping in the work environment</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Prepare and maintain a safe, tidy and efficient work area</li> <li>• Prepare and if need remedy the surfaces to which systems and appliances will be installed</li> <li>• Select and use appropriate personal protective equipment when necessary</li> <li>• Select and use appropriate hand tools to complete tasks safely</li> <li>• Follow the specific precautions when manual handling, long and/or heavy items</li> <li>• Follow the specific precautions when working with electrically powered hand tools</li> <li>• Follow the specific precautions when soldering</li> <li>• Schedule work to maximize efficiency and minimize disruption</li> <li>• Plan, prepare and complete each task within the available time</li> <li>• Restore the work area to an appropriate condition</li> <li>• Prepare reports based on the type of work completed</li> </ul>	

<b>2</b>	<b>Communication and interpersonal skills</b>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The range and purposes of documentation, including text, graphical, paper based and electronic</li> <li>• Drawing notation and the symbols for pipe work, fittings, and appliances</li> <li>• The technical language associated with the skill</li> <li>• The standards required for routine and exceptional reporting in oral, handwritten, and/or electronic form</li> <li>• The nature of the reports provided by measuring equipment, together with their interpretation</li> <li>• The required standards for customer service and care</li> </ul>	
	<p>The individual shall be able to</p> <ul style="list-style-type: none"> <li>• Read, interpret and extract technical data and instructions from manuals and other documentation</li> <li>• Communicate in the workshop by oral, written and electronic means using standard formats with clarity, effectiveness and efficiency</li> <li>• Use a standard range of communications technology</li> <li>• Respond to customer's needs face to face and indirectly</li> <li>• Explain the functionality and operation of appliances and/or installations</li> </ul>	
<b>3</b>	<b>Design and adapt installation systems</b>	<b>15</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The required information regarding the design of the installation</li> <li>• Symbols and abbreviations used in specifications and drawings</li> <li>• Drawing aspects (e.g. plan, elevations, isometric, and schematic)</li> <li>• The uses and limitations of the generally available drawing tools</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Design installation systems within given parameters</li> <li>• Produce simple freehand sketches including isometric to support given architect drawings to aid the installation process, using standard symbols and abbreviations</li> <li>• Estimate the requirement for equipment and materials</li> <li>• Select the equipment and materials according to given criteria</li> <li>• Recommend alternative, and either order the equipment and materials or amend the design of the system</li> </ul>	

4	Installation of pipe work, fixtures, and appliances	40
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The uses and limitations of the specified bending and jointing methods, materials and fittings in order to complete a leak-free installation</li> <li>• The range and characteristics of bending/jointing methods, materials, and fittings</li> <li>• Properties of the piping material available:               <ul style="list-style-type: none"> <li>• for example:                   <ul style="list-style-type: none"> <li>• Copper</li> <li>• Black mild steel (no heat bending or welding)</li> <li>• Press fit stainless steel or galvanised steel</li> <li>• Cast iron</li> <li>• Polymer pipe</li> <li>• Plastic (single or multi-layered)</li> </ul> </li> </ul> </li> <li>• The handling, cutting, bending, jointing, and forming sub-assemblies</li> <li>• The safe operation of the cutting, bending, threading, soldering and testing equipment provided</li> <li>• The applications appropriate to:               <ul style="list-style-type: none"> <li>• Pre-wall installation systems</li> <li>• Surface wall installation</li> <li>• Hot water installations</li> <li>• Cold Water Installations</li> <li>• Heating systems</li> <li>• Rainwater harvesting or grey water system Installation of the piping system above ground level</li> <li>• Underfloor heating</li> <li>• Solar thermal heating</li> <li>• Waste water systems</li> <li>• Gas installation systems</li> </ul> </li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Read and interpret drawing for a range of systems and appliances</li> <li>• Interpret drawings to facilitate pipe-work fabrication and the installation of appliances</li> <li>• Modify the area and surfaces, as required, to permit fixing and assembly</li> <li>• take and transfer measurements and angles from given drawings to surfaces and piping materials</li> <li>• Select suitable fixing methods for the available surfaces, appliances, and environment</li> <li>• Fix an appropriate number and diameter of pipe brackets/clips in the correct or specified configuration</li> <li>• Determine the optimal way to use the given materials to complete the assembly in a sustainable manner</li> <li>• Create freehand sketches for the purposes of pipe bending and assembly</li> <li>• Limit the generation of scrap and waste</li> <li>• Determine and use the correct positions for cutting the piping material</li> <li>• Measure, set out, and mark the materials and pipe-work</li> <li>• Determine the correct positions for bending the piping material</li> <li>• Select an appropriate and safe method for handling, cutting, installing, and jointing the piping material</li> <li>• Utilize the chosen method to bend the piping material safely</li> <li>• Utilize the chosen jointing method to form the pipe-work sub-assemblies</li> </ul>	

	<ul style="list-style-type: none"> <li>• Install the pipe-work utilizing the previously fitted brackets/clips</li> <li>• Install sanitary fixtures</li> <li>• Install appliances</li> <li>• Connect the pipe-work to the appliances/utilities</li> <li>• Install gas, water, heating, and effluent pipe work</li> </ul>	
<b>5</b>	<b>Connect, test, and commission assemblies and appliances</b>	<b>15</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The procedures, equipment and tools for applying soundness tests to systems</li> <li>• The methods of establishing adequate supply from the utilities</li> <li>• The actions to take where pre-commissioning checks or tests reveal system or component defects</li> <li>• How to complete commissioning documentation</li> <li>• The sources of information on the performance of systems or components</li> <li>• The procedures for ensuring the component performance against the design specification</li> <li>• The sequences for commissioning systems or components</li> <li>• The actions to take when components are being commissioned and do not meet design requirements</li> <li>• System handover procedures and demonstrating the operation of systems and components to end users</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Perform all pre-commissioning/commissioning tasks</li> <li>• Connect test equipment to the pipe-work</li> <li>• Test the plumbing and heating components (pressure test and/or other tests) to ensure conformity to specification</li> <li>• Flush and drain the installation</li> <li>• Fill the pipe-work and appliance and assess the flow rate/pressures to domestic sanitary appliances</li> <li>• Hand over the installation to the customer including documentation</li> <li>• Provide the customer with all appropriate user information and answer questions</li> </ul>	

6	<b>Generate and apply solutions for maintenance, repair, and replacement</b>	<b>10</b>
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Features of excellent customer service</li> <li>• The techniques for identifying the customer’s problem</li> <li>• The information that should be available on the routine and non-routine service and maintenance requirements of systems and components</li> <li>• The methods of protecting customers’ property in the area where the work is carried out</li> <li>• The maintenance procedures necessary to ensure compliance with industry requirements for routine and non-routine maintenance activities</li> <li>• How to complete records and reports of the maintenance of systems and components</li> <li>• The action to take when the system or component does not work to full performance specification</li> <li>• The measures to ensure that systems do not present a safety hazard to potential users, or the workforce, when carrying out rectification procedures</li> <li>• How to isolate unsafe systems and components</li> <li>• Research the main features of each possible option, including risk factors</li> <li>• Select and use different methods for exploring the problem, including dividing it into sub-problems, and analyse its features</li> <li>• System handover procedures and demonstrating the operation of systems and components to end users</li> </ul>	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Prepare the work area, safeguarding surrounding areas</li> <li>• Diagnose the quality or deficiencies of appliances, components and systems</li> <li>• Identify the relative advantages or possibilities of maintenance, repair or replacement</li> <li>• Identify the method of maintaining, repairing or replacing the appliances or systems</li> <li>• Acquire components or replacements as determined</li> <li>• Isolate and drain the plumbing and heating components</li> <li>• Maintain, repair or replace the appliances or systems, as advisable and agreed</li> <li>• Open isolating valves, recharge with water and check for leaks</li> <li>• Re-commission system</li> <li>• Check for correct function (flow and pressure)</li> <li>• Restore the area to its former condition (housekeeping)</li> <li>• Hand over the installation to the customer</li> <li>• Provide the customer with all appropriate user information and answer questions</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							2.00	9.00	2.00	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

Prior to the submission of the marking scheme to the CIS, All Experts will discuss and decide on the marking criteria, reference points, and the dimensional tolerances on Measurement Marking Forms.

Competitors will be given all the necessary materials prior to the commencement of each module. It is the responsibility of the Competitor with the compatriot Expert to check the material supplied against the module material list, which will have been previously checked and signed by the Workshop Manager and Workshop Manager Assistant and/or the compatriot Expert.

### Criteria for measurement marking

The criteria for the assessment of measurement marking can be found in the "Task Description" document and the Appendix (12.1) document for the "Assessment Document - Skill 15 Plumbing and Heating".

### Pressure test

- Directly after each successful pressure test, the two Experts who witnessed it must prove its validity by ensuring that the entire pipe-work installation was actually under test. Proving points provided at opposite ends of each pipe-work material Module, during the 30% change, would accommodate this;
- Competitors may pressure test their own work, as many times as they consider necessary, within the competition time;
- When the Competitor reaches the stage in a Module when the two Experts are requested to witness the pressure test, this test will be considered the last and final test for this Module and this result will be the one recorded for assessment. The Competitor will not be permitted under any circumstances to carry out further leak detection/repair work or request another pressure test for this Module.
- The entire witnessed pressure test must be completed within the competition time allocated to the Module for the result to be included in the Competitor's assessment total;
- Waste pipes will be tested in this Competition;
- Hot water, cold water, gas and heating pipes will be air tested to 200KPa (two bar) for two minutes;
- The duration of the pressure test is two (2) minutes and as such the Competitor must have his pressure test verified by the two Experts assigned at least two (2) minutes before time limit.
- The pressure test will ONLY be done if the complete module is done within time limit and according the test module drawing;
- The pressure gauge used for pressure testing gas, water and heating pipes to have a full-scale deflection of two bar;
- The testing of sanitation pipework may be done if the project and material from Competition Organizer makes this a possibility;
- A log sheet must be installed at each workstation, in order to record the Competitors' pressure test results, safety warnings, extra material, and the material list check.

## 4.10 SKILL ASSESSMENT PROCEDURES

- If the project is modular, this will be assessed in the evening or following morning of the day in which it was carried out;
- If the project is a short project on a shift system and not modular this will be assessed on the completion of the project/module;
- The Experts will be divided into teams of minimum of THREE by the Chief Expert, as outlined in the Skill Management Plan, to carry out the assessment each evening;
- The Chief Expert will ensure (within reason) that an equal number of assessment criteria and marks are allocated to each Expert marking group;
- Sufficient measuring instruments to be available for all assessment teams e.g. rules, protractors, levels, etc. required for the assessment of the modules will be provided by the Competition Organizer and will be new and used solely by the Experts for this task. If templates are required, these will be prepared by an Expert nominated by the Chief Expert and checked by all of the Experts prior to their use;
- All pressure tests must be witnessed and signed off by two Experts and the result entered on the Competitor's log sheet. This duty will be rotated daily among the Experts, by the Chief Expert, as outlined in the Skill Management Plan;
- Two Experts will be assigned daily to check that all Health, Safety and Environment regulations are observed by the Competitors. A record of each Competitor's safety warnings will be entered on his/her log sheet. This duty will be rotated among the Experts on a daily basis, by the Chief Expert, as outlined in the Skill Management Plan;
- Verification of each Competitors material check list and the recording, on the log sheet, of any extra material requested by a Competitor will be carried out by two Experts, who will be assigned to this task on a daily basis. This duty will be rotated among the Experts on a daily basis, by the Chief Expert, as outlined in the Skill Management Plan

## 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 2.1 refers.

### 5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The format of the Test Project is a series of standalone modules.

The project will be in modular format, the minimum number of modules being one, the maximum number being six installed over an 18 to 22-hour period. Each module must be completed in the prescribed order and pressure tested within the time allocated for that particular module.

Each pressure test must be validated as set out in section 4.8.

The Test Project may contain the following modules:

1. Installation of plumbing systems into a pre-wall structure
2. Design an installation;
3. Effluent pipe installation;
4. Gas pipe installation;
5. Heating installation;
6. Cold water installation;
7. Hot water installation;
8. Solar pipe installation

## 5.3 TEST PROJECT DESIGN REQUIREMENTS

- The Test Project shall reflect current commercial, domestic plumbing, and heating standards and practices;
- The project should be as small as practical and materials available in the host country for sustainability;
- Where possible the hosting Member and the Skill Management Team should partner with local sponsors willing to organize a "Help Project" within the host country to support sustainability of materials after the competition. The final Test Project must be designed as much as possible to match this Help Project.
- Copper, carbon steel, and PEX pipes supplied by the Competition Organizer must be of a grade that permits bending by hand operated machines;
- All piping materials supplied by the Competition Organizer must be of uniform wall thickness throughout;
- The use of solvent weld adhesives on PVC pipe-work and components is not permitted;
- The bronze welding of copper pipe and copper fittings is not permitted;
- The work may only involve the use of the following materials:
  - Galvanized, Black Mild Steel, Press fit Stainless Steel;
  - Copper pipes (half hard temper bender quality in straight lengths);
  - Plastic pipes (PE, PEX, PB, HDPE, PP, PVC, composite pipe) for water supply, heating, and effluent services;
  - Commercially available fittings to suit all piping materials as required without any adaptation;
  - Jointing and sealing materials;
  - Pipe brackets and fixing materials;
  - Leak detection fluid or spray;
- Project to be designed should be in accordance with the tools described in the Technical Description.
- The Test Project must:
  - Be a Computer Assisted Drawing (CAD) supplied on disk and in hard copy;
  - Contain a detailed material list. Note: the materials must be available in the host country or region;
  - Be self-explanatory requiring a minimum of translation;
- A comprehensive list of materials and components (including the relevant manufacturer's catalogues) for both the pipework and "workstation" components must accompany all projects and must be submitted six months prior to the Competition.

## 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

An external "Help Project" is developed by an independent agency. The "Help Project" supports sustainability after the competition.

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

The Test Project or modules are developed independently.

#### 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 "Help Project" is presented to Experts on C-4.

### 5.5 TEST PROJECT VALIDATION

It must be demonstrated that the Test Project/modules can be completed within the material, equipment, knowledge, and time constraints by a photograph being submitted with the Test Project proposal.

### 5.6 TEST PROJECT SELECTION

The Test Project is selected by the independent designer in consultation with the Skill Competition Manager.

### 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)

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

### 5.9 TEST PROJECT CHANGE AT THE COMPETITION

There is no 30% change to the Test Project at the Competition.

### 5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

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

The Competition Organizer must make available the following information about the pipes and sanitary appliances and fixtures to be used for the competition.

- Technical data sheets;
- Joining methodology;
- Tools and equipment related to the installation;
- Properties of the pipes;
- Installation brochures of sanitary appliances/fixtures

Copper, carbon steel and PEX pipes supplied by the Competition Organizer must be of a grade that permits bending by hand operated machines. A data sheet for such pipes from the Competition Organizer and details of the supplier or merchant must be made available to all participating Members via the Infrastructure List.

## 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
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

### 6.3 TEST PROJECTS [AND MARKING SCHEMES]

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

### 6.4 DAY-TO-DAY MANAGEMENT

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

## 7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

- Each Competitor **MUST** be equipped with the appropriate personal safety equipment as required by the Host Country's safety standards. As a minimum clear safety glasses and steel toe capped safety shoes must be worn during the Competition and familiarization;
- All Competitors and Experts must always use clear safety glasses and steel toe capped safety shoes;
- Full heat-resistant gloves must be worn by Competitors when performing all hot work that is, heat bending of mild steel pipe, welding, hard and soft soldering;
- Long sleeve apparel must be worn when carrying out any work involving heat;
- Laser Tools are prohibited;
- Ear plugs are permitted to be used.

## 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.

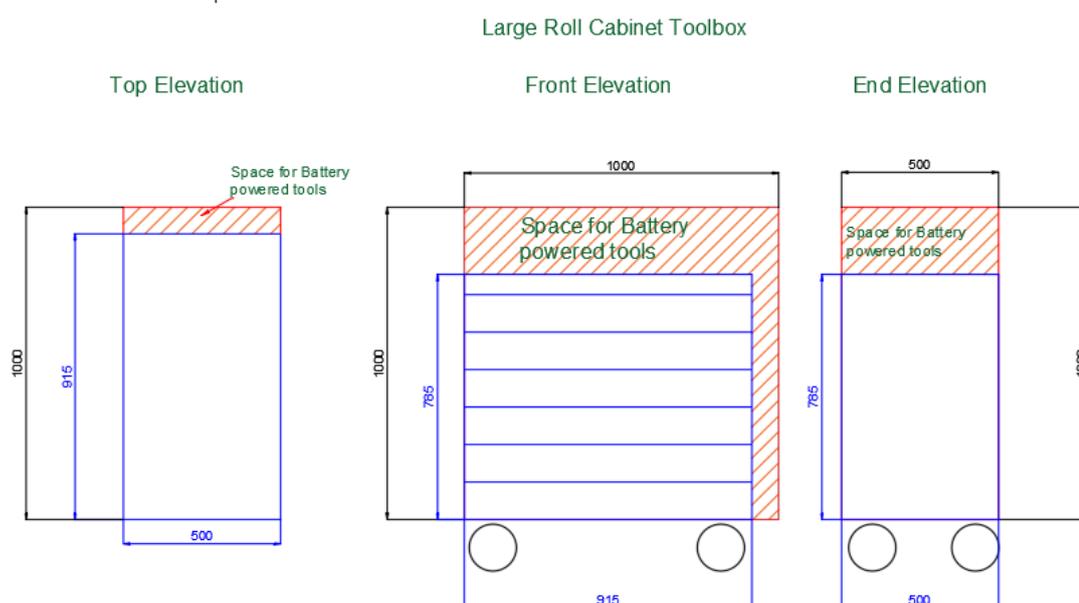
At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

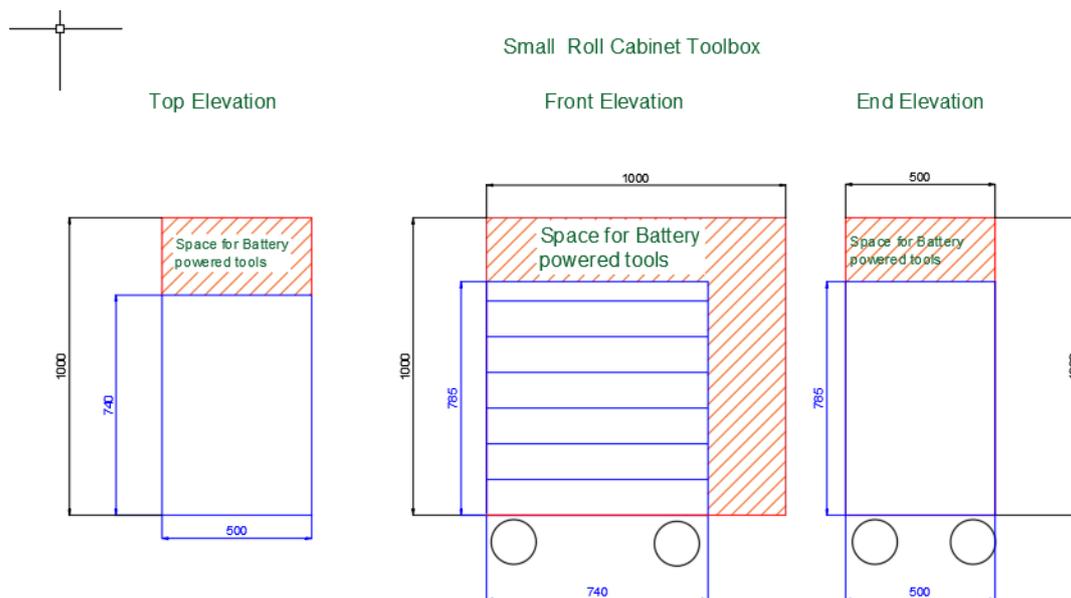
The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

### 8.2 COMPETITOR'S TOOLBOX

Each Competitor is allowed toolboxes up to a maximum capacity of 500 litres. External measurements of the toolbox are used to determine the capacity. Note the container when measured will not include the wheels. Competitors are also allowed up to four battery powered tools. All to be stored within the 500-litre space

Examples:





Competitors will also be allowed a tube of max. diameter of 125 mm and max. 2.1m in length for levels and rulers.

Competitors who bring larger toolboxes to the Competition will not be permitted to keep them in the workshop area and they must be stored in an off-site location. When this occurs, Competitors will be permitted to take with them into the workshop area the equivalent of 500 litres of hand tools from the oversized toolboxes in one trip, using an appropriate container provided by the Competition Organizer.

Please ensure that the overall packing around the toolbox is kept to a minimum size to accommodate the toolbox and battery tools.

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

All battery-operated hand tools and chargers brought to the competition by the Competitor must be capable of being accommodated within the maximum 500 litre toolbox.

Hand tools of the trade required to complete the Test Project. The following minimum list of tools is provided for guidance only. A tool list will be developed and published six months prior to the competition. Competitors are provided with the tools specified in Infrastructure List. The designer of the Test Project must ensure that the project can be constructed by the usage of specified tools in the Infrastructure List.

Only tools that are commercially available are to be used.

A definitive tool list will be provided on the WorldSkills Forum for the competition when the final project is developed and subject to sponsors.

The list of tools are the ONLY tools that will be permitted in the competition area. Tool manufacturers are not prescriptive; however, this will depend on sponsorship of WorldSkills competitions.

Note: All other tools will be supplied by the Competition Organizer. See the Infrastructure List – [www.worldskills.org/infrastructure](http://www.worldskills.org/infrastructure).

Safety equipment: See Section 7, Skill-specific safety requirements.

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

Not applicable.

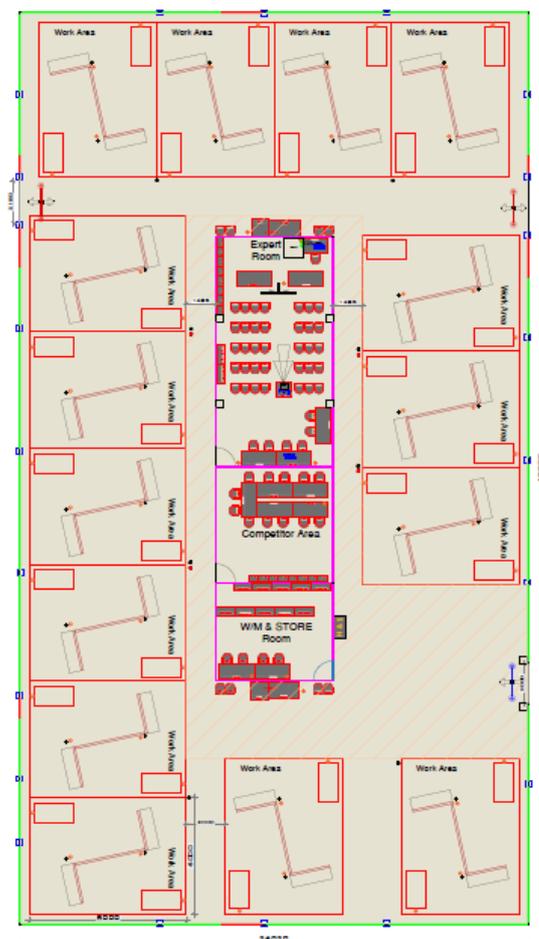
## 8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

- Mains electric powered equipment other than rechargeable battery-operated hand tools;
- Competitor's own or any pre-made templates, jointing material, fluxes, and soldering consumables are prohibited in the skill area;
- Note: the use of solvent welded joints on PVC pipe and cupro-eutectic joints on copper pipe are not permitted.
- Pre-made jigs and pipe stands are not allowed to be used.
- Battery operated disc cutters and grinders are not permitted to be used for the competition.

## 8.6 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

Workshop layouts from previous competitions are available at [www.worldskills.org/sitelayout](http://www.worldskills.org/sitelayout).

Example workshop layout:



## 9 SKILL-SPECIFIC RULES

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, internet access, procedures and work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – USB, memory sticks	<ul style="list-style-type: none"> <li>Competitors are not allowed to bring memory sticks into the workshop.</li> <li>Experts and Interpreters are allowed to bring memory sticks into the workshop.</li> </ul>
Use of technology – personal laptops, tablets, and mobile phones	<ul style="list-style-type: none"> <li>Competitors are not allowed to bring personal laptops, tablets or mobile phones into the workstation.</li> <li>Experts and Interpreters are allowed to bring personal laptops, tablets or mobile phones into the workshop.</li> </ul>
Use of technology – personal photo and video taking devices	<ul style="list-style-type: none"> <li>Experts and Interpreters are allowed to use personal photo and video taking devices during the competition in such a way that it is not within the workstation, obstructing the work flow of Experts and the competition proceedings.</li> </ul>
Tools/infrastructure	<ul style="list-style-type: none"> <li>Only battery-operated tools and commercially available tools are allowed.</li> </ul>
Templates, aids, etc.	<ul style="list-style-type: none"> <li>Competitors are not allowed to use pre-made templates or jigs.</li> </ul>
Sustainability	<ul style="list-style-type: none"> <li>Each Competitor is allowed toolboxes up to a maximum capacity of 500 litres approx. Competitors who bring larger tool boxes/chests to the Competition will not be permitted to keep them in the workshop, they must be stored in an off-site location. When this occurs, Competitors will be permitted to take with them into the workshop the equivalent of 500 litres of hand tools from the oversized tool boxes/chests in one trip, using an appropriate container provided by the Competition Organizer. All battery-operated hand toolschargers brought to the competition, by the Competitor, must be capable of being accommodated within the - 500 litre approx. tool box/chest.</li> </ul>
Assessment	<ul style="list-style-type: none"> <li>Experts are to use the Competitor’s measuring equipment during the marking process if requested by the Competitor.</li> </ul>
Other: Waste Materials	<ul style="list-style-type: none"> <li>All waste pipe (off cuts) must be placed in the container provided at the end of each time session. If the off cuts are too long they must be placed close to the container.</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>

## 10 VISITOR AND MEDIA ENGAGEMENT

The following ideas may be considered to maximize visitor and media engagement:

- A full colour copy of the project drawing (without dimensions) should be prepared for displaying to the public, for information, at the skill area;
- A live timed water test may be carried out by Competitors, possibly three at a time with an explanation via loud speaker to visitors and media to maximize engagement;
- A four-hour team challenge could comprise of two identical renewable energy/green technology projects, which each team of Competitors would be required to erect, assemble and test in the allocated time. In relation to the projects. The task could be either a Grey Water Recycling System or a Passive Solar Hot Water System;
- Presentation of the pre-Competition task to visitors (not assessed).
- A model of a similar plumbing project (not the actual Test Project) could be prepared by the Competition Organizer and put on display to attract public interest and publicity

Other ways to maximize engagement may include:

- Try a skill – for example the bending of copper pipe;
- Display screens;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status.

## 11 SUSTAINABILITY

Project design and skill competition preparation will consider the following:

- Recycling of materials and water where used;
- Use of 'green' materials where possible;
- Use of completed Test Projects or components of the Test Projects after the Competition.

## 12 REFERENCES FOR INDUSTRY CONSULTATION

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

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

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

This WSSS (Section 2) appears most closely to relate to *Plumber*:

<https://www.onetonline.org/link/summary/47-2152.02>

<http://data.europa.eu/esco/occupation/ed3cf43d-c2c1-4c46-82fc-1375e27e0290>

Adjacent occupations can also be explored through these links.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Standards Specification in place for WorldSkills Kazan 2019.

ORGANIZATION	CONTACT NAME
Schweizerisch- Liechtensteinischer Gebäudetechnikverband (Suissetec), Switzerland	Markus Niederer, Department Manager Plumbing at the National Vocational Education and Training Centre (Suissetec), Trainer for Swiss Certificate Masters and Chiefs in Plumbing
British Plumbing Employers Council (BPEC), UK	Neil Collishaw, Head of Innovation and Development
Geberit	Walter Brandle, Technical Sales Manager, Swiss market
Inretis Holding AG	Matthias Sulzer, Co-Founder
R. Nussbaum AG	Head Product Manager, not named
IAPMO Group	Grant Stewart, Project Manager, International

## 13 APPENDIX

### 13.1 ASSESSMENT DOCUMENT - SKILL 15 PLUMBING AND HEATING

The assessment document will be available three (3) months prior to the Competition. This assessment document should be descriptive on the main criteria and sub criterion to be assessed. This document should give more information pertaining to assessment to enable all Competitors to have a clearer view of the assessments criteria.

The Experts should be given a practical demonstration and tests to understand further the assessment criteria.