Technical Description

Refrigeration and Air Conditioning

Construction and Building Technology

worldskills

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

The Technical Description consists of the following:

Effective 12.10.16

Stefan Praschl
Chair of the Competitions Committee

Michael Fung
Vice Chair of the Competitions Committee

1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

Refrigeration and Air Conditioning

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

A refrigeration and air conditioning engineer works on commercial, residential, public, and industrial projects, including transportation and storage. There is a direct relationship between the nature and quality of the product and service required and the resulting cost and price; therefore, this branch of engineering covers a wide range of products and services. It is also essential for the refrigeration and air conditioning engineer to meet high and growing standards of service in order to comply with the requirements of the customer and maintain and grow the business. Refrigeration and air conditioning is closely associated with other parts of the construction and transportation industries at all stages and is equally affected by rapid change in these sectors, including growing environmental trends, and requirements.

The refrigeration and air conditioning engineer generally works inside domestic, commercial, or public buildings during and after construction and production, and on projects of all sizes and types. He or she will plan and design, install, test, commission, 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 refrigeration and air conditioning engineer is working alone or in a team the individual takes on a high level of personal responsibility and autonomy. From ensuring a safe and reliable installation and maintenance service, in accordance with relevant standards (see below), through to diagnosing malfunctions, upgrading and commissioning, and fault finding and correction, the skills of concentration, precision, accuracy, and attention to detail at every step in the process are crucial. Mistakes may be very expensive and damaging, while substandard work will significantly undermine the performance of the building or equipment that it is intended to serve.

The cold chain plays a monumental role in modern global trade in all food commodities, and skilled refrigeration and air conditioning engineers are crucial in this connection as well as supplying human comfort at home and in buildings. Reducing environmental impact by using environmental friendly refrigerants (low GWP-refrigerants), minimizing leakage, and reducing energy consumption (minimize heat load and improve efficiency) is an important part of this skills contribution to a sustainable future on Earth, because this reduces the consumption of fossil fuel like coal, gas and oil for electricity generation.

Refer to the following International Standards:

- ISO 817:2014 Refrigerants - Designation and safety classification
- ISO 5149-1:2014: Refrigerating systems and heat pumps - Safety and environmental requirements Part 1: Definitions, classification and selection criteria
- ISO 5149-2:2014 Refrigerating systems and heat pumps - Safety and environmental requirements Part 2: Design, construction, testing, marking and documentation
- ISO 5149-3:2014 Refrigerating systems and heat pumps - Safety and environmental requirements Part 3: Installation site
- ISO 5149-4:2014 Refrigerating systems and heat pumps - Safety and environmental requirements Part 4: Operation, maintenance, repair and recovery

1.1.3 Number of Competitors per team

Refrigeration and Air Conditioning 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).

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	**Work organization and management**	**10**
	The individual needs to know and understand: • The health and safety standards that apply to the RAC industry • How to recognize and respond to hazardous situations while working in the RAC industry • The safe personal protection measures while working in the RAC industry • How to apply manual handling techniques • How to respond to accidents that occur while working in the RAC industry • The procedures for electrical safety when working in the RAC industry • How to apply basic electrical safety measures in the RAC industry • The methods of working safely with heat producing equipment (heat pumps) in the RAC industry • How to safely work with refrigerant hot gas heating equipment • The methods of safely using access equipment • The methods of working safely in confined spaces • The purposes, uses, maintenance, and care of all equipment, together with their safety implications • The purposes, uses, care, and potential risks associated with materials and chemicals • The first aid requirements and actions required for both minor and major injury • The use of new technologies as a work aid • The working time associated with each activity • The parameters within which work needs to be scheduled • Principles and their application for good housekeeping within the work environment • How to apply environmental protection measures within the RAC industry • The applications of energy sources used in the RAC industry • The importance of energy conservation when commissioning RAC systems • The methods of reducing waste, and safe disposal of materials in the RAC industry	
	The individual shall be able to: • Produce risk assessments and method statements • Apply the respective health and safety legislation for the RAC industry • Take responsibility for those working in the RAC industry • Identify hazards and dangers to the workforce and members of public where RAC work is carried out • Identify and implement methods to control common hazardous substances and prevent accidents or dangerous situations occurring in the RAC industry • Plan and perform safe manual handling of heavy and bulky items including mechanical lifting aids	

	• Prepare and maintain a safe and tidy work area at all times • Select and use appropriate personal protective equipment in all RAC activities • Select and use appropriate hand tools to complete RAC tasks safely and efficiently • Apply first aid procedures for dealing with minor and major injuries in the RAC industry and record near misses and accidents at work • Safely use access equipment such as step ladders, extension ladders, and mobile towers • Identify common electrical hazards encountered during RAC activities • Demonstrate safe working practice for working with electrically powered tools • Identify how bottled gases and equipment should be transported in the RAC industry • Identify types of energy sources and uses in RAC • Identify and apply basic operating principles of vapour compression systems • Plan work within time limits to maximize work efficiency and minimize disruption • Restore the work area to an appropriate condition	
2	**Communication and interpersonal skills**	**5**
	The individual needs to know and understand: • The identities and roles of the members of the construction team and the building services industry • How to apply information sources • How to communicate the technical language associated with the skill with others in the building services industry • The dynamics of working in a team and collaboration with other related skill groups and teams to achieve task completion • The working requirements of other trades either operating in the immediate area or affected by the installation works • The range and purposes of documentation, including text, graphical, paper based, and electronic • The standards required for routine and exceptional reporting in oral, handwritten and electronic form • The nature of the reports provided by measuring equipment, together with their interpretation • The required standards for health, safety, and environment, customer service and care	
	The individual shall be able to: • Read, interpret and extract technical data and instructions from manuals and other documentation • Communicate in the workshop by oral, written, and electronic means using standard formats with clarity, effectiveness, and efficiency • Use a standard range of communications technology • Respond to legislative requirements, customers' needs face to face and indirectly • Use search methods to obtain specific and non-specific information, specifications, and guidance	

3	Design refrigeration and air conditioning systems	15
	The individual needs to know and understand: • The standard units of measurement used in the RAC industry • The detailed properties of materials and fluids used in the RAC industry • Relevant Directives applicable to RAC industry • The relationship and interactions of energy, heat, and power • Principles of force and pressure and their application to RAC industry • Principles of electricity and control circuits as related to RAC industry • The detailed properties of fluids used in RAC industry • The refrigeration and heat pump cycle • Condensate drainage and secondary refrigerant circuits • The information requirements for the design of a refrigeration or air conditioning system • The principles and conventions used in specifications and drawings • The range of specifications and drawings in use, and their purposes • The uses and limitations of the generally available drawing tools • The types and use of electrical cables and devices for different applications	
	The individual shall be able to: • Appraise the purposes of the required systems • Appraise the feasibility of locating the system within designated areas • Calculate relative density of refrigerants to air and water • Apply specialist knowledge of the principal applications and detailed properties of solid materials • Apply the principal applications and basic properties of fluids used in the RAC industry • Use the terminology associated with latent, sensible heat and fluid change of state • Carry out simple heat energy and power, force, and pressure calculations • Carry out simple electrical calculations i.e. ohms law, power consumption, voltage, current, and resistance circuits • Design an efficient refrigeration system that includes a range of heat exchangers and refrigerant types; HFC, HC and those with low or zero ODP and GWP • Choose components and joining methods that ensure leak-tight installation • Design an air conditioning system that would serve a comfort cooling application and also a full building application • Produce simple drawings and specifications, using standard conventions and symbols • Estimate the cost/budget requirement for equipment and materials • Select the required equipment and materials according to given criteria, including price and environmental considerations • Check the price and either order the equipment and materials or amend the design of the system to maintain the budget	

4	**Installation and maintenance of refrigeration and air conditioning**	**30**
	The individual needs to know and understand: • Specific health and safety requirements that apply to fitting and fixing, servicing, maintaining, and decommissioning RAC systems • The working principles and layouts of RAC and heat pump systems • The procedure for fitting, fixing and testing materials, equipment, and components in RAC systems • The service and maintenance procedures for RAC systems, equipment, and components	
	The individual shall be able to: • Interpret diagrams, plans, and specifications for piping and electricity routes • Work safely with hot gas heating equipment in the RAC industry • Prepare and, if need be, improve the area and surfaces which the installation depends upon • Itemize the required tools, components, and materials required for installation • Take and transfer measurements and angles from given drawings to surfaces and piping materials • Identify, check, and use various types of gases and equipment used for joining materials in the RAC industry • Safely drain oil and recover refrigerant • Join similar and dissimilar materials commonly found in refrigeration and air conditioning systems using a range of permanent and accessible jointing methods (brazing) • Fabricate and install mechanical materials and components according to drawings and specifications • Install electrical materials components and control devices according to drawings and specifications • Install ancillary components and systems found in refrigeration and air conditioning systems such as condensate drainage, and leak detection systems • Use tools and equipment to apply pressure to test the strength of a refrigeration system or any part of it (see e.g. ISO 5149.2:2014) • Use tools and equipment to apply pressure to test the tightness of a refrigeration system or any part of it (see e.g. ISO 5149.2:2014) • Use tools and equipment to evacuate moisture and non-condensable gases from inside a refrigeration system, and ensuring that the system is dry and free of leakage	
5	**Commission refrigeration and air conditioning systems**	**20**
	The individual needs to know and understand: • How to interpret the design parameters of the given systems • Safety standards relating to the handling and application of refrigerants • Safe procedures for applying electrical supply to RAC systems • How to set up safety controls and devices to satisfy design requirements • How to ensure the integrity of RAC systems • How to ensure efficient operation of a system	

	The individual shall be able to: • Charge the system with the correct type and quantity of refrigerant for efficient operation without leaking refrigerant to the environment • Examine the system for leakage after commissioning, using direct or indirect measuring methods (see e.g. ISO 5149.2:2014) • Assess the refrigeration system for correct operation • Assess the air conditioning system for correct operation • Assess any secondary refrigerant or cooling system for correct operation • Assess the refrigeration or air conditioning system electrical installation for correct operation • Adjust refrigerant controls and flow devices for optimal system performance • Adjust electrical and electronic controls for optimal system performance • Balance the air distribution systems • Measure and record the RAC system operating parameters • Ensure the availability of essential client documentation • Provide training for the client operators • Demonstrate the safe functioning and care of the system to the client • Hand over the system to the client, while responding to all relevant queries	
6	**Fault finding refrigeration and air conditioning systems**	**20**
	The individual needs to know and understand: • The electrical standards that apply to the RAC industry • The inspection and testing requirements of electrically operated RAC services and components • The procedures for safely diagnosing and rectifying faults in electrically operated RAC services and components • The layout and features of electrical circuits in RAC systems • The procedure for safe isolation of the specific systems • The procedure for carrying out a risk assessment prior to investigating RAC systems • The importance of the original design and operational parameters • The impact of system isolation on client operations	

	The individual shall be able to: • Inspect and test electrically operated RAC system components • Safely diagnose and rectify faults in electrically operated RAC services and components • Prepare and safeguard the area of work and its surroundings • Carry out safe isolation of electrical systems • Assess the refrigerant system for integrity and correct operation • Replace faulty refrigerant system components • Evaluate and test electrical wiring integrity prior to energizing • Assess the electrical installation for correct operation • Examine the whole system for leakage using direct and indirect methods, knowing the parts most likely to leak • Reclaim HFC and HFO refrigerant from systems without leakage to the environment • Safely purge natural refrigerants, like Ammonia or Carbon Dioxide • Drain and refill compressor lubricant • Restore the work area and its surroundings to its prior state • Explain, advise, and report on findings, actions, and matters requiring further attention	
	Total	**100**

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 skill assessment criteria are clear concise Aspect specifications which explain exactly how and why a particular mark is awarded. The following table is an example how the marks can be organized. The final Marking Scheme will be decided by the Experts prior to the Competition.

SECTION	DESCRIPTION	CRITERION (MODULES)					
		1	**2**	**3**	**4**	**5**	**Total**
A	Component fabrication	12.5	0	0	0	0	12.5
B	Component and system installation	0	12.5	7.5	0	0	20
C	Electrical installation	0	10	5	0	0	15
D	Commissioning and adjustment	0	10	5	2.5	0	17.5
E	Electrical fault-find and repair	0	0	0	0	10	10
F	Refrigeration fault find and repair	0	0	0	10	0	10
G	Refrigerant recovery and emission control	0	0	0	10	0	10
H	Safety	1	1	1	1	1	5
	Total	**13.5**	**33.5**	**18.5**	**23.5**	**11**	**100**

TIME	MARKS ALLOCATION		TOTAL
Group one	First day: 1A+1H Last day: 2B	13.5 12.5	= 26.5 marks
Group two	Second day: 3B+3C+3D+3H Third day: 5E	7.5+5+5+1 10	= 28.5 marks
Group Three	Third day: 4D+4F+4G+4H+5H	2.5+10+10+1+1	= 24.5 marks
Group four	Last day: 2C+2D+2H	10+10+1	= 21.5 marks

4.10 SKILL ASSESSMENT PROCEDURES

There is to be a majority agreement (minimum = 50% + 1) from Experts on the accepted Competition marking scale.

The Experts will decide on the marking criteria and the dimensional tolerances of the Objective Marking Form, Subjective Marking Form and the Mark Summary Form.

The Chief Expert will then divide the Experts into teams for the purpose of marking and setting up the marking schedule in accordance with the requirements of subsection 5.3. Every team will mark a similar percentage of marks. Each team will be assigned to a workstation on a rotation basis by the DCE.

The teams will be divided into preference of expertise with each team being led by an English-speaking team leader.

All teams will be on the floor at once providing assistance to the Competitors where required and observing for illegal actions or unsafe actions by Competitors.

There will be four teams of which each team will mark approximately 25% of the project each. Each team will judge all aspects in their control.

The Experts must sign the written hard copy assessment sheet daily of their compatriot Competitor and use it to verify with the final copy from CIS system in the last day

Primary clarification and dispute resolution will be addressed by module ESR and DCE in the first instance, in order to ensure a tiered management structure.

The Chief Expert will not judge Competitor's work but will be responsible for clarifying disputes or inconsistencies in the final marking, if called upon by the DCE.

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 Test Project is a series of standalone modules.

The Test Project will be divided into two parts, part A and part B. Part A consists of the descriptions of the tasks. Part B consists of the instructions to the Competitors, specifications and operating manuals of the equipment.

The Test Project may include any of the following standalone modules designed to test the skills of the Competitors:

- Module one: Component fabrication and brazing;
- Module two: Refrigeration equipment, installation, commissioning, and adjustment;
- Module three: Air Conditioning equipment installation, commissioning, and adjustment;
- Module four: Heat Pump equipment installation, commissioning, and adjustment;
- Module five: Mobile Air Conditioning equipment installation, commissioning, and adjustment;
- Module six: Refrigerant fault finding and component replacement;
- Module seven: Electrical fault finding and component replacement.

5.3 TEST PROJECT DESIGN REQUIREMENTS

Overall, the Test Project must:

- Be modular;
- Be in accordance with the current Technical Description;
- Be in accordance with the current WorldSkills Refrigeration Standards;
- Comply with WorldSkills requirements and numbering standards;
- Be accompanied by a marking scale that will be finalized at the Competition in accordance with subsection 4.7;
- Be supplied digitally and in hard copy;
- Contain a detailed material list;
- Be self-explanatory and include schematic diagrams and tables to minimize the requirement of translation;
- Be accompanied by proof of function/proof of construction/completion in the set time etc. – as appropriate to this skill category. For example, a photograph of a project done according to the Test Project within material, equipment, knowledge, and time constraints;
- The marking criteria must be designed to mark the Test Project objectively;
- The Competitor must independently carryout the required modules of the Test Project using the material and equipment provided by the Competition Organizer.
- Use low GWP refrigerants meeting Health, Safety, and Environment regulations.
- Use of fixed gauges in refrigeration circuit for suction and discharge pressure is recommended

5.4 TEST PROJECT DEVELOPMENT

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

5.4.1 Who develops the Test Project or modules

The Test Project/modules are developed by a team of Experts. The development team will be elected by ballot at the previous Competition. The timeline for the Test Project modules development is set out in paragraph 5.4.3.

The refinement of the Test Project modules is open to all Experts who volunteer to participate on the Discussion Forum.

5.4.2 How and where is the Test Project or modules developed

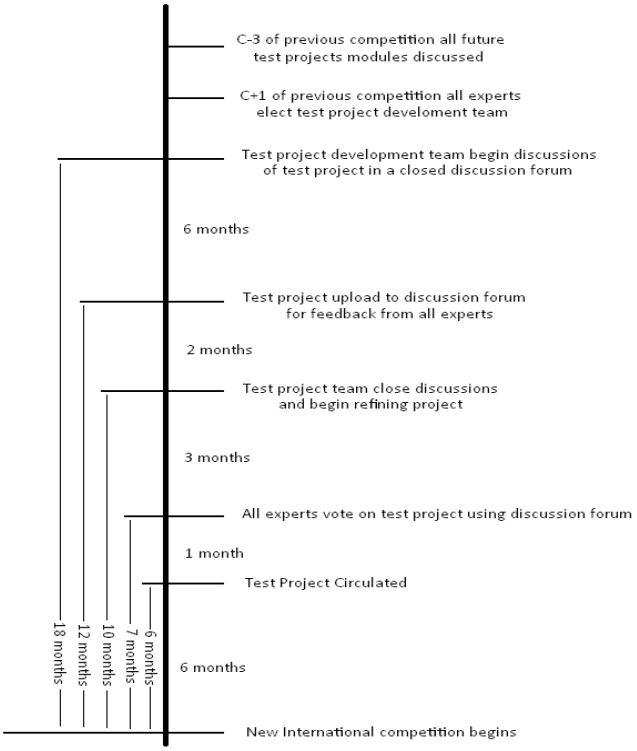
The Test Project/modules are developed independently.

Proposed Test Project modules for the next Competition are invited from all Experts. The Test Project modules for the next Competition will be proposed at the completion of each Competition, four Experts will be elected to develop the Test Project modules prior to a ballot being undertaken on the Discussion Forum. All Experts will have the right to vote. The Chief Expert and the Test Project development team are entrusted to develop the selected Test Project modules for the next Competition by contributing to the Discussion Forum in accordance with the current Technical Description.

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At the previous Competition (C-3)	Discuss Test Projects for the next Competition
At the previous competition (C+1)	Elect four Experts to form the Test Project development team
18 months prior to the Competition	TP development team begins discussions on a closed Discussion Forum
Twelve (12) months prior to the Competition	Upload proposed TP modules on the Forum for discussion
Ten (10) months prior to the Competition	TP development team closes the open discussion and refines the project based on the comments
Ten to seven (10-7) months prior to the Competition	The refined TP is built and validated according to paragraph 3.5 of the TD
Seven (7) months	Experts vote on the final Test Project
Six (6) months	Test Project is circulated on the WSI website



The Skill Competition Manager will coordinate the materials and equipment required with the Workshop Manager.

The Chief Expert will ensure that all required communication occurs between all Experts and participating countries/regions.

5.5 TEST PROJECT VALIDATION

The Test Project is validated by proof of function/construction/completion in the set time as appropriate to this skill competition. Photographs and operational specification of the completed Test Project modules including material and equipment knowledge is to be presented within the time constraints of paragraph 5.4.3.

5.6 TEST PROJECT SELECTION

The Test Project is selected by vote of Experts at the current Competition.

Development of the Test Projects will be done by elected Experts. All Experts will have the right to vote on the selected Test Project.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The Test Project is circulated via WorldSkills International website six months before the current Competition.

Part A (task descriptions) of the Test Project will be provided to participating countries at least six months prior to the WorldSkills Competition via the Technical Delegates of each country.

Part B (Competitor instructions) of the Test Project is given to the Competitors at the Competition.

The Marking Scheme is to be circulated on the Discussion Forum at least three months prior to current Competition.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

Coordination of the Test Project will be undertaken by the Skill Competition Manager in coordination with the Test Project development team.

5.9 TEST PROJECT CHANGE AT THE COMPETITION

A minimum of 30% change will be decided by all the Experts at the Competition taking into consideration the materials available.

Part B of the Test Project is given to the Competitors at the Competition. This equates to 10% of the marks. A further 20% will be changed to the circulated modules.

5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

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

Full operating manual, wiring diagrams and specifications of the major equipment must be submitted to all participating countries at least six months prior to the Competition.

All material-related requirements and manufacturers specifications shall be provided to the Competitors at the same time as the Test Project is given twelve months before the Competition.

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).

This information includes:

- Competition Rules
- Technical Descriptions
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

6.3 TEST PROJECTS [AND MARKING SCHEMES]

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

6.4 DAY-TO-DAY MANAGEMENT

The day-to-day management of the skill during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manger, 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).

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations and WorldSkills Health, Safety, and Environment requirements for this Skill and the following:

- 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;
- Experts will use the appropriate personal safety equipment when inspecting, checking, or working with a Competitor's project.
- All Competitors must use electrical safety gloves (rubber) for above 500V when live testing equipment.

8 MATERIALS AND EQUIPMENT

8.1 INFRASTRUCTURE LIST

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

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

The Infrastructure List specifies the items and quantities requested by the 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 COMPETITORS TOOLBOX

The maximum external size of the toolbox in volume is 1.00m^3. This size should not include the outside packing used to transport the toolbox. Any other special requirements of the toolbox must be specified here, for example the number allowed.

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

Each Competitor must bring with them the necessary hand-tools of the trade required to complete the project unless there is no requirement because the Competition Organizer agrees to provide the Competitor any additional tools.

Tools, materials, and equipment listed on the IL cannot be brought to the Competition.

The Competitor must bring their own personal protective equipment (PPE). Overalls or trousers with tool pockets; and tool belts can be worn by competitors.

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Competitors are not allowed to use tools, equipment, materials, or consumables supplied by Experts.

8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

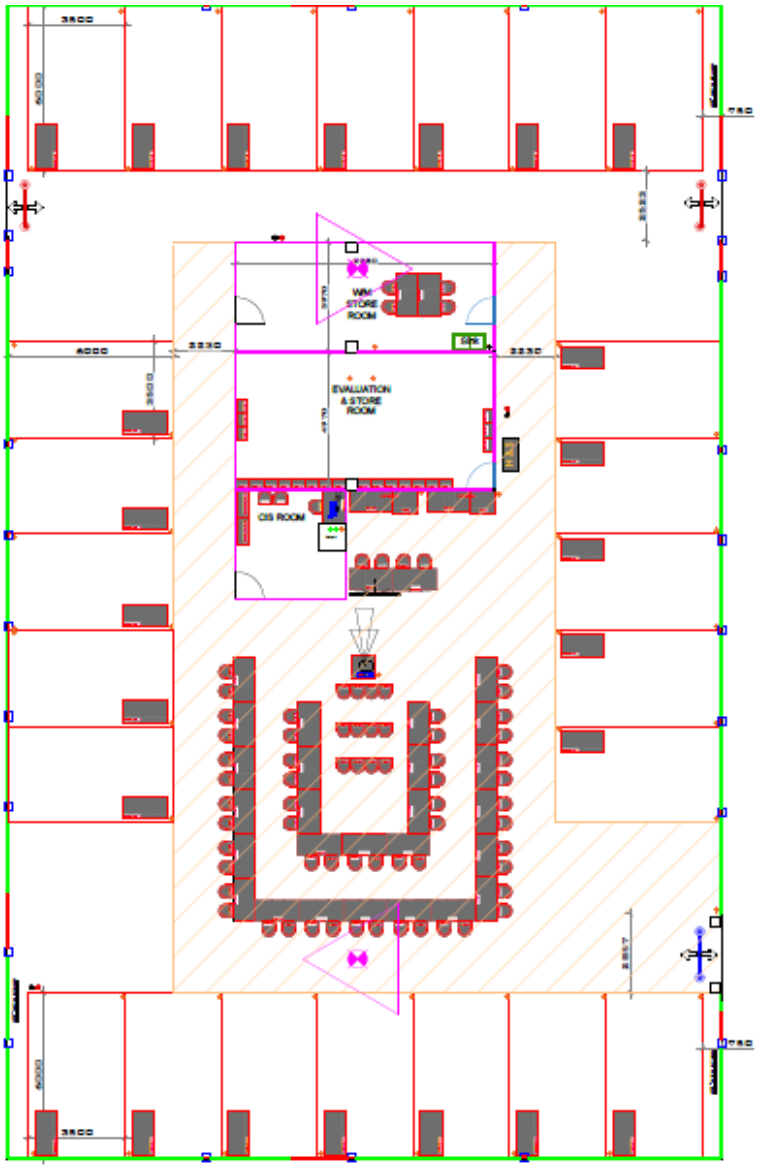
Competitors are not allowed to use their own materials or consumables for the work.

8.6 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

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

The general layout of the workshop venue will be as below, ensuring that there is sufficient space for the booth and for the Competitors working area as defined in below, which should not be less than 1200 m² for 25 Competitors. For visitors it is desirable to have as many open barriers as possible to have a view of the Competitors work.

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.

Not applicable

10 VISITOR AND MEDIA ENGAGEMENT

Following is a list of possible ways to maximize visitor and media engagement:

- Interactive media display of trade;
- Posters and information bulletin boards in prominent locations;
- Display screens with footage of all Competitors;
- Presentations by sponsors in the VIP village;
- A working demonstration project be put on display during Competition to engage the visitor's interest.

11 SUSTAINABILITY

This skill competition will focus on the sustainable practices below:

- Material recycling;
- Energy reduction, and innovation;
- Use of 'green' materials when possible;
- The Competition Organizer should organize as many tools as possible, also hand tools, to reduce the Competitor toolbox requirements. The ideal is that the Competitors will not be required to bring any of their own tools. The sponsors could supply everything with the agreement that everything is returned after the Competition.
- Re-use of completed Test Projects after Competition.

12 REFERENCES FOR INDUSTRY CONSULTATION

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

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

- ISCO-08: (http://www.ilo.org/public/english/bureau/stat/isco/isco08/)
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.**oneto**nline.org/)

This WSSS (Section 2) appears most closely to relate to *Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technician*: http://data.europa.eu/esco/occupation/3ce9c89d-6f1a-48b5-942d-386e46e2fd06

and also to *Heating and Air Conditioning Mechanics and Installers:* https://www.onetonline.org/link/summary/49-9021.01 and *Refrigeration Mechanics and Installers*: https://www.onetonline.org/link/summary/49-9021.02

Adjacent occupations may 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
The Norwegian HVAC and Refrigeration Association (VKE)	Stig Rath, Branch Manager, Refrigeration