TECHNICAL DESCRIPTION

Refrigeration and Air Conditioning

© 2010 WorldSkills International
TD38 v3.1 – WSC2011

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

The Technical Description consists of the following:

Effective 30.06.10

Liam Corcoran
Technical Committee Chair

Copyright © 2010 WorldSkills International. All rights reserved.

INTRODUCTION

1.1 Name and description of skill

1.1.1 The name of the skill is Refrigeration and Air Conditioning.

1.1.2 Description of skill
The refrigeration (HVAC/R) technician deals with the installation, maintenance, fault finding and repair of refrigeration systems which transfer heat by means of the vapour and compression refrigeration cycle; e.g. refrigeration systems as applied to cool rooms, freezer rooms, air-conditioning systems, liquid coolers and heat pumps. Systems must operate on a commonly used HFC refrigerant.

1.2 Scope of application

1.2.1 Every Expert and Competitor must have knowledge of this Technical Description.

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

1.3 Associated documents

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

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

2. COMPETENCY AND SCOPE OF WORK

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

2.1 Competency specification

The Competitors must be able to carry out the following tasks with their working skills:

- Installation of refrigerant piping
- Installation and setting of controls and regulating devices
- Installation and commissioning of completed systems
- Charging, recovering and transferring refrigerants
- Draining and refilling compressor lubricant
- Electrically connecting the components and testing the circuits
- Troubleshooting and repairing systems
- Replacing components
- Measuring and recording system operating parameters
- Interpreting manufacturers operating manuals, piping diagrams and electrical diagrams
- Completing material list from system specifications and drawings

Copyright © 2010 WorldSkills International. All rights reserved.

2.2 Theoretical knowledge

2.2.1 Theoretical knowledge is required but not tested explicitly.

All theoretical knowledge required to do the practical work:
Identification and utilisation of materials, components, tools and charts.

2.2.2 Knowledge of rules and regulations is not examined.

2.3 Practical work

All theoretical knowledge required to do the practical work including identification and utilization of materials, components and tools is necessary.

The Test Project is designed to test the skills of Competitors in the following areas:

- Refrigeration pipe-work
- Electrical wiring
- Component & system installation
- Commissioning & adjustment
- Fault finding
- Repair and part replacement
- Refrigerant recovery and control
- Work practices and safety

3. THE TEST PROJECT

3.1 Format / structure of the Test Project

The Test Project is a series of standalone modules.

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

- Module 1: Component fabrication and brazing
- Module 2: Refrigeration equipment positioning, installation, commissioning & adjustment
- Module 3: Refrigeration electrical, fault finding and repair
- Module 4: Air conditioning system Installation & commissioning

There should be a minimum of two (2) and a maximum of eight (8) modules for the Test Project.

3.2 Test Project design requirements

Overall, the Test Project must:

- Be modular
- Be in accordance with the current Technical Description
- Comply with WorldSkills requirements and numbering standards
- Be accompanied by a marking scale that will be finalized at the Competition in accordance with Subsection 5.1.
- 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 Host Member.

Copyright © 2010 WorldSkills International. All rights reserved.

3.3 Test Project development

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

The Test Project will be divided into 2 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.

3.3.1 Who develops the Test Project / modules

The Test Project / modules are developed by some Experts who volunteer.

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

3.3.2 How and where is the Test Project / 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 selected by ballot process. Only Experts who submit a proposal for discussion will have the right to vote. The Chief Expert and all participating Experts 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.

3.3.3 When is the Test Project developed

The Test Project is developed 12 months prior to the current Competition.

The Chief Expert will forward the completed Test Project to the Jury President so that material availability can be confirmed at the Technical Committee meeting that is held prior to the WorldSkills Competition.

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

3.4 Test Project marking scheme

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

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

3.4.2 Marking schemes should be entered into the CIS prior to the Competition and available to be accessed by experts on the forum at least three (3) months prior to current competition.

3.5 Test Project validation

The Test Project is validated by proof of function/construction/completion in the set time as appropriate to this skill category. Photographs and operational specification of the completed Test Project modules including material & equipment knowledge is to be presented within the time constraints of section 3.3.3.

3.6 Test Project selection

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

Only Experts who submit a Test Project proposal for discussion will have the right to vote.

3.7 Test Project circulation

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

Copyright © 2010 WorldSkills International. All rights reserved.

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.

Test Project coordination (preparation for Competition)
Coordination of the Test Project will be undertaken by the Chief Expert.

3.8 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.

3.9 Material and manufacturer specifications
Full operating manual, wiring diagrams and specifications of the major equipment must be submitted to all participating countries at least 6 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 12 months before the Competition.

4. SKILL MANAGEMENT AND COMMUNICATION

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

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

This information includes:
- Competition Rules
- Technical Descriptions
- Test Projects
- Other Competition-related information

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

Copyright © 2010 WorldSkills International. All rights reserved.

4.4 Day-to-day management

The day-to-day management is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalised at the Competition (agreed by Experts and submitted to the Chair/Vice Chair of the Technical Committee). The Chief Expert is to regularly share updates of the Skill Management Plan via the Forum.

5. ASSESSMENT

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

5.1 Assessment criteria

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

Section	Criterion	Marks		
		Subjective (if applicable)	Objective	Total
A	Refrigeration pipe work		29	29
B	Electrical wiring		18	18
C	Component and system installation		11	11
D	Commissioning and adjustment		12	12
E	Fault finding		8	8
F	Repair and part replacement		5	5
G	Refrigerant recovery and control		12	12
H	Work practices and safety		5	5
	Total =		100	100

5.2 Subjective marking

Not applicable

5.3 Skill assessment specification

The skill assessment criteria are clear concise Aspect specifications which explain exactly how and why a particular mark is awarded.

Section	Description	Criterion (Modules)					
		1	2	3	4	-	Total
A	Refrigeration Pipe Work	12	13		4	-	29
B	Electrical Wiring		14		4	-	18
C	Component System Installation		7		4	-	11
D	Commissioning & Adjustment		7		5	-	12
E	Fault Finding			8		-	8
F	Repair & Part Replacement			5		-	5
G	Refrigerant Recovery & Emission Control		5		7	-	12
H	Safety	1	2	1	1	-	5
	Total =	**13**	**48**	**14**	**25**	**-**	**100**

Copyright © 2010 WorldSkills International. All rights reserved.

	Marks Allocation			Total	
Group1	First day : 1A+1H+ 2A	12+1+13		=26	Marks
Group2	2nd day : 2C+3Total	7+14		=21	Marks
Group3	3rd days : 2B+2D+2G	14+7+5		=26	Marks
Group4	Last days : 2H+4Total	2+25		=27	Marks

A - Refrigeration pipe work
- Pipe branch
- Dimension accuracy
- Flare & Swage joint quality
- Silver brazing
- Strength pressure & Leak test
- Brazing alloy penetration
- Suction and liquid lines to standard
- TX and solenoid valves assembly & position

B – Electrical wiring
- Connection of electrical circuit
- Test the electrical circuit
- Component layout

C – Component system installation
- Material list
- Condensing unit position
- Fan coil units position
- Installation of electrical control & safety devices
- Installation of condensate drain

D- Commissioning and adjustment
- Pressure & Leak test
- Evacuation & Dehydration Test
- Set pressure controls
- Set defrost/temperature controller for freezer and/or cooler
- Measure Freezer and cooler TX valve superheat
- Commissioning & FGas report

E – Fault finding process & decision
- Use of test instruments

F – Repair and part replacement
- Correct removal and installation

G - Refrigerant Recovery & Emission Control
- Refrigerant recovery/ handling
- Emission control
- Oil recovery / charging
- Refrigerant charging
- Maintain Records

H – Safety
- Safe working practice

Copyright © 2010 WorldSkills International. All rights reserved.

5.4 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 Marking Summary.

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 lead 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 4 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 own country candidate 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.

6. SKILL-SPECIFIC SAFETY REQUIREMENTS

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

- All Competitors must use safety glasses when using any hand, power or machine tools or equipment likely to cause or create chips or fragments that may injure the eyes.
- Experts will use the appropriate personal safety equipment when inspecting, checking or working with a Competitor's project.

7. MATERIALS & EQUIPMENT

7.1 Infrastructure List

The Infrastructure List lists all equipment, materials and facilities provided by the Host Country.

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

The Infrastructure List specifies the items & quantities requested by the Experts for the next Competition. The Host Country will progressively update the Infrastructure List specifying the actual quantity, type, brand/model of the items. Host Country supplied items are shown in a separate column.

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts must advise the Technical Director of any increases in space and/or equipment.

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

Copyright © 2010 WorldSkills International. All rights reserved.

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

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

Each Competitor will bring with him the necessary hand-tools of the trade required to complete the project, and there is no requirement for the host country to provide any additional tools.

7.3 Materials, equipment and tools supplied by Experts

Competitors are not allowed to use tools supplied by Experts.

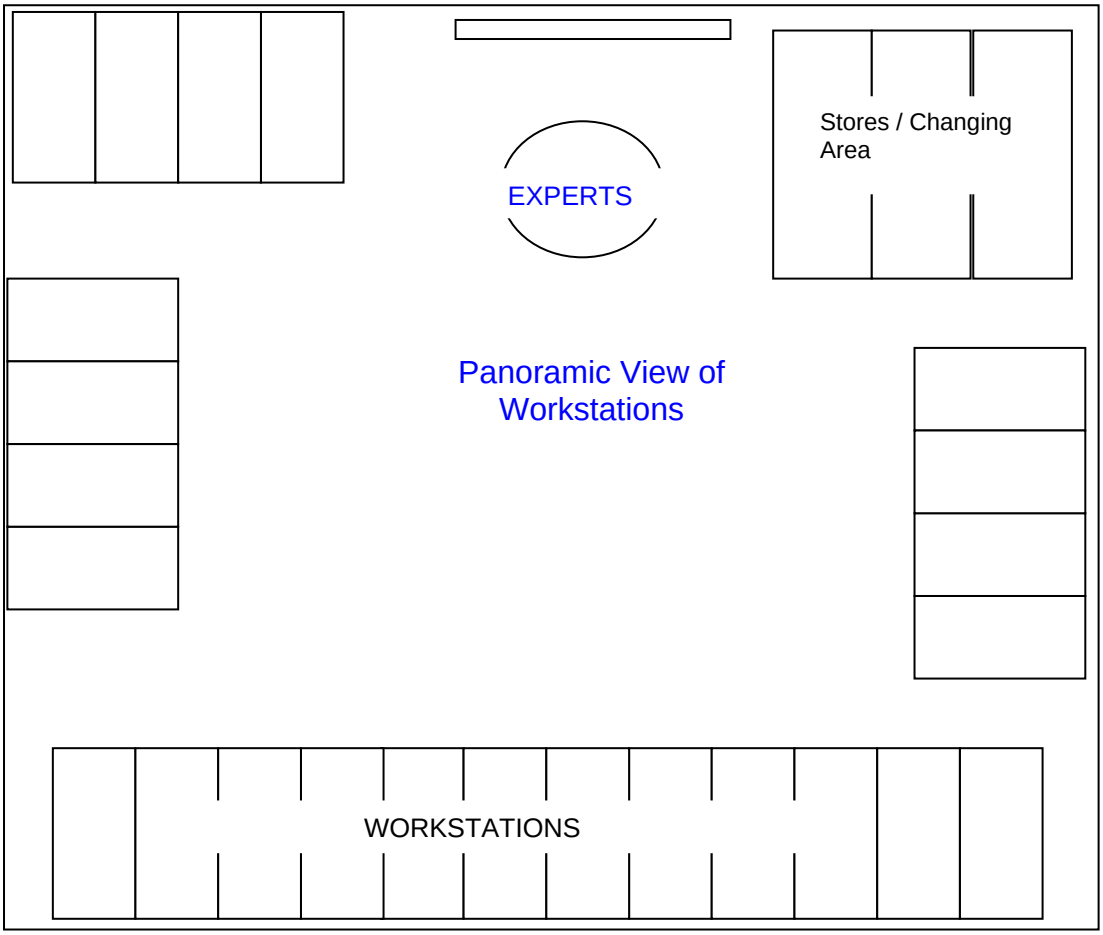
7.4 Materials & equipment prohibited in the skill area

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

7.5 Proposed workshop and workstation layouts

Workshop and workstation layout to be as follows

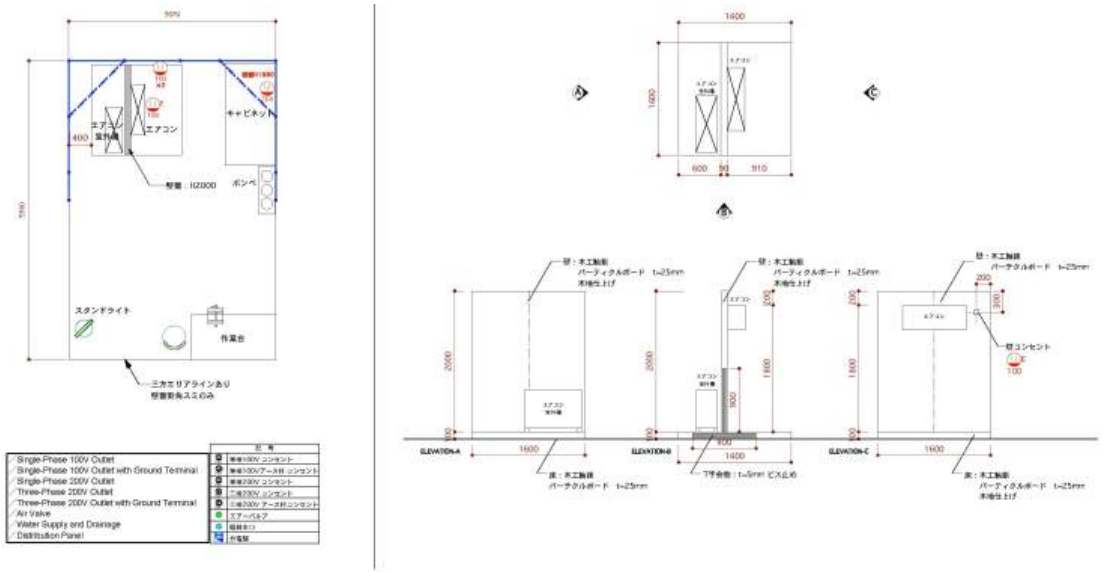
Workshop layout:



Copyright © 2010 WorldSkills International. All rights reserved.

Workstation layout:

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 688 square metres for 17 Competitors.



8. MARKETING THE SKILL TO VISITORS AND MEDIA

8.1 Maximising visitor and media engagement

To maximise visitor and media engagement for Refrigeration and Air Conditioning the following will be carried out:

- 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

8.2 Sustainability

- Material recycling
- Energy reduction
- Use of 'green' materials when possible
- Re-Use of completed Test Projects after Competition

Copyright © 2010 WorldSkills International. All rights reserved.