



## COMPETITION GUIDE

### Training Guidance for Regional Heats

# TRAINING TO PRODUCE QUALITY WORK

## Introduction

The aim of this guide is to help competitors prepare for the RACHP skills UK competition heats and perform to the best of their ability during the event. It contains technical tips and advice to enable competitors to achieve their full potential. By working through this guide, alongside the 'WSUK Preparation Toolkit', you can ensure you are competition ready.

This manual contains three main sections:

**Section 1: General Information** - covering areas such as

- Personal preparation
- Time management
- Competition preparation
- Marking Summary
- Safe working

**Section 2: Competition Outline** - covering the specifics relating to the activities in the regional competition.

- Pipework fabrication
- Refrigerant handling
- Pressure testing and Evacuation
- Electrical circuit test
- Operational efficiency

**Section 3: Technical Guidance** – covering specific tolerances and standards

Using the tips and advice in this training guide should help you to:

- ✓ Practice the basic skills at a higher level of accuracy
- ✓ Appreciate the standards for the tasks at this level
- ✓ Think before acting
- ✓ Check the quality of your work to see if it looks right compared to the specification
- ✓ Remember it's not a race – you are competing against a standard that is achievable

## 1) General Information

### 1.1 Personal Preparation

Being ready for any competition requires preparation, and this includes preparing your mind set (mental), physical (body) and technical (skills and knowledge) through training. To perform well at a higher level in any competition, whether it is RACHP, Soccer, Basketball, Formula 1 or the Olympics, all have one thing in common: repeated training along with attention to detail will result in improved performance.

#### Preparing the Mind / Body

- Keep yourself fit – you will be on your feet all day
- Have a 'can do' attitude – all competition tasks are achievable in the time available
- Reflect on your own performance, what's good and what needs improving – write it down
- Concentrate on your performance not that of others – don't look at others whilst competing (they may be doing it wrong)
- Prepare yourself for a change in plan – especially if you make an error. Park the problem, re-plan and move on. Consider "I can still do it".
- Prepare yourself for a noisy and distracting environment. Could you do the task in front of the crowd at Twickenham? At the Skills Show LIVE final there will be just as many people watching you during the week – you need to be focussed whether the crowd are present or not.
- Keep hydrated – start to drink at least 2 litres of water per day, a few weeks before your event so your body gets used to that amount of liquid.
- Make sure you eat regularly through the day – always have a healthy breakfast.
- Arrive at the event location in plenty of time, this will ensure you are not rushed and improve your state of mind.

#### Top Tips

- Don't drink energy drinks – they give a short energy burst then you'll drop dramatically
- ✓ Do eat bananas rather than energy bars – they give a slow, lasting energy release rather than a quick boost.

## Preparing your Skills

- Training in the basic skills is very important – measuring, bending, flame brazing, pressure testing, handling refrigerants etc.
- Can you work to dimensions? You are working to manufacturing tolerances, so use the right tools.
- Have you got access to training support – can you get extra time in college or at your workshop to help you?
- Think about tooling – what do I need? Keep them close - don't waste time walking around looking for things during competition.
- Set up a video camera to record your training – watch it back to see where you can save time, plan to improve. How much time did you spend just stood doing nothing? Time lost cannot be regained.
- Practice by producing the same high quality in your everyday work environment.
- Do not be afraid to go back to tasks you did in your first few days and weeks of training, you may perform them much better second time.

### Top Tips

- ✓ Read instructions, carefully, check how components fit together before you start.
- ✓ Practice using any new tools before the competition starts.

## 1.2 Time Management

- Plan your time – write down a detailed plan with clear times of activity completion e.g. setting out, positioning, bending, brazing, clips etc.
- Be prepared to re-plan. If problems arise, park the issue and move on. Developing a new plan quickly can help get your mind over the problem.
- Make sure that you complete a task before breaks, as stopping and re-starting in mid task can present even bigger problems.
- Visit the rest room prior to starting work and make sure you can wait until your next break for a visit.

### Top Tips

- ✓ Set times that are achievable as this will make you feel good as you check your progress.
- ✓ There are no trick questions. If something doesn't make sense – just ask.

The regional event will follow a typical workday

TIME	ACTIVITY
0800	Arrival sign in
0815 -0830	Induction and competition introduction
0830-0900	Familiarisation with tools, materials and equipment
0900-1200	Skill Competition Part A – 3hrs
1200-1300	Lunch and work area changeover
1300-1330	Familiarisation with tools, materials and equipment
1330-1630	Skill Competition Part B - 3hrs
1630-1730	Marking & Feedback to competitors
1730-1800	Depart

### 1.3 Competition preparation

This document provides you with the competition brief outline. Ask your tutor/employer for support – or contact the competition manager in advance if you have any questions.

All competitions will have a test project document presented on the day, that includes the specific diagrams and instructions for your test.

- Always read it thoroughly, make sure you understand what is required
- Ask questions to clarify what is required.
- Make sure you understand the marking criterion.
- Use the marking criterion when planning / problem solving, to minimise points lost.

#### Top Tips

- ✓ Use the competition web site for additional competition information
  - Training tests
  - Tool lists

### 1.4 Marking Summary

Every competition is assessed by judges according to a marking criteria, and for the RACHP regional competition it is as follows:

Weighting	Aspect	Criteria	Maximum mark
1	D	PRESSURE TESTING & EVACUATION	14
2	B	REFRIGERANT RECOVERY (emission control)	16
3	E	REFRIGERANT ADDITION (emission control)	16
4	F	COMMISSIONING (efficient operation / set up)	20
5	C	ELECTRICAL WIRING & CONTROL FAULT FINDING	12
6	A	PIPE WORK FABRICATION	22
	<b>Total marks</b>		<b>100</b>

The maximum mark for each criterion may change slightly for each annual cycle.

However, it will be the same for each regional event in an annual cycle.

## 1.5 Safe Working

Safety is everyone's responsibility.

A generic risk assessment and method statement is available in the competition manual. We have listed the required personal protective equipment to be worn for every activity.

Each centre hosting a regional heat will have carried out its own risk assessment for the workplace activities.

You are responsible for using the tools and equipment according to the manufacturer's instructions, this means you that you need to be made aware of the potential hazards and be trained in their use.

The marks for safety can only be taken away – so wear the correct personal protective equipment for the specific activity.

- No power tools are required
- No open bladed knives are to be used for wire stripping
- Battery screwdrivers are allowed (No impact drivers)
- Ensure batteries are charged prior to arrival.
- Ensure the floor area is free from clutter and keep your work bench under control
- Keep your hands clean and wash before eating

### ❖ The risk of fire –

Flame brazing poses a very high risk to property and persons.

Always use a low flame looking away from combustible materials and surfaces.

Practice lighting up and shutting down the flame brazing torch efficiently – **cigarette lighters cannot be used to ignite the fluid gas.**

### Top Tips

- ✓ Get used to always wearing safety glasses at work
- ✓ Find a pair that are comfortable – and keep them clean
- ✓ Don't wear gloves that have fingers missing
- ✓ Don't wear tracksuits, baseball caps etc – it's a work environment not a gym!

## 2) Competition Outline

### Pipe work fabrication task

Competitors are to fabricate a test piece using permanent (brazed) and non-permanent mechanical joints (flared) according to a detailed diagram.

You will be supplied with soft copper pipe, that will need to be straightened without the use of mechanical tools.

Additional materials and components will be provided to allow you to make a sealed system that will require pressure testing.

You will be expected to maintain a safe working environment and apply a systematic method of work to complete the installation within the timescale specified.

You will have to use various methods of pipe bending and flame brazing of fittings, using both 5% & 40% silver/copper alloy.

You will need to ensure the structure is protected from damage during installation and the surrounding area when carrying out hot work.

Whatever the requirements, you will be made fully aware of the task prior to the competition in the briefing, so you will need to take notes and listen very carefully.

### Refrigerant handling task

Competitors are to recover refrigerant from an existing system, pressure test, evacuate, and add refrigerant back into the system.

You will need to complete specific records and demonstrate your actions using the following documents.

- F-Gas record (Refrigerant additions, removals, leak testing)
- Pressure testing certificate (high side and low side)
- Evacuation certificate
- Operational log record

To do well in this task, you must not contaminate the refrigerant by adding any non-condensable gases during recovery and charging, and you must demonstrate best practice to avoid refrigerant emissions to atmosphere.

#### Top Tips

- ✓ Practice flame brazing copper joints in all orientations (1/2", 3/8", 1/4")
- ✓ Practice flame brazing copper to brass joints in all orientations (horizontal, vertical, upside down)
- ✓ Isolate cylinder valves and drain fluid lines at the end of the test.

#### Top Tips

- ✓ Prove your vacuum pump before starting evacuation test.
- ✓ Use the vacuum pump to evacuate air from service hose lines all the way to the service valve on the system or receiver cylinder.
- ✓ If you cannot evacuate lines all the way, only purge with refrigerant vapour
- ✓ **Never purge refrigerant liquid.**

## Electrical Test and Fault Find task

The electrical fault find test will be carried out on the same system as used for refrigerant handling.

Competitors are to use a multi-meter to test the electrical wiring will not trip the main power supply breaker when the system is powered up.

You will need to demonstrate your actions to the judge during the test.

The functional tests will require testing to ensure no voltage is present prior to testing for earth continuity.

You will be expected to check all terminations and complete a specific electrical test record for

- Earth continuity test
- Neutral continuity test
- Short circuit test

Remember, simply uncovering control covers to find a loose wire will not earn you the points.

The judges are looking to see if you know the process of using a multi meter to find a fault.

### Top Tips

- ✓ Use a voltage probe to test for dead (zero voltage).
- ✓ Practice using a multi meter to test for resistance of a circuit.
- ✓ For resistance checks -touch the leads together to know the resistance of the meter before your test begins
- ✓ **Safe isolation is critical**



### 3) Technical Guidance

#### 3.1 Tolerances and standards

The tolerance connected to the quality of work required to gain maximum marks are:

- Measurements should be within +/- 2mm of the specification
- Angles to be within +/- 2 degree of the specification
- Brazed joints will be -
  - full and even all round
  - no parent metal loss,
  - no excess alloy on exterior (blobs above 2mm)
  - no sharp peaks
  - no component burn marks
  - all flux removed (if used for silver alloy joint)
  - leak free
- Pressure leak and strength tests carried out according to BSEN 378 (2016) for 10 minutes (time to be part of the test period)
- Evacuation down to below 2000 micron, and not rise above 2000 micron after a 10-minute rise test (time to be part of the test period)
- Wiring terminations to be tight and without conductors showing when viewed at 90°
- Earth continuity and Polarity dead resistance no more than 5ohms.
- Zero escape of refrigerant liquid, purging only allowed by using vapour
- Superheat between 5 & 10K inclusive (using dew scale)
- Sub-cooling between 3 & 8K inclusive (using bubble scale)
- High pressure switch set between 55°C saturation pressure x 1.0 or x 0.9
- LP switch cut in set no higher than 3bg, +/- 0.5bar
- LP switch differential set to cut out no lower than 0.1bg and no higher than 0.5bg

#### Top Tips

- ✓ Leak test before and after every activity – make sure the judge observes
- ✓ Make sure you know how the reclaim unit works – use the purge process to transfer all the refrigerant into the cylinder – service gauges should show a vacuum on the suction
- ✓ Replace caps on all devices to save any refrigerant escape
- ✓ Remove service gauges by ensuring only low-pressure vapour is present

### 3.2 Back to Basics for competition success

#### Pipe Bending quality

Dimensional accuracy is a big point scoring area, so make sure you check the accuracy of your installation.

Take plenty of sharp pencils to use when marking out for cutting and bending.

Use a steel rule, not a tape measure.

#### Top Tips

- ✓ Make a pencil mark all around the pipe

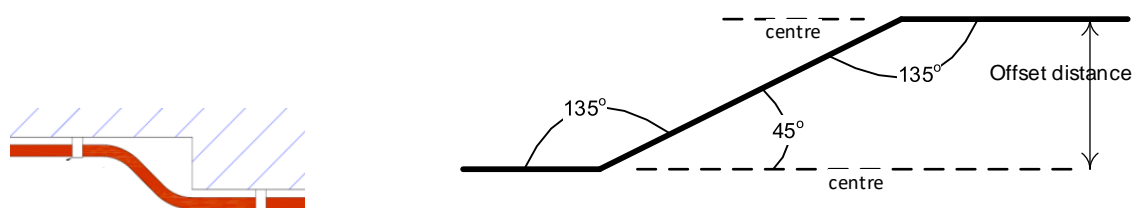
Double check angles prior to moving on to next bend – you will be surprised at how many competitors have lost marks because they cannot bend to 90° accurately.

Check bends using a small digital angle finder (Trend from Screwfix)

Flattening, kinking and wrinkling during bending copper pipe can be avoided. Practice slowly with different benders if possible.



Learn how to make an offset angle by understanding the bending tool radius.



Offset bends often require two or three pipes next to each other that are identical, so you need to think about the need to set out.

#### Top Tips

- ✓ Consider mounting your bender in a vice on a workbench for best results. It is much easier to bend accurately if you have your hands free for marking pipe, hold squares, steel rule etc.
- ✓ Check with either a square or an angle finder that the bend is accurate before removing from the bending machine.

## Copper Pipe Joint Quality

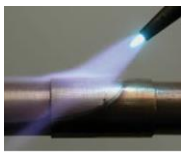
Ensure you have cleaned the fitting and the pipe for best results, even if your using flux.

Do not over-do the flux on a dissimilar metal joint – it will not improve quality.

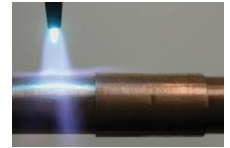
Ensure that the flame is not too fierce to burn the fitting and the wall. Heat the pipe outside the fitting to get some heat into it, before putting heat on the fitting.



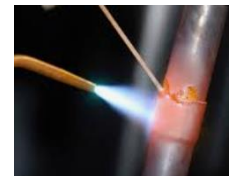
Control the flame and apply heat evenly all around the male pipe first.



Move the heat into the female and apply the alloy into the joint.



Apply alloy behind the heat, so that the alloy flows towards the heat and into the joint.



Feed alloy into the joint at intervals around the pipe – don't wipe it.

Good  
quality



Poor  
quality

Dissimilar metal brazed joints require flux applying before assembly. Make sure you remove all flux after the pipe/ joint has cooled down.



Copper to brass brazed joint.

Copper to steel brazed joint.



Use 5% Ag CuP for copper to copper joints and 40% Ag silver brazing alloy and flux for copper to brass and steel joints.

## Summary

Refrigeration and air conditioning has a very long history in UK and international competitions and now we include heat pumps. Competitors are always eager for a challenge and always respond well.

We hope this competition training guide will help to raise standards further and improve your chances of achieving a Gold Medal at WorldSkills.

College tutors and trainers can help by spending a little time with competitors prior to competition, to re-visit the basic skills taught and tighten up on the standards achieved.

These basic skills are often overlooked in the race to complete the big task in time. The time element is of course important, however through regular practice of the basic skills at work and in college, and spending a little additional time to perfect, the speed will come.

To win, a competitor needs to hit the standards at between 75-80%.

That said it's about enjoying the experience and doing your best. It is virtually impossible to achieve 100%, but if you can get into the high 70s or 80s then you will have done exceptionally well and are credit to the industry.

Little things make big differences, it takes a better person to make a better world.

The data from National Competitions shows that small improvements have been made in relation to overall scores.

The evidence shows that dimensional accuracy, flame brazing quality, knowledge of pressure testing, refrigerant handling and system set up are the areas where improvements need to be made. Competitors can install pipe but they need to develop:

- Producing accurate bend angles and off set dimensions
- Use of flame brazing equipment to produce a consistent quality finish
- Apply BSEN 378 pressure testing procedures to ensure system integrity
- Handle refrigerants to minimise refrigerant loss to atmosphere
- Charge a system efficiently using sub cooling and superheat settings
- Set up pressure safety and control switches
- Electronic leak testing during all activities

# National & International Competition Cycle

