City & Guilds Level 3 End-point Assessment for Refrigeration air conditioning and heat pump engineering technician (6090-50)

Standard: ST0322
EPA Plan: Version AP02
QN: 603/4157/9

November 2025 Version 1.9

End-point Assessment Pack

For Centres / End-point Assessment Customers / Employers / Training Providers

Version and date	Change detail	Section
February 2019 1.1	Minimum size of cold rooms reduced from 8m3 to 6m3. Additional guidance added.	4 End-point Assessment Resources list
February 2019 1.2	Additional guidance around grading caps and assessment achievement criteria added. Inclusion of details around External Quality Assurance provider. Timeline of events added	Determining Apprenticeship Grade, 702 Practical Test, 701 Professional Discussion. Introduction End-point assessment timeline.
	Additional guidance added. List of refrigerants updated. Example bay layout added. Mechanical pipework schematic updated. Example timetable added.	4 End-point Assessment Resources list Assessment 702 Practical Test
March 2021 1.4	'Clamp ammeter' added to equipment list. Task guidance updated for interview re: journal synopsis. Amended timeline to remove contradiction re: time of Synopsis submission (post-gateway, 4-weeks prior to booked EPA date).	4 End-point Assessment Resources list Assessment 701 Professional Interview 5 End-point Assessment timeline
June 2022 1.5	Clarification on required temperatures for practical test added	4 End-point Assessment Assessment 702
June 2024 1.6	Confirmation candidates should have a hard copy of the psychrometric chart when undertaking the knowledge test. Clarification of the use of the rigs and equipment for training and final assessments.	3 End-point assessment guidance for centres/End-point assessment customers 4 End-point Assessment Resources list Assessment 600 Resources List
May 2025 1.7	Clarification on preparing learners for retrofit assessment task requirements	4 Task instructions for customers - Retrofit

Version and date	Change detail	Section
July 2025 1.8	Amendment to titling conventions	Title page, 1 Introduction
	Amendment to maths and English requirements entry requirements for end-point assessment	1 Introduction
	Addition of component number	Assessments 702 and 703 Practical Test
	Addition of Assessment Specification	Assessment 701 Professional Interview
	Updated Security, confidentiality and copyright of End-point Assessment materials, and contact details	Security, confidentiality and copyright of End-point Assessment materials, Contact details
	Addition of City & Guilds Position Statement on artificial intelligence	3 End-point assessment guidance for centres/End-point assessment materials
November 2025 v1.8	Addition of partial resit information.	Opportunities to retake/resit or improve results for End-point assessments
	Addition of recommendation that Ph diagram/chart is printed on A3 size paper	Assessment 702 and 703
	Addition of timings for 3 day assessment to include Task 1 and Task 2 of the practical test and the professional interview	Assessment 702 and 703

Contents

1 Introduction

About this apprenticeship occupation

This End-point Assessment pack has been designed to assess all requirements as stipulated in the ST0322 Refrigeration Air Conditioning and Heat Pump Engineering Technician Assessment Plan (Version 02).

The Refrigeration Air Conditioning and Heat Pump (RACHP) Engineering Technician is a specialist occupation involved in planning, preparing and safely carrying out work activities in process, product and space cooling. Knowledge must be transferrable between any of the core activities of refrigeration, air conditioning or heat pumping.

The work is carried out in a variety of applications essential for key UK business activities such as food production, product distribution, retail storage and display, transport and office climate control, manufacturing processes (e.g. petrochemical, pharmaceutical), IT/Datacentres and medical/healthcare services temperature and environmental control.

Key activities are the design, installation, routine maintenance, reactive service, commissioning and de-commissioning of Refrigeration, Air Conditioning and Heat Pump systems. Technicians require a thorough competency in their understanding of the engineering principles of thermodynamics and the vapour compression cycle in order to perform operations. A fully competent technician works without immediate supervision, and liaises effectively with other trades and with end users.

Environmental, legislation and technology changes mean that the requirements for technicians in this sector are constantly evolving. European and UK Safety and Environmental legislation are key drivers in rapid technology changes in the sector that is responsible for an estimated 10% of UK greenhouse gas emissions and 16% of electricity use. RACHP Engineering Technicians have important responsibilities for the safety of themselves, work colleagues and the public as well as minimising the environmental impact of cooling systems.

External Quality Assurance

External quality assurance of this standard is carried out by Ofqual.

Details of the End-point assessment approval is given below:

Title and level	City & Guilds product number	Ofqual accreditation number
City & Guilds Level 3 End-point assessment for Refrigeration air conditioning and heat pump engineering technician	6090-50	603/4157/9

What is in this document

- The occupational standard
- Resource requirements for End-point assessment
- Timeline for End-point assessment
- End-point assessment tasks and guidance on grading
- Guidance for Customers

This document must be used alongside **the End-point Assessment Recording Forms for Customers** document.

End-point assessments

The focus of the End-point assessment is for the apprentice to demonstrate the knowledge, skills and behaviours set out in the apprenticeship standard and to be able to demonstrate this level of professional competence in authentic workplace contexts.

End-point assessments are formal summative assessments that conclude an apprenticeship programme. Each apprenticeship will be assessed in a number of ways to provide a clear indication of the apprentice's knowledge and skills. For this apprenticeship the following assessment methods need to be achieved:

- Knowledge & Skills Test
- Practical Test
- Professional Interview supported by an Apprentice Development Journal synopsis.

Grading

This apprenticeship is graded Pass, Merit, Distinction. End-point assessments are assessed and graded by City & Guilds Independent End-point Assessors (IEPAs), more information about how each assessment is graded and how the overall apprenticeship grade is determined can be found in later sections of this document.

Entry requirements for End-point assessment

To be eligible for End-point assessment the apprentice must have successfully achieved the following:

- A minimum of 12 months on-programme, it is expected that this apprenticeship will take approximately 36 months
- Certification in Level 2 Certificate in F Gas and ODS Regulations Category 1
- A completed Apprentice Development Journal, which provides sufficient evidence of the apprentice's ability to apply knowledge, skills and behaviours specified in the standard in their work place, to allow them to prepare for the Professional Interview element of the EPA
- A synopsis of the journal is ready to submit
- English and maths qualifications in line with the apprenticeship funding rules.

Gateway – prior to End-point assessment

When all on-programme content has been completed, the employer and/or training provider are required to sign-off the apprentice as being ready to undertake the End-point assessment. In order to do this, they will be required to submit a **City & Guilds End-point Assessment Gateway Declaration form**. This confirms that the apprentice has acquired the required knowledge, skills and behaviours, along with any mandatory qualifications. Each occupation has a specific Gateway Declaration form.

Completed Gateway Declaration forms are submitted to City & Guilds as part of the booking process and are checked by the End-point assessment team, prior to the allocation of an IEPA to undertake the assessments.

A copy of this form can be found within the appendix of this document and in the **End-point Assessment Customer Recording Forms**.

Remote Assessment

Remote assessment is live assessment that is supported by technology where the independent End-point assessor and the apprentice are not in the same physical location when the assessment takes place.

The following assessments can be conducted remotely

- Professional Interview.

2 Apprenticeship Occupational Standard

Knowledge	
Legislation, Regulations and Standards	• Understanding of relevant UK and international standards, technical and environmental legislation including health & safety, environmental protection, working with pressure systems, electrical circuits and flammable substances. • Familiarity with industry Codes of Practice and other sources of up to date information and advice on technical safety and legislative aspects of their work.
Underpinning principles	• Sound understanding of principles of thermodynamics, gas laws, psychrometrics, fluid flow, electricity, properties of refrigerant fluids and lubricants.
Data analysis	• Ability to understand relevant diagrams, calculations, tools, charts, tables and formulae and apply them as appropriate.
System fundamentals	• Understanding of the function and operation of system components and how they interact in a range of different systems and applications.
Sustainability	• Understanding of environmental impact of refrigerants, maximising efficient system performance and mitigation of direct and indirect carbon emissions. • Understanding of environmental technologies employed in the sector such as heat recovery, low GWP refrigerants, and other equipment which can be used to reduce heat gain, cooling load or energy use.

Skills	
Safe working practices	• Installation, commissioning, testing, fault diagnostics, rectification of systems, component/refrigerant suitability and selection. • Working with pressure systems and electrical circuits and systems. • Evaluating and mitigating risks of refrigerants including toxicity, flammability and other potential risks or hazards to self and the general public. • Decommissioning, safe recovery and disposal of equipment and hazardous waste transfer.
Control circuit application	• Electrical and electronic control systems setting, testing and fault finding; and their integration with system-associated communication networks.

Skills	
Mechanical operations	• Positioning, fixing, jointing and testing of pipework, electrical circuits and water circuits where relevant.
Application of mathematical principles	• Determining heating and cooling loads and selecting and balancing appropriate components and systems for maximum performance and efficiency.
Sustainable system operation	• Using system-operating parameters for efficient performance to achieve measurable and sustained reductions in carbon emissions. • Routine and reactive service and maintenance, testing, fault finding, reporting and rectification. • Retrofitting and retro filling of existing equipment to lower GWP refrigerants including safety, reliability and environmental considerations.

Behaviours	
Safety approach	• Disciplined approach to assessing, managing, mitigating and avoiding risk in a variety of situations to themselves, colleagues, the public and the environment.
Strong work ethic	• Positive ethical attitude and behaviours including reliability, willingness to take responsibility. Commitment to completing tasks and ability to work as part of a multidisciplined team.
Logical problem solver	• Employs logical thinking, and determined attitude to problem solving and technical challenges.
Focus on quality	• Attention to detail, following procedures, planning and preparation, verifying compliance.
Personal responsibility	• Takes responsibility for work and interactions with colleagues, customers, suppliers or subcontractors.
Communicates well	• Uses a range of communications methods effectively, positively and in timely fashion.
Adaptable	• Able to adapt to changes in conditions, technologies, situations and a wide variety of different working environments.
Self-motivated	• Willingness to learn and commitment to professional development and to applying principles of sound engineering and sustainability of engineering systems.

3 End-point assessment guidance for Centres/End-point assessment customers

Introducing the end-point assessment to the apprentice

Employers/training providers should make the apprentice aware of the different assessment methods that make up the End-point assessment of the apprenticeship prior to the gateway process.

While End-point assessments will be assessed by the IEPA, for this apprenticeship the following assessment methods it is the responsibility of the employer/training provider to introduce the assessments to the apprentice ahead of the End-point assessment visit.

- **Development Journal Synopsis** that supports the Professional Interview

Customers should be using 6090 RACHP **Apprentice Development Journal** from the 6090 City & Guilds webpage to support apprentices in producing evidence that can be used to support their responses within the Professional Interview. This synopsis must be submitted to City & Guilds at the point the apprentice passes the Gateway to End-point assessment.

As this evidence will be gathered over the 36 month duration of this apprenticeship employers/training providers should work with apprentices to develop a submission schedule that aligns with the overall timeline for assessments and with the timelines agreed with City & Guilds when booking End-point assessment.

The practical test will be introduced to the Apprentice by the IEPA, however customers should use the information within this pack, along with the assessment plan to prepare apprentices for that assessment.

The knowledge test should be scheduled by the customer on City & Guilds e-volve (online testing) platform. The customer must provide a controlled environment accessible to the apprentice which is quiet and free from distractions. The test shall be invigilated by a nominated non-technical person. The maximum invigilator to apprentice ratio must be 1 to 15. The invigilator's role is to authenticate the apprentice's identification and ensure apprentices do not have access to technical literature or external assistance online that may aid their performance in the test. The candidate must be provided with a hard copy of the psychrometric chart, which is available on the 6090 City & Guilds webpage, before starting the test.

Health and safety / Codes of practice

The importance of safe working practices, the demands of the Health and Safety at Work Act and any Codes of Practice associated with the industry **must** always be adhered to.

The requirement to follow safe working practices is an integral part of all City & Guilds assessments, and it is the responsibility of the End-point Assessment venue to ensure that all relevant health and safety requirements are in place when working on any projects or before apprentices begin any practical assessment.

Should an apprentice fail to follow correct health and safety practices and procedures during practical assessment, IEPAs should **stop the assessment** and advise the apprentice of the reasons why. The apprentice should be informed that they have not reached the standard of assessment required. It is at the IEPA's discretion to confirm whether the End-point assessment can restart.

Should IEPAs identify something, when reviewing evidence submitted for the apprenticeship or pick up on something during an oral assessment that indicates that health and safety practices and procedures may not have been adhered to, IEPAs should feed this back to the City & Guilds End-point assessment team.

Authenticating the apprentice's work

When making judgements on evidence of unobserved tasks, the IEPA must ensure all decision satisfy VACS. For evidence produced outside controlled conditions the apprentice will be required to:

- sign a declaration that the work is their own
- reference all sources.

The centre/employer can also aid authentication by:

- supplementary (oral) questioning to gauge familiarity with the topic
- looking out for any changes to the apprentices usual writing style, unusual sources/examples or the use of e.g. US spellings or phrases that might indicate cutting and pasting from the internet
- requiring access to evidence of steps in the process e.g. drafts, notes, planning etc.

For further information on authenticating work, see: **www.ofqual.gov.uk/plagiarism-teachers**

City & Guilds have produced evidence reference forms for both apprentices and IEPAs to use when reviewing evidence produced outside of controlled conditions. These forms, include a declaration of authenticity form, and must be completed when submitting evidence. These forms can be found in the **6090 RACHP Apprentice Development Journal** document. These should be completed and signed by both the tutor/employer and the apprentice.

City & Guilds Position Statement on artificial intelligence

The following guidance on artificial intelligence (AI) is designed to help candidates, teachers and assessors to complete NEAs, coursework and other internal assessments successfully. Please ensure familiarity with it.

Position Statement on AI | City & Guilds

Recording forms

City & Guilds have designed specific recording forms for apprentices and centres / End-point assessment customers / employers to use for this apprenticeship.

These can be found in **End-point Assessment Recording Forms for End-point Assessment Customers** document.

Centres must use the forms provided by City & Guilds in the format laid out in this document.

Notes on the grading criteria

Each assessment will be individually assessed and graded by a City & Guilds IEPA. The grade will be determined using the grading criteria detailed in the tasks.

Determining the overall apprenticeship grade

IEPAs are responsible for grading all tasks, apart from the Knowledge and Skills Test, and communicating these outcomes to City & Guilds. IEPAs are also responsible for determining the overall grade of the apprenticeship.

Each assessment method holds equal weighting towards the overall apprenticeship grade. The IEPA must combine the grades of all the assessment methods to determine the EPA grade. A fail in any element of the End-point assessment results in an overall fail, the apprentice must re-attempt and pass the failed assessment in order to achieve the End-point assessment.

Each assessment method within this End-point assessment is capped, meaning that the maximum grade that can be achieved when re-sitting/re-taking an assessment is a Pass. Therefore any re-sits/re-takes of the Knowledge and Skills Test can only be booked against 6090-650.

If any of the EPA components have been resat/retaken, the component grade is capped at a Pass. The overall grade is the result of the combination of those grades as shown below.

The table below lists the three assessments and their associated grade scales.

Assessment	Grade Scale
Knowledge and Skills Test	Pass/Merit/Distinction/Fail
Practical Test	Pass/Fail
Professional Interview	Pass/Merit/Distinction/Fail

To aggregate the overall End-point assessment grade, this standard uses a conditional grading model, outlined below.

Grade of Practical Test (P/X)	Grades of Theory Test/Professional Interview (DMPX)	Apprenticeship Grade
Pass	Pass/Pass	Pass
Pass	Pass/Merit	Pass
Pass	Pass/Distinction	Merit
Pass	Merit/Merit	Merit
Pass	Merit/Distinction	Merit
Pass	Distinction/Distinction	Distinction

Feedback

The IEPA will not provide feedback to the apprentice during or immediately following the assessment process. The provider will be informed by the City & Guilds EPA Team of the assessment results.

The IEPA will communicate the grade allocated for each assessment to the Lead Independent End-point Assessor (LIEPA) for quality assurance and sampling. The LIEPA will submit the results to the City & Guilds EPA Team.

Summary feedback will be provided to all apprentices after any grade determination has been carried out. The feedback will cover the areas against which insufficient evidence has been provided, leading to a 'Fail'. Our 'End-point Assessment Feedback' will also cover the areas against which the apprentice's evidence has resulted in the award of a Pass, Merit or Distinction in the assessment component, as applicable

If the apprentice has passed EPA, the City & Guilds EPA Team will issue the EPA Statement of Achievement to the provider confirming the grade achieved and will notify the Institute for Apprenticeships and Technical Education (IfATE) who will issue the apprenticeship certificate.

Results submission and Certification

The City & Guilds IEPA will submit the apprentice results to City & Guilds. City & Guilds will issue the End Assessment record of achievement confirming the grade achieved and will notify the appropriate body who will issue the Apprenticeship certificate.

Opportunities to retake/resit or improve results for End-point assessments

If an apprentice fails any part of the End-point assessment they should not retake the End-point assessment until they have completed a period of further learning or training and the employer and training provider (if applicable) is confident the apprentice is competent. A separate resit booking will be needed with City & Guilds for the relevant assessment.

If an apprentice fails any part of the End-point assessment for reasons out of their control, a resit can be booked at the earliest opportunity.

The maximum component grade an apprentice can achieve when retaking any element the End-point assessment is a pass.

Partial resit/retake of the Practical Test

If the resit or retake relates to the Practical Test, the apprentice must be observed under the same circumstances and the Practical Test will be carried out in the same way as the original assessment. Please refer to the section titled Assessment Instructions: Practical Test in this pack.

The apprentice is only required to resit/retake the tasks failed. The resit/retake is for the whole practical task failed, either Task 1 (6090-702) and/or Task 2 (6090-703) not at the sub task levels detailed in this guidance.

Resit/Retake of Task 1 Retrofit (6090-702)

At the start of the resit/retake of Task 1, the venue must ensure that the system is set up as detailed in the **Resources required: Practical Test** section of the Resources pack and EPA Pack.

The time allowed for a resit/retake of Task 1 Retrofit activity is 12 hours over 2 days.

Resit/Retake of Task 2 Fault Finding (6090-703)

If an apprentice is retaking/resitting Task 2, they must be assigned different faults to previous assessment attempts.

At the start of the resit/retake of Task 2, the venue must ensure that the system is set up as detailed in the **Resources required: Practical Test** section of the Resources pack. The system can contain either the refrigerant that would be in the system at the start or finish of Task 1, however all elements of the system must be functional/operational with no faults.

The apprentice must be informed which refrigerant is in the system at the start of the Task 2 Partial Resit.

The EPA Centre technician will set up two faults at a time on to the system, the IEPA will advise the technician which faults need to be set up. Each set of faults will take approximately 15 minutes to introduce. The apprentice must leave the assessment area whilst the first two faults are being set up by the IEPA. Once the faults have been introduced to the system, the apprentice can return to the assessment area and begin the assessment. This will then be repeated for the second set of 2 faults.

The time allowed for a resit/retake of Task 2 Fault Finding activity is 6 hours over 1 day. All four faults need to be resolved during the total 6 hour assessment time.

4 End-point Assessment Resources list

Resources required: Online test and Interview/Professional discussion	
Online test	Suitable IT systems for evolve as outlined in the manual for End-point assessment services
	An invigilator
	A quiet room with adequate lighting, space and privacy. It must be away from the pressures of work activities, in a controlled environment. This may be on or off the employers' premises
	A hard copy of the psychrometric chart, which is available on the 6090 page on the City & Guilds website
Interview / Professional discussion	A suitable room for the professional discussion/interview to take place, large enough to accommodate all those involved.
	Seating area or room for any other apprentices to wait
	Access to water and cups
	Where applicable, internet access and suitable equipment for remote assessment as outlined in the **manual for End-point assessment services**.

Resources required: Practical Test
Refrigerants

At the beginning of the retrofit task, the venue must ensure that the system contains an existing high GWP Zeotropic refrigerant that will be recovered by the apprentice. A list of examples are given in the table below.

Refrigerant Categories	Example Refrigerant	GWP	Classification
Existing High GWP	R407F R407A R452A	1825 2107 2140	A1 A1 A1 Blend

EPA venues must provide **four** alternative GWP Zeotropic refrigerants for apprentices to select from. There must be **four** refrigerants available from a number of classifications/categories given below. It is expected that venues will provide four refrigerants that range from **at least three** different classifications in the table below.
This is not a definitive list and venues may identify suitable alternatives provided they are comparable to the examples listed and thus classified and categorised in the same way.

Refrigerant Categories	Example Refrigerant	GWP	Classification
Hydrocarbon (HC)	R600a	3	A3
Hydrofluorocarbon (HFC)	R32 R454A	675 246	A2L A2L
Hydrofluorocarbon and HFO (HFC/HFO Blend)	R513A R448A R449A	631 1387 1397	A1 A1 A1
Hydrofluoro-olefin (HFO)	R1234yf	4	A2L

EPA venues **must** also provide the Manufacturer's Information for the refrigerants available including the Ph charts and thermodynamic data.

For the Fault Finding task, a centre technician must be available to implement the required faults as directed by the Independent End-point Assessor.

Space

It is permissible for candidates to be trained on the centre's rigs and equipment **and** to use these for the final assessments of the EPA. However, the assessment area must be secured such that only the candidates under assessment have access during the EPA activity. Training cannot take place in the same area whilst the EPA is being carried out.
The assessment rig includes a two-chamber cold room that allows different temperature requirements to be set in each room.

Each chamber must have the minimum dimensions of $6m^3$

The cold-room must be of a size that allows for the IEPA to directly observe the apprentice at work comfortably (i.e. able to stand within the cold room without being intrusive). This sizing is recommended to ensure the assessment replicates a real working environment and allows the system to work at full capacity.

One chamber should be set lower than -10°C and up to -18°C the other higher than +1°C and no higher than +5°C.

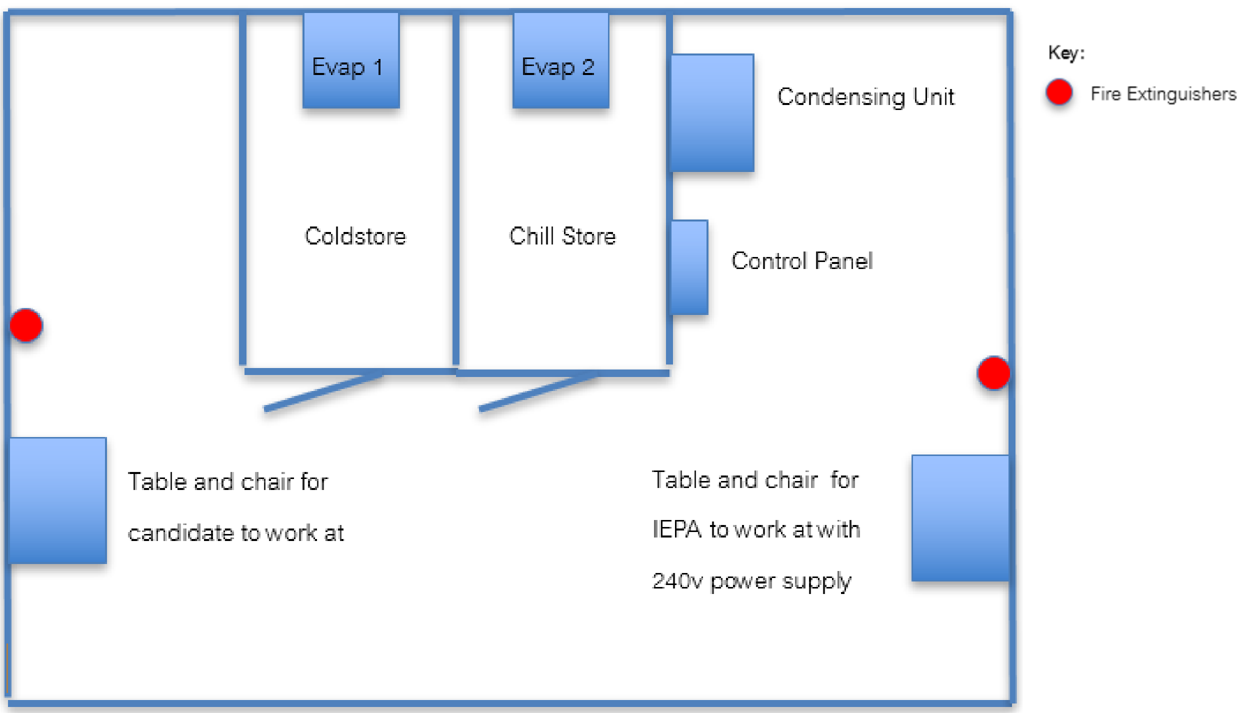
Note: The EPA will contain a brazing activity. If, for safety reasons, this has to be carried out away from the system, the exact orientation and position must be replicated as per the original drier installation on the rig. Any obstructions or difficulties must be replicated. No extra time will be allowed for this process.

Where possible brazing should be carried out in the rig location.

Where brazing action must be carried out away from the rig for legal reasons approval must be confirmed via City & Guilds before the assessment takes place.

Example bay layout

See below for an example of a bay set up – the actual arrangement may vary, but all components required for the assessment must be available in the same bay.



System Requirements

The system must contain as a minimum:

- 1 low back pressure condensing unit
- evaporators (one with electric defrost, one needs an electronic expansion valve the other needs a thermostatic expansion valve)
- evaporator pressure regulator
- single semi hermetic compressor with crank case heater
- oil separator
- control panel (including electronic thermostat/temperature control PLC for each room)
- suction line accumulator
- mechanical safety (HP/LP switch) set to allow standard operation i.e. -10K on suction and +15K on discharge
- 2 liquid line solenoid valves (if stepper expansion valve is selected)

- brazed liquid line drier and sight glasses
- oxyacetylene
- Suitably sized artificial load to allow unit to run during assessment
- All equipment and valves should be sized to allow the system to run in a balanced and efficient manner.

Permitted Materials
Apprentices must have access to the following documentation during the assessment:

- electrical diagrams
- F Gas Log books
- equipment manuals (if relevant)
- manufacturer's information for the refrigerants available including; the Pressure Enthalpy (P-H) charts and thermodynamic data
- templates given within the Venue EPA Recording Forms Pack
- An 'as installed' wiring diagram must be supplied by the venue to the apprentice for the electrical fault finding exercise.

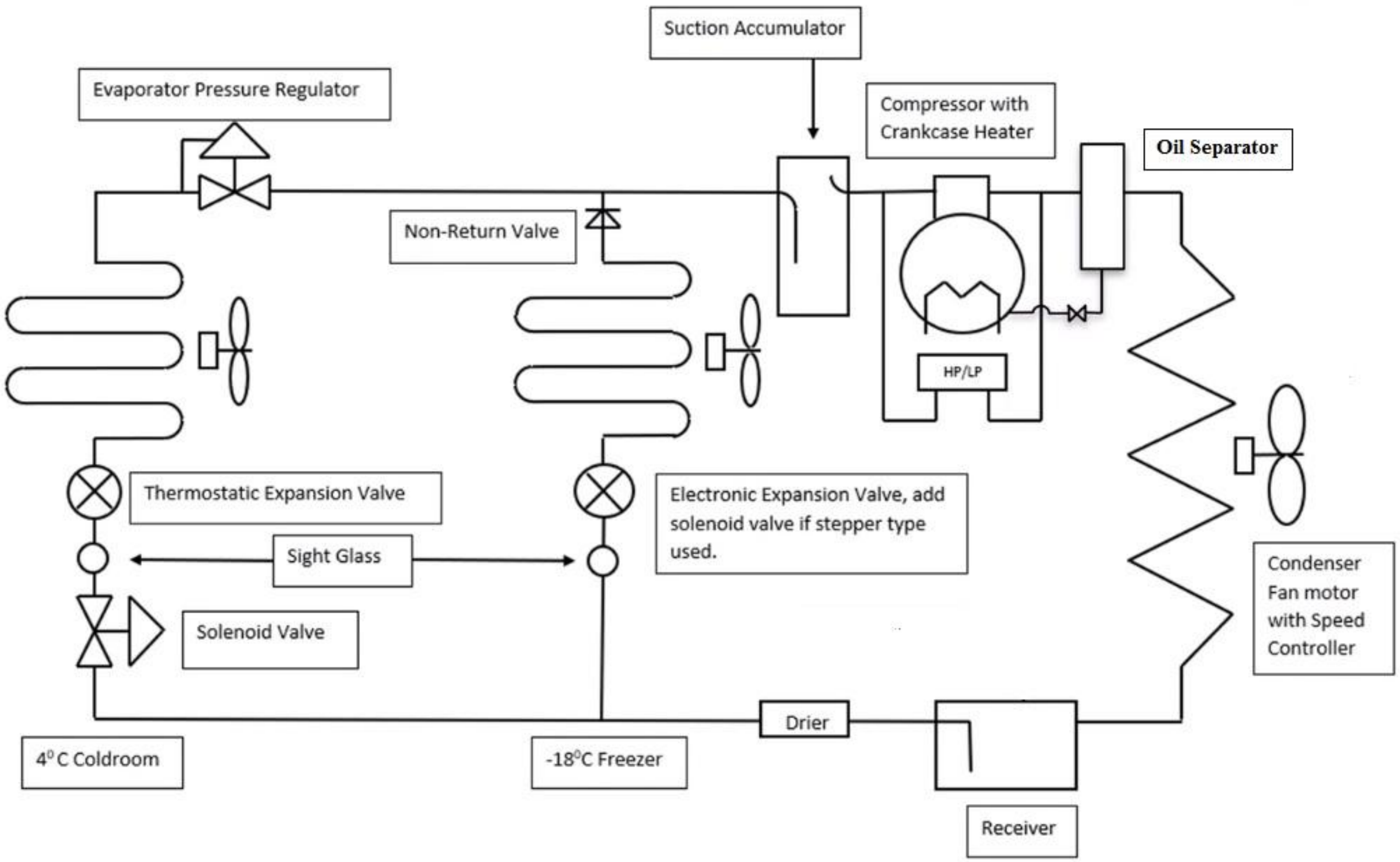
Apprentices are permitted access to the following during the assessment:

- commercial software for selecting the replacement refrigerant during Task 1 (Retrofit)

Equipment

- suitable PPE
- hand tools
- bucket with water and cloths
- access equipment if required
- spare batteries
- recovery machine and hoses
- suitable recovery cylinder(s)
- appropriate gauge manifold set
- air temperature probe
- refrigerant comparator
- electronic leak detector
- scales
- surface temperature probe
- high pressure gauge and pressure test set
- leak detection fluid
- appropriate regulator (nitrogen)
- vacuum pump
- vacuum gauge (to record less than 2 Torr, 2000 microns/2.7 mb/270 Pa)
- oxygen free nitrogen cylinder and trolley
- voltage tester (GS38 compliant) for dead testing
- multi-meter (GS38 compliant)
- electrical insulation tester (GS38 compliant)
- capacitor tester
- electrical lock off kit – padlock, signage etc.
- ratchet Key
- thermometer
- torque wrench
- solenoid magnet (minimum of 2)
- clamp ammeter

Figure one - Mechanical Pipework Schematic



System Requirements

The system must contain as a minimum;

- suitable condensing unit with crank case heater
- 2 evaporators (one with electric defrost, one needs an electronic expansion valve the other needs a thermostatic expansion valve)
- evaporator pressure regulator
- oil separator
- control panel (including electronic thermostat/temperature control PLC)
- suction line accumulator
- mechanical safety (HP/LP switch) HP must be manual reset.
- 2 liquid line solenoid valves (see note)
- brazed liquid line drier and sight glasses

5 End-point assessment timeline

<table>
<tr><th>Time line</th><th>Activity</th></tr>
<tr><td>Throughout on programme</td><td>Employer
reviews progress and ensures Apprentices' performance is on track as part of the regular performance management system
Identifies gaps and creates a plan for the end-point assessment with the Apprentice
Supports apprentice in the collation of workplace evidence.
Training Provider
Supports apprentice in ensuring sufficient evidence is being captured in the workplace.
Apprentice
completes the English and Maths components of the Apprenticeship
uses the Apprentice Development Journal as a template to collate evidence.</td></tr>
<tr><td>Gateway process</td><td>The Apprentice and line manager/tutor review progress and confirm that the apprentice is ready for End-point assessment and has met all gateway requirements.
The employer/training provider submits the completed Gateway Declaration Form.</td></tr>
<tr><td>Book End-point assessment in line with City& Guilds booking timelines*</td><td>Employer/training provider:
makes End-point assessment booking with City & Guilds.</td></tr>
<tr><td>Post-gateway/before EPA booking date</td><td>Employer
supports apprentice selecting evidence to put forward as their development journal synopsis.
Training Provider
Supports apprentice by ensuring the evidence selected for their synopsis allows them to fully address all 12 themes within the interview.
Apprentice
Selects three jobs that cover the tasks listed in the journal and can be used to support the professional interview.</td></tr>
<tr><td>4-weeks prior to booked EPA date.</td><td>Employer/training provider:
submits the development journal synopsis on behalf of the apprentice.</td></tr>
</table>

Time line	Activity
Completion of assessment tasks	There is no prescribed order that the assessments must be taken in.

Assessment 600 End-point Assessment – Knowledge Test

Assessment specification

Assessment type: Multiple choice, usually delivered online*
Assessment conditions: Invigilated examination conditions*
Grading: D/M/P/X
Grade boundaries: P: 30, M: 40, D: 45

The grade scale for this assessment is capped after the first attempt. The maximum grade an apprentice can achieve when resitting is Pass.

All resit attempts should be booked under the assessment number 6090-650.

Customers should not book apprentice's initial attempt against the assessment 6090-650, the maximum an apprentice could achieve would be a Pass, they would not be able to access the Merit or Distinction grade against 6090-650.

Candidates should have with them a hard copy of the psychrometric chart, which is available on the 6090 page on the City & Guilds website.

Exam 600	**Duration: 75 minutes**		
Standard ref	**Criteria**	**Number of marks**	**%**
1 Legislation, Regulations and Standards			
1.1	Understanding of relevant UK and international standards, technical and environmental legislation including; • health & safety • environmental protection, • working with pressure systems • electrical circuits • flammable substances.	7	14
1.2	Familiarity with industry Codes of Practice and other sources of up to date information and advice on technical safety and legislative aspects of their work.	1	2
2 Underpinning principles			
2.1	Sound understanding of principles of; • thermodynamics • gas laws • psychrometrics • fluid flow • electricity • properties of refrigerant fluids and lubricants.	15	30

3 Data analysis			
3.1	Ability to understand relevant; • diagrams / calculations • tools / charts • tables and formulae and apply them as appropriate.	6	12
Standard ref	**Criteria**	**Number of marks**	**%**
4 System Fundamentals			
4.1	Understanding of the function and operation of system components and how they interact in a range of different systems and applications.	5	10
5 Sustainability			
5.1	Understanding of environmental impact of: • refrigerants • maximising efficient system performance and • mitigation of direct and indirect carbon emissions.	6	12
5.2	Understanding of environmental technologies employed in the sector such as: • heat recovery • low GWP refrigerants • other equipment that can be used to reduce heat gain, cooling load or energy use.	6	12
6 Application of mathematical principles			
6.1	Determining heating and cooling loads.	2	4
6.2	Selecting and balancing appropriate components and systems for maximum performance and efficiency.	2	4
	Total	**50**	**100**

*These exams are sat under invigilated examination conditions, as defined by the JCQ: **http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations**.

Entry for exams can be made through the City & Guilds Walled Garden.

Assessments 702 and 703 Practical Test

Assessment specification

Assessment type: Practical assessment, assessed by Independent End-point Assessor
Assessment conditions: Invigilated, independent working
Permitted Materials: manufactures information, information about the refrigerants made available
Grading: P/X

Ref	Skills	Ref		Mapped to Task
S1	Safe working practices	S1.1	Installation, commissioning, testing, fault diagnostics, rectification of systems, component/refrigerant suitability and selection.	Retrofit & Fault Finding
		S1.2	Working with pressure systems and electrical circuits and systems.	Retrofit & Fault Finding
		S1.3	Evaluating and mitigating risks of refrigerants including toxicity, flammability and other potential risks or hazards to self and the general public.	Retrofit
		S1.4	Decommissioning, safe recovery and disposal of equipment and hazardous waste transfer.	Retrofit
S2	Control circuit application	S2.1	Electrical and electronic control systems setting, testing and fault finding; and their integration with system-associated communication networks.	Fault Finding
S3	Mechanical operations	S3.1	Positioning, fixing, jointing and testing of pipework, electrical circuits and water circuits where relevant.	Retrofit
S4	Application of mathematical principles	S4.1	Determining heating and cooling loads and selecting and balancing appropriate components and systems for maximum performance and efficiency.	Retrofit
S5	Sustainable system operation	S5.1	Using system operating parameters for efficient performance to achieve measurable and sustained reductions in carbon emissions.	Retrofit
		S5.2	Routine and reactive service and maintenance, testing, fault finding, reporting and rectification.	Fault Finding
		S5.3	Retrofitting and retrofilling of existing equipment to lower GWP refrigerants including safety, reliability and environmental considerations.	Retrofit

Task instructions for Customers

This End-point Assessment will consist of two parts:

1. **Retrofit**
   Apprentices will be presented with a refrigeration system that is currently filled with a high GWP refrigerant. The apprentice must be informed what this refrigerant is and given manufacture's information including Ph charts and thermodynamic data.

   Requirements for the Ph chart and associated analysis sheet
   Apprentices must be able to:
   - Record system performance
   - Plot readings onto the Ph chart
   - Carry out calculations with accuracy
   - Interpret the data accurately
   - Provide a supported evaluation on their alternative refrigerant selection (GWP, compressor work done, oil type and latent heat capacity)
   - Compare the analysis gained for a minimum of four refrigerants
   - Select an appropriate refrigerant which meets the specification of the assignment brief.

   The objective of the task is for the apprentice to identify a suitable alternative refrigerant that will improve the sustainability of the system and lessen the environmental impact. Once an appropriate refrigerant is identified the apprentice must retrofit the system with it.

2. **Fault Finding**
   Apprentices will be required to identify and rectify a number of electrical and mechanical faults on a system.

Over the duration of the assessment, each apprentice will need to:

- select a replacement refrigerant from a choice of available fluids
- recover the waste refrigerant
- charge the system with new refrigerant
- replace the brazed drier into the system
- determine the system's optimum operating conditions
- set up the system to meet those operating conditions
- commission the new refrigerant through the system.

Timings
The assessment will take 18 hours. The Retrofit activity has a duration of 12 hours and the Fault Finding activity has a duration of 6 hours.

The structure of the assessment day will be outlined by the assessor as they will need to manage the number of apprentices, bays and resources etc. If all assessments are to be completed, then the assessments would be delivered as below over a 3 day period:

Day 1
- approx. 7.5 hours of the 12 hours required for Task 1 completed

Day 2

- remaining approx. 4.5 hours of Task 1 completed. If the system is not fully functional at the end of Task 1 then the remainder of day 2 would be utilised by the Centre Technician to reset the system**.**
- Apprentice will complete Professional Interview in the afternoon of Day 2 regardless of whether the system is operational at the end of Task 1

Day 3

- Apprentice completes 6 hours required for Task 2

Preparation

Customers must ensure they have a venue with an installation that meets the requirements set out within the 'Resource Requirements' section of this document.

Before the assessment begins, the IEPA will discuss what refrigerants are currently in the test rigs and the four alterative refrigerants that will be available with a representative from the assessment venue. The IEPA must confirm that this selection is appropriate in line with the resource guidance in this document before commencing the assessment.

If the system is not left fully operational and fault free at the end of Task 1, the Centre technician must be available to return the system to a fully operational state so that Task 2 can be taken, this should take a maximum of 4 hours depending on the resetting of the system required at the end of Task 1.

In preparation for Task 2, fault finding, the EPA venue must make a technician available to assist implementing the required faults onto the test rigs. The IEPA must validate that these faults have been implemented correctly before the assessment begins.

Throughout the duration of the practical test, if an IEPA observes an apprentice working unsafely, the IEPA should put an immediate stop to the assessment and terminate the EPA. If the assessment is stopped during Task 1 due to the apprentice working unsafely, the apprentice will not be able to attempt Task 2

The customer must also print and make available the following recording documentation for each apprentice, these forms can be found in the Customer Recording Forms document:

Recording form
Risk Assessment – one for Task 1 and one for Task 2
Method Statement – one for Task 1 and one for Task 2
Resource List – Task 1
Flame Brazing Planning Sheet – Task 1
pH Analysis Sheet – Task 1
Refrigerant Removals and Additions Record – Task 1
Waste Transfer Note – Task 1
Operational Log – Task 1
New System Efficiency Evaluation -Task 1
Electrical test results – Task 2
Pressure testing notes – Task 2

Task Specific Guidance

Task 1 - Retrofit
Apprentices are required to perform a change of refrigerant on a single refrigeration system, which operates a two-chamber cold room that allows different temperature requirements to be set in each room. Each chamber must have the minimum dimensions of $6m^3$ (1.73m x 1.73m x 2m). One chamber should be set to -18°C and the other +4°C.

This task involves:
- planning the work appropriately managing time, resource required and risk
- selecting the replacement refrigerant from a choice of available fluids (commercial software can be used)
- recovering refrigerant
- installing new components
- replacing the brazed drier into the system
- charging with new refrigerant
- determining operating conditions
- setting the system parameters so that it is working correctly
- commissioning the new system
- measuring the new system's efficiency
- handing over the works to the client.

It is recommended that the pH chart/diagram provided by the Centre is printed on A3 size paper to support the accuracy of plotting by the apprentice.

Task 2 – Fault finding.
The purpose of this task is for apprentices to demonstrate knowledge of the process of diagnosing and rectification of faults. Apprentices are required to safely diagnose and rectify four faults by interpreting the given symptoms and/or conditions.

Grading Criteria

This assessment is grade Pass/Fail.

Apprentices must meet all pass criteria for both tasks within this assessment.

Below details the grade descriptors taken from the assessment plan that the marking criteria is built upon.

Ref	Area of Standard	Fail Criteria	Pass Criteria
S1	Safe working practices	If the apprentice carrying out the Practical Test during EPA fails to adhere to safety, legal or environmental requirements at any time during the assessment, the IEPA will intervene, stopping the assessment and the apprentice will have failed the assessment.	Develops and works to risk assessments and safe working procedures.
S2	Control circuit application	Fails to demonstrate pass criteria to set controls accurately and to carry out effective controls fault finding.	Sets, tests and fault finds in electrical control circuits. Positioning, installing, testing and fault finding electrical controls to ensure effective control of the system operation including system associated communication networks, in line with current standards.
S3	Mechanical operations	Fails to demonstrate pass criteria in carrying out mechanical operations Is unable to install, test and set to work a system operating in line with the test specification within the time scale provided. (app4)	Carries out mechanical operations for pipework, electrical and other circuits to a system design and setting system to work including the ability to identify and rectify faults.
S4	Application of mathematical principles	Fails to demonstrate pass criteria in applying mathematical principles related to load determining, component selecting and system balancing activities.	Produces evidence of mathematical principles applied, formulae used and calculations carried out to evaluate the choice and balancing of components and selecting refrigerants, for maximising efficiency and effective and environmental operation of the installation. This includes: select, apply and manipulate mathematic formulae Plot and interpret graphical information.
S5	Sustainable system operation	Fails to demonstrate pass criteria to reduce system emissions by measuring system performance and use of low GWP refrigerants.	Uses data to ascertain system performance and implement modifications to reduce direct and indirect system emissions and takes into account overall environment impact.

Assessment 701 Professional Interview

Assessment specification

Assessment type: Professional interview, assessed by Independent End-point Assessor
Assessment conditions: One-to-one within a controlled environment, ie a quiet room
Permitted Materials: Apprentices should have their Apprentice Development Journal Synopsis with them for reference during the interview
Grading: D/M/P/X

The grade scale for this assessment is capped after the first attempt. The maximum grade an apprentice can achieve when resitting is Pass.

Knowledge/ Skills/ Behaviour	Ref	Area of Standard
Knowledge	K4	Underpinning Principles
	K7	Sustainability
Skills	S1	Safe working practices
	S5	Sustainable system operation
Behaviours	B1	Safety Approach
	B2	Strong Work Ethic
	B3	Logical problem solver
	B4	Focus on quality
	B5	Personal Responsibility
	B6	Communicates well
	B7	Adaptable
	B8	Self motivated

Task instructions for Customers

This is a focused one-to-one interview carried out by the IEPA that enables the apprentice to give evidence verbally of how they have applied the required knowledge, skills and behaviours through their work experience, drawing on examples from their Apprentice Development Journal synopsis. The synopsis itself will not be assessed as part of the Interview and will not contribute to the grading of the apprenticeship – it is used as a resource for apprentices and IEPAs to refer to during the interview and to provide context for the apprentice's responses.

The apprentice should have submitted three jobs, which they will use as examples to answer the questions within this interview. Apprentices should be familiar with the **City & Guilds 6090 Apprentice Development Journal** and ensure their evidence is mapped to the themes within this document.

The interview focuses on 12 main themes as prescribed within the assessment plan. The interview is designed as a framework that is flexible to incorporate the many diverse specialisms within the RACHP industry. It is designed to allow for contextualisation to the apprentice's workplace experience in relation to the standard.

The next few pages will give details of the themes and the associated grading criteria from the RACHP Assessment Plan.

The duration of the interview will be 45-55 minutes. As the interview is a formal documented conversation it must be conducted in a 'controlled environment' i.e. a quiet room. There will be provision for the interview to take place remotely if needed.

The grade scale for this assessment is capped after the first attempt. The maximum grade an apprentice can achieve when resitting is Pass.

Permitted materials

Apprentices should have their **Apprentice Development Journal Synopsis** with them for reference during the interview.

Apprentice Development Journal Synopsis

Centres should refer to the **City & Guilds 6090 Apprentice Development Journal** document available on the City & Guilds website. This document contains detailed guidance on what must be submitted in preparation for the Professional Interview.

Forms have been provided by City & Guilds to assist centres in preparing the Apprentice Development Journal Synopsis for the Professional Interview. Copies of all forms can be found in the **Recording Forms** section of the **City & Guilds 6090 Apprentice Development Journal** document.

The following list is an example of what should be submitted:

- **Apprentice Development Journal Cover Sheet**
- **Declaration of Authenticity** form
- **Evidence mapped to professional interview (by task)** form
- **Evidence mapped to professional interview (by KSB)** form
- **Expert Witness Sample Signatures** form if applicable (only where expert witness testimony is included in evidence)
- Job Sheet 1 – a completed **RACHP Apprenticeship Job Sheet** form
    - Related pieces of evidence (presented with a completed **Evidence Header Sheet** for each piece of evidence)
- Job Sheet 2 – a completed **RACHP Apprenticeship Job Sheet** form
    - Related pieces evidence (presented with a completed **Evidence Header Sheet** for each piece of evidence)
- Job Sheet 3 – a completed **RACHP Apprenticeship Job Sheet** form
    - Related pieces of evidence (presented with a completed **Evidence Header Sheet** for each piece of evidence)

It is not mandatory that all City & Guilds materials are used; if centres or employers have suitable alternatives they are permitted to use these, however they must ensure they are able to clearly map evidence towards the Professional Interview.

Assessment 701 Professional Interview

Task instructions for Apprentices

You will be interviewed around the below 12 themes taken from the apprenticeship standard;

You must consider how you have evidenced this knowledge, skill or behaviour in the workplace and look to support your answer with evidence from your Apprentice Development Journal Synopsis as appropriate.

- Theme 1 – Safety Approach
- Theme 2 – Safe working practices
- Theme 3 – Sustainable System Operations
- Theme 4 – Sustainability
- Theme 5 – Underpinning Principles
- Theme 6 – Communicates Well
- Theme 7 - Focus on Quality
- Theme 8 – Strong Work Ethic
- Theme 9 – Logical problem solving
- Theme 10 – Adaptability
- Theme 11 – Personal Responsibility
- Theme 12 – Self Motivated

Permitted materials

You may have your **Apprentice Development Journal Synopsis** with you for reference during the interview. You may use the evidence within your synopsis to ‘back up’ and reference your answers to the interview questions.

Assessment Grading

This assessment is graded Distinction/Merit/Pass/Fail. The grade is calculated as follows:

Grade	What is required
Distinction	Must meet the distinction criteria in all 12 themes.
Merit	Must meet the pass criteria in all 12 themes, with at least 6 of these 12 themes achieving the distinction criteria.
Pass	Must meet the pass criteria in all 12 themes.
Fail	Fails to meet all the pass criteria detailed above.

Grading Criteria

Theme 1 – Safety Approach	Pass Criteria	Distinction Criteria Achieve the pass criteria and in addition
Apprentice solves technical problems, explains their role and how they select the appropriate techniques, procedures and/or methods.	• Follows safe working practice behaviours related to the tasks carried out.	• Applies safety behaviours proactively and flexibly to a range of work environments, demonstrating ability to respond to changing circumstances • Influences safety policy for example by bringing to the attention of others changes required related to a task or project or in their employers' policies.

Theme 2 – Safe working practices	Pass Criteria	Distinction Criteria Achieve the pass criteria and in addition
Apprentice has taken action to prevent harm to people, equipment or data.	• Develops and works to risk assessments and safe working procedures.	• Continually reassesses, monitors and communicates to others risks throughout the job being carried out and is able to contribute to the management of others in the work environment in order to mitigate risk and ensure the safe working practices of a variety of roles and tasks in a variety of work situations.
Theme 3 – Sustainable System Operations	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice has taken action to evaluate and minimise environmental impacts.	• Uses data to ascertain system performance and implement modifications to reduce direct and indirect system emissions and takes into account overall environment impact.	• Works to reduce environmental impact across a range of new and existing systems consistently • Evaluates the potential to implement sustainable technology changes into existing systems, contributes to developing new ways to apply such technologies and influences the behaviour of others • Regularly applies a range of sustainable technologies.

Theme 4 – Sustainability	Pass Criteria	Distinction Criteria Achieve the pass criteria and in addition
Apprentice can explain potential impact of systems on the environment, direct and indirect emissions.	• Has awareness and understanding of sustainability issues for the RACHP sector and their personal responsibility for the environmental impact of systems they work with.	• Can justify the use of a more sustainable technology and understands what actions they should be taking in the workplace to reduce environmental impact of systems • Understands how to evaluate the impact of different technologies to achieve more sustainable systems and improve the sustainability of existing systems • Provides a documented argument to justify adopting new more sustainable technologies to others.
Theme 5 – Underpinning Principles	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice can explain what equipment is used, why, how data is gathered and analysed and how they initiated the project to produce the desired outcome. Apprentice uses scientific, technical or engineering principles to complete their project.	• Can discuss knowledge of underpinning principles relevant to their job role.	• Demonstrates a greater depth of knowledge of a wider range of underpinning principles beyond their own job role • Explains to advanced principles, and proactively seeks to deepen their knowledge of those principles.

Theme 6 – Communicates Well	Pass Criteria	Distinction Criteria Achieve the pass criteria and in addition
Apprentice uses data to make reports and support recommendations on work they have carried out to their employer or other people involved such as clients or suppliers.	• Gives examples of a wide range of communication methods used to communicate with peers and customers, e.g. verbal communication, written communication in the form of diagrams/charts etc.	• Prepares their own communications to explain complex information effectively • Persuades and influences stakeholders involved in projects by selecting and using the most suitable method of communication.
Theme 7 - Focus on Quality	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice identifies, plans, and organises the resources needed to effectively complete a project, explaining how they took into consideration cost, quality, safety and environmental impact.	• Follows instructions to support the importance of getting it right first time and assesses the potential implications if attention to detail is lacking • Attention to detail in planning, documenting, preparing and checking.	• Takes responsibility for ensuring a quality assurance system across a range of projects, for both their own work but also their team / project members.
Theme 8 – Strong Work Ethic	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice can demonstrate their role and commitment to successful completion of a project	• Takes responsibility for completion of own projects, taking ownership for own actions and identifying and working with appropriate team members.	• Considers and adopts multiple solutions to challenges they are responsible for • Consistently takes leadership in completion of projects by working proactively with all those involved in the project (team members management and clients) to provide range of solutions responding to problems which arise in a variety of situations.

Theme 9 – Logical problem solving	Pass Criteria	Distinction Criteria Achieve the pass criteria and in addition
Apprentice exercises logical problem solving in a working environment relation to completion of a project	• Uses of logical problem solving and solution analysis.	• Anticipates and avoids potential problems for themselves and others in a range of projects or technical challenges.
Theme 10 – Adaptability	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice exercises adaptability in a working environment in relation to completion of a project	• Responds and adapts to changes to working practices within projects.	• Proactively implements changes to own working practice within projects • Influences others to implement changes in a variety of projects.
Theme 11 – Personal Responsibility	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice complies with professional engineering Institutions' Code of Conduct and Ethics	• Acts professionally at all times • Maintains an awareness of impact of their own behaviour on their personal reputation and that of their employer, their customers and the engineering profession.	• Takes the initiative to influence the behaviour and professional standards of others in work situations.
Theme 12 – Self Motivated	**Pass Criteria**	**Distinction Criteria Achieve the pass criteria and in addition**
Apprentice ensures they keep up to date with developments in their technical area and continues to develop their professional competence	• Is aware of factors that can influence performance • Recognises how their own working style and team dynamics impact on a project's success.	• Plans own learning and identifies appropriate learning resources related to projects.

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