T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Building Services Engineering for Construction

Air Conditioning Engineering

Guide standard exemplification material

Distinction – Sample 2021

City & Guilds | eal

Introduction

The sample assessment materials within this document refers to the air conditioning engineering sample occupational specialism assignment. The aim of these materials is to provide centres with examples of knowledge, skills and understanding that attest to a distinction grade. In this document all exemplar evidence attests as examples of a distinction grade. The examples provided do not reflect all evidence from the sample assignment as the focus of this material is the quality and standards that need to be achieved rather than the volume of exemplar evidence provided. However, the examples provide a representative example of all tasks in the sample assignment. It is important to note that in live assessments a candidate's performance is very likely to exhibit a spikey profile and standard of performance will vary across tasks. A distinction grade will be based on a synoptic mark across all tasks.

The materials in this GSEM are separated into three sections as described below. Materials are presented against a number of tasks from the assignment.

Task

This section details the tasks that the candidate has been asked to carry out. What needs to be submitted for marking and any additional evidence required including any photographic evidence. Also referenced in this section are the assessment themes the candidates will be marked against when completing the tasks within it. In addition, candidate evidence that has been included or not been included in this GSEM has been identified within this section.

In this GSEM there is candidate evidence from:

Task 1
Task 2
Task 3
Task 4

Candidate evidence

This section includes exemplars of candidates work, photographs of the work in production (or completed) and practical observation records of the assessment completed by centre assessors. This will be exemplar evidence that was captured as part of the assessment and then internally marked by the centre assessor.

Commentary

This section includes detailed comments to demonstrate how the candidate evidence attests to the standard of distinction by directly correlating to the grade descriptors for this occupational area. Centres can compare the evidence against the performance indicators in the marking grid descriptors within the assessor packs, to provide guidance on the standard of knowledge, skills and understanding that need to be met for distinction.

It is important to note that the commentary section is not part of the evidence or assessment but are evaluative statements on how and why that piece of evidence meets a particular standard.

Grade descriptors

To achieve a Distinction, a candidate will be able to:

Demonstrate an exemplary performance that fully meets the requirement of the brief and is able to enter the industry to begin to work in the occupational area.

Demonstrate exemplary technical skills in cutting, bending, fixing pipework, and installing components that is in line with industry standards.

Demonstrate relevant and comprehensive knowledge and understanding of air conditioning principles and processes through the tasks completed.

Work safely showing an understanding in the selection and use of tools and equipment and demonstrates an advanced awareness of straightforward preparation and application processes.

Solution focussed, confidently attempting to diagnose complex tasks and faults in refrigeration. They will be able to accurately research, identify and rectify issues and independently.

Consistently uses industry terminology that is accurate in both written and verbal contexts.

Task 1 – Design

(Assessment themes: health and safety, design and planning)

For task 1 candidates need to produce the following pieces of evidence:

- Completed calculation showing all workings

For illustration, the guided exemplification materials (GSEM) for Task 1 contain examples of candidate evidence for the following assessment requirements only:

- Completed calculation showing all workings

Candidate evidence

Completed calculation showing all workings

)HEAT INGRESS THROUGH WALLS

USING Q = AREA x U FACTOR x TEMPERATURE DIFFERENCE

INTERNAL WALLS AREA (LESS DOOR)

AREA = ((4 + 5 + 4) x 3·2) − (2·1 x 1)

AREA = (13 x 3·2) − 2·1

AREA = 41·6 − 2·1

AREA = 39·5 m²

EXTERNAL WALL AREA (LESS WINDOW)

AREA = (5 x 3·2) − (4 x 2)

AREA = 16 − 8

AREA = 8 m²

HEAT INGRESS

INTERNAL WALLS = 39·5 x 1·7 x (25 − 22)

INTERNAL WALLS = 39·5 x 1·7 x 3

INTERNAL WALLS = 201·45 WATTS

EXTERNAL WALLS = 8 x 0·52 x (32 − 22)

EXTERNAL WALLS = 8 x 0·52 x 10

EXTERNAL WALLS = 41·6 WATTS

WINDOW = 8 x 4·8 x (32 − 22)

WINDOW = 8 x 4·8 x 10

WINDOW = 384 WATTS

DOOR = 2·1 x 3·2 x (25 − 22)

DOOR = 2·1 x 3·2 x 10

DOOR = 67·2 WATTS

FLOOR = (5 x 4) x 2·25 x (25-22)
FLOOR = 20 x 2·25 x 3
FLOOR = 135 WATTS

CEILING = (5 x 4) x 2·25 x (25-22)
CEILING = 20 x 2·25 x 3
CEILING = 135 WATTS

AIR INFILTRATION = 1/3 x 1 A.C.H x (5 x 4 x 3·2) x (32-22)
= 1/3 x 1 x 64 x 10
= 213·333 WATTS

TOTAL HEAT INGRESS = 201·45 + 41·6 + 384 + 67·2 +
135 + 135 + 213·333
= 1177·583 WATTS

SOLAR GAIN = AREA x INCIDENT RADIATION x CORRECTION FACTOR
= 8 m² x (389 + 180) x 0·9
= 8 x 569 x 0·9
= 4096·8 WATTS

OCCUPANCY (FROM TABLES)

PEOPLE = 3 x 130W = 390 WATTS
LAPTOPS = 3 x 500W = 1500 WATTS
PRINTER = 1 x 750W = 750 WATTS.

TOTAL OCCUPANCY = 390 + 1500 + 750
= 2640 WATTS

LIGHTING = AREA x W/m²
= 5 x 4 x 50
= 1000 WATTS

TOTAL HEAT LOAD = 1177·583 + 4096·8 + 2640 + 1000
= 8914·383 WATTS = 8·9 KW

Commentary

The candidate has demonstrated an excellent understanding of design calculations, all possible factors have been considered and working out is detailed. Candidate has worked to three decimal places with only rounding the final answer demonstrating a good understanding of mathematical principles. This ensures the most accurate design calculations are considered as part of the planning process to give an accurate estimation of the heat load for the entire room.

The candidate has demonstrated an excellent level of understanding for heat gains to a room and how this can impact on design and installation of air conditioning systems. The candidate has considered all of the possible heat gains and correction factors in calculating the total heat gain to a room and made the correct use of the charts provided to extract the required data to make the calculation.

Task 2 – Planning the installation

(Assessment themes: Design and planning, systems and components)

For task 2 candidates need to produce the following pieces of evidence:

- Risk assessment
- Method statement with justifications
- Installation drawing showing all location dimensions of indoor and outdoor units and pipe route
- Materials list
- Measurements and marking out of space allocation/ work area checked against the installation drawing

For illustration, the guided exemplification materials (GSEM) for Task 2 contain examples of candidate evidence for the following assessment requirements only:

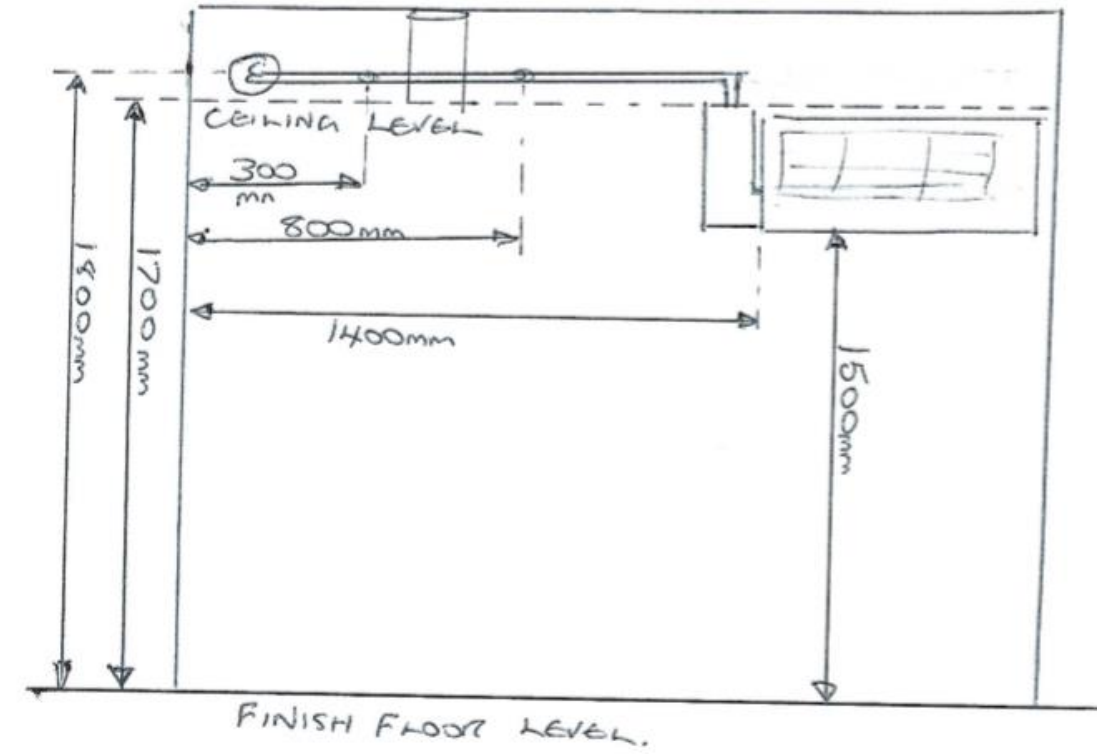
- Risk assessment
- Method statement with justifications
- Installation drawing showing all location dimensions of indoor and outdoor units and pipe route
- Materials list

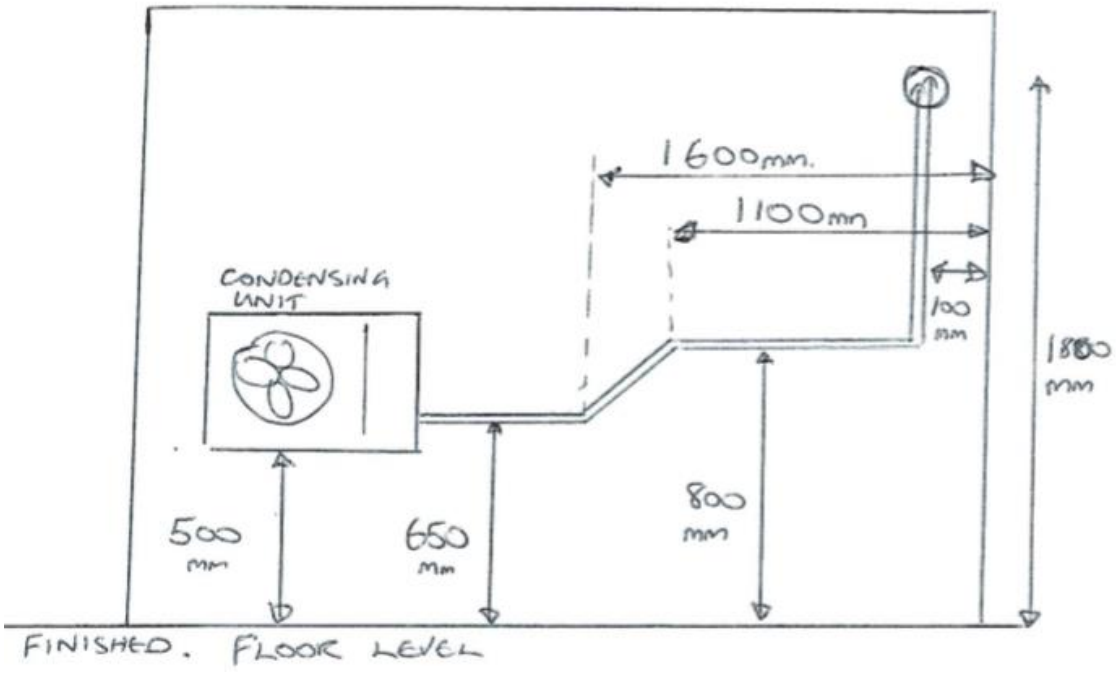
The following task 2 candidate assessment requirements have not been included as example candidate evidence for this version of the guided exemplification materials.

- Assessor observation of measurements and marking out of space allocation/ work area checked against the installation drawing

Candidate evidence

Installation drawing





Commentary

The drawing of the installation is annotated to include all pipe sizes and dimensions correctly contained within the brief.

The candidate has demonstrated the understanding and use of datum lines to provide a highly accurate plan to prevent any confusion or misunderstanding when marking out and positioning the system components.

The candidate has completed the drawing considering all the aspects of the design brief. They have correctly identified all the components and produced a detailed drawing. The completed drawing is well presented and accurate with all dimensions included.

Candidate evidence

Risk assessment

Activity: Air conditioning project **Location: Centre A**		**Date: 31/01/21** **Position: Candidate**						
SEVERITY (S): Degree of harm which may be caused (including numbers affected) **1 Minor Injury 2 Major Injury 3 Fatality** **LIKELIHOOD (L): Probability that event will occur** **1 Remote 2 Possible 3 Likely**					**RISK RATING (RR): Severity x Likelihood** **1-2 Low** **3-5 Medium** **6-9 High**			
Item No:	**Activity:**	**Hazard**	**Persons at Risk**	**Existing Controls (Mitigation)**	**S 1-3**	**L 1-3**	**RR**	**Are the Risks Controlled?**
1	Pipe installation	Slip, Trips, Falls	Operator	Keep work area clean and tidy. Be mindful of other workers around work area	1	1	1	Yes
		Fall from height	Operator, other in work area	Check ladder both use, maintain 3 points of contact, barrier off work area, get someone to foot ladder before use and tie off top and bottom	2	1	2	Yes
		Cuts and grazes	Operator	Wear protective gloves and goggles when cutting and deburring pipe	1	1	1	Yes

2	Brazing, jointing pipework	Burns Fire Explosion	Operator, other in work area Operator, other in work area. Operator, other in work area.	Wear protective gloves and goggles at all times when brazing. Cool down hot joints or put up warning signs. Remove or protect any flammable materials or surfaces. Have fire extinguisher next to brazing area. Fire watch for 1 hour after brazing Check brazing equipment before use, Leak check equipment and hoses and operation and setting of regulators	1 1 2	2 2 1	2 2 2	Yes Yes Yes
3	Manual Handling	Muscles Strain crush injury	Operator, other in work area.	Maximum single person lift 25kg. Two man lift if over 25kg. Use mechanical lifting aids if at all possible	1	1	1	Yes
4	Pressure Testing	Explosion Asphyxiation	Operator, other in work area. Operator, other in work area.	Check operation and setting of equipment before use. Clear area, barrier off and put up warning signs. Work in well ventilated area only, check with tutor if working in a confined space.	1 1	2 1	2 1	Yes Yes
5	Electrical work	Electric shock	Operator, other in work area.	Isolate and lock off mains supply before work, Test supply is dead. Live and functional testing must be supervised at all times.	1	2	2	Yes
6	Commissioning	Asphyxiation Explosion Cold burns Electric shock	Operator, other in work area.	Work in well ventilated area. Check operation and settings of all regulators and valves before start. Wear gloves, goggles and long sleeved overall when handling refrigerant. All live and functional testing to be closely supervised.	1	1	1	Yes

Commentary

The candidate identifies all major hazards and associated risks. The candidate identifies relevant controls in comprehensive detail for all of the identified risks and makes justification for the control measures that are appropriate. Probability of each of the hazards/ risks occurring has been considered for all risks.

Candidate evidence

Method statement

Ensure you have the correct PPE which includes steel toe cap boots, boiler suit and heat proof hi visibility vest to ensure risk of personal injury is limited and in line with risk assessment.

I will then carry out a visual inspection to make sure my work space is safe; I will move anything that is unwanted out of the way. I will also put a dust sheet down in my working area to keep it protected and tidy.

Indicate the component and pipework layout in pencil on the work surface to the correct measurements in line with drawing and ensuring the use of a datum line and spirit level to ensure all components and pipe-runs will be accurate. Fit the components to the correct height in line with specification and the installation drawing.

Collect all pipework, fittings and necessary tools required to complete the installation in line with my materials list, also checking that all the fittings and materials are British standard kite marked. This is an imprint on each fitting and show that they are of the right quality for purpose. I will put them in a safe place in the working area where they are easily accessible but do not cause a trip hazard.

Measure from the centre line for the cooler and the condensing brackets and drill and fix the brackets using heavy duty block work fixings according to the specification and install all the appropriate pipe clips at equal distancing to both provide support and ensure the installation is aesthetically pleasing. Carefully and accurately measure the pipe lengths and make allowance for any X dimensions to allow for pipe gain and then cut the copper pipe, then continue to pull any angles, kicks, or passovers needed for the task.

Once all pipework is prefabricated Install the pipework and add the fittings tightening any flare joints to provide some stability. When happy with the fit of the installation pipework dismantle all joints and clean all the surfaces that are to be brazed, this will allow the solder to run smoothly once heat is applied and ensure that the installation is gas tight and free from leaks. Braze all the copper joints ensuring all surfaces are protected from damage using a suitable heat mat or shield.

Using the clips already installed place the drain pipework into position and tighten all the mechanical joints to ensure the drain is all connected and free from leaks.

Calculate the strength (1.43 x Ps) and tightness (1 x Ps) test pressure in accordance with BSEN378:2016 where Ps is saturated pressure of the refrigerant at 55^{o}C. Before pressurising with nitrogen check the settings of the valves and regulators, clear any person in the vicinity of the installation and erect barriers and warning signs in case of explosion.

Leak test all joints using a proprietary leak spray during the tightness test ensuring gloves and goggles are worn at all times. Clean all leak fluid off after testing to prevent corrosion or damage to pipework and fittings.

If a leak is found, depressurise the system, venting the nitrogen gas outside to prevent any chance of asphyxiation, and re-pressurise after fixing the source of the leak.

Leave the system under tightness test pressure for 24 hours, measuring the pressure and temperature at the start and finish to so pressure changes can be calculated using the Gas laws.

Commentary

The methods given demonstrate comprehensive sequencing in relation to the given tasks, detailing all aspects of the install for example, marking out tasks, collecting materials and making allowance for dimensions for fittings on straight pipe runs. Clearly demonstrating excellent understanding of system installation processes.

The process given follows logical and methodical stages of the installation, for example, dry fixing the installation for accuracy prior to brazing. The candidate has clearly considered the aesthetics of the final installation by ensuring the pipework and surfaces are cleaned.

The candidate demonstrates a depth of knowledge and understanding regulations by accurately refencing the appropriate British Standards to which the strength and tightness testing should be carried out.

The methods described are both accurate and provide reasoning as to why the actions are carried out.

Candidate evidence

Materials list

Equipment/Materials	Quantity
Pencil	1
1m long Spirit level	1
Tape measure	1
Large and small pipe cutters	1
¼" and 3/8" Pipe benders	1
Philips screwdriver	1
Adjustable spanner	2
1/4" and 3/8" soft-rolled Pipe	6 metres each
1/4 and 3/8 Flare nuts	20
Abrasive cloth	1
Copper brazing rods	2
Heat proof mat	1
Oxy-Acetylene equipment	1
CO_2 fire extinguisher	1
24V Battery drill	1
¼" and 3/8" pipe insulation	6 metres
1/4" and 3/8" pipe clips	10
No 8 Screws and M4 washers	20
Unistrut Brackets	2 sets
Heavy duty expansion fixings	8
Indoor unit	1
Outdoor unit	1
In-line condensate pump	1
Plastic wall trunking	2m
Refrigerant cylinder	1
Nitrogen cylinder	1
Nitrogen regulator and manifold	1
Clean cloth	1
Leak spray	1
PPE	
Overalls	
Steel toe capped boots	
Goggles	
Gloves	

Commentary

Candidate identifies all resources, components, and PPE with accurate quantities and types/sizes to carry out the tasks and meet the assignment brief requirements.

Consideration has been given to aesthetics of finished product by including the use of clean cloth to allow the fixing of the brassware to be carried out without evidence of tooling damage, and to clean excess leak spray fluid from pipe and fittings.

Task 3 – Install and commission

(Assessment themes: Health and safety, systems and components, inspection and testing, reports and information, handover and communication)

For task 3 candidates need to produce the following pieces of evidence:

- Pressure test certificate
- Commissioning checklist
- Assessor observations:
    - Safe isolation process
    - Installation of systems and components
    - Commission and handover system

For illustration, the guided exemplification materials (GSEM) for Task 3 contain examples of candidate evidence for the following assessment requirements only:

- Pressure test certificate
- Assessor observations:
    - Safe isolation process
    - Installation of systems and components
    - Commission and handover system

The following task 3 candidate assessment requirements have not been included as example candidate evidence for this version of the guided standard exemplification materials

- Commissioning checklist
- Commissioning photographic evidence

Photographic evidence required:

Installation

- Photograph of the offset conforming to the 150mm dimension. – demonstrates that the candidate can bend pipe accurately to a tolerance. **(photograph 1)**
- Photograph showing the offset around the soil pipe obstruction – demonstrates the candidate's pipework skills forming bend around the soil pipe. The photo demonstrates how the pipework visibly varies in distance from the soil pipe. **(photograph 2)**
- Two photos one each side of the wall showing finished pipework (without insulation). This demonstrates the aesthetics of the completed installation. Visible signs of pipework damage that are not straight or horizontal/vertical and bends that are not properly formed. None of which stops the system operating correctly. **(photograph 3 and 4)**
- Four to six photographs of each brazed joint – Demonstrates how well the joint if finished. This photo demonstrates some excessive solder and scorch marks on the wall surfaces. **(photograph 5,6,7,8)**

Commissioning

- Evacuation and use of vacuum gauge. **(not included in this GSEM)**
- Weighing in the refrigerant charge. **(not included in this GSEM)**
- Visual inspection of system and pipework and measurement of temperature. **(not included in this GSEM)**

Candidate evidence

Practical Observation Form – Safe isolation process

Assessment ID	Qualification number
8710-351	8710-38
Candidate name	**Candidate number**
Candidate A	12345
Centre name	**Assessment theme**
City & Guilds	Health and Safety

Task	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Safe isolation	The candidate was confident in describing the industry safe isolation procedure, and how they planned to proceed with the task and described a clear logical sequence giving reasons to the process that would eliminate any risk of injury. The candidate correctly selected all the equipment required, including voltage indicator, lock off kit, correct signage. The candidate correctly checked the testing equipment and confirmed operation before continuing with tests to prove supply was DEAD. The candidate could clearly articulate the purpose of each step in ensuring the electrical supply was correctly isolated. The candidate correctly identified signage and placed notices to advise the system was isolated and tested.

Assessor signature	Date
Assessor A	26.02.21

Commentary

Candidate confidently carried out all necessary steps in the safe isolation process.

Candidate evidence

Practical Observation Form – Installation of systems components

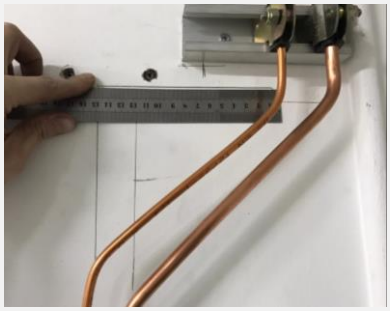
Assessment ID	Qualification number
8710-351	8710-38
Candidate name	**Candidate number**
Candidate A	12345
Centre name	**Assessment theme**
City & Guilds	Systems and components, Inspecting and testing systems and components

Task	Notes – *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Installation of systems and components	Correct and full Health and safety procedures were followed throughout the installation both in accordance with the candidate's risk assessment and industry SOP and HASWA 1974. Candidate prepared the workspace with consideration to health and safety and good housekeeping, by putting dust sheets on floor, collecting all the correct equipment, and storing tools and materials in safe location. Candidate maintained workspace throughout and adhered to the risk assessment throughout the installation. All tools and materials not in use were stored safely and securely until needed. Candidate details any pre-existing marks or damage to the wall prior to marking out for their installation. Candidate set about the task in a highly organized manor and prefabricated lengths of pipework including bends to ensure accuracy, consistency and efficiency and minimizing wastage of materials. Candidate prepared the workspace using accurate clipping distancing to support the installation of pipework. This was installed with 300mm spaces with attention to aesthetics and ensuring pipework is parallel and secured. Cooler was installed at a suitable height for correct operation however when measured was not completely accurate but within 2mm of tolerance. Candidate has effectively marked out and measured pipework to suitable lengths to carry out the installation, with no wastage of materials. All tolerances met throughout the installation producing a piece of work that was aesthetically pleasing.

Assessor signature	Date
Assessor A	26.01.21

Photographic evidence

Photo:.1



(Photograph 1) This photo demonstrates the candidate being able to work to +/- 2 mm tolerance. Shows offset conforming to the 150mm dimension. – demonstrates that the candidate can bend pipe accurately to a fine tolerance.

Photo:.2

(Photograph 2) Demonstrates the candidate's pipework skills in forming an offset around the soil pipe. The photo demonstrates how the pipework visibly maintains a constant dimension around the soil pipe and is symmetrical throughout

Photo:.3 and 4

Photo:

(Photograph 3 and 4). installed components where the condensing and cooling unit match the installation drawing. This photo demonstrates the candidate's ability to install components to a +/- 2mm tolerance. This demonstrates the aesthetics of the completed installation. The photos show that the pipework is perfectly vertical and horizontal, with the pipe clips equally spaced and no damage to any of the surrounding surfaces.

Photograph 3- shows final installation of outdoor condensing unit and associated pipework.

Photograph 4 – shows final installation of indoor evaporating unit and associated pipework.

Photo:.5

Photo:.6

Photo:.7

Photo:.8

(Photograph 5,6,7,8)

Demonstrates how well the joint is finished. This photos demonstrate that all the joints are clean and neatly finished with no excessive solder around the joints and no burn marks or other damage to the surrounding surfaces.

Candidate evidence

Pressure test certificate

Evidence Recording Template - Certificate of Pressure Testing

CERTIFICATION OF PRESSURE TESTING

(IN ACCORDANCE WITH BS EN 378)

Name of client	A COLLEGE	Job No.	8710-31
Site address	A STREET A TOWN	Date of Test.	22 Feb 2021
Contact detail	Tel. 01234 56789	email	ACOLLEGE@COLLEGE.AC.UK
System/component under test.	FUJITSU ASYG07 SPLIT AIR CONDITIONING SYSTEM. Serial Number ABCD12345		

TEST DETAIL

Strength Test Ps x 1.43	START PRESSURE	START TEMP	DURATION	FINAL PRESSURE	FINAL TEMP	RESULT
	48.89Barg	20°C	15 min	48.89BAR	20°C	PASS
Tightness Test Ps x 1.0	START PRESSURE	START TEMP	DURATION	FINAL PRESSURE	FINAL TEMP	RESULT
	34.2 BAR	20°C	24 HOUR	34.0Barg	18 °C	PASS

Details of person carrying out the test

Name	Signature	Date
A Candidate.	ACand.	22 Feb 2021

Details of person who witnessed the above test

Name	Status	Signature	Date
AN ASSESSOR	ASSESSOR.	ANAssess	22 Feb 2021

P_s at 55°C = 34.19 Barg (R32).

$\frac{34.2}{293.15} \times 291.15 = 33.97$ Barg (PRESSURE DROP OK).

Commentary

Candidate follows a highly methodical and logical process for the installation of system. The candidate clearly demonstrates an ability to sequence tasks logically in particular with regard to the use of health and safety, marking and cutting materials, brazing and jointing pipework, pressure testing, charging and commissioning. Candidate did not require reassurance and was highly focussed and assured when carrying out the installation. An example of this includes prefabricating all the pipework and accounting for dimensions to produce and installation that was accurate first time.

The student demonstrates they can use the correct method to take accurate measurements from an allocated space/ work area in line with their installation diagram.

Candidate evidence

Practical Observation Form – Commission and handover

Assessment ID	Qualification number
8710-351	8710-38
Candidate name	**Candidate number**
Candidate A	12345
Centre name	**Assessment theme**
City & Guilds	Handover and communication, Inspecting and testing systems and components

Assessment theme	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Commission and hand over	**Commissioning checks** Candidate follows correct process for commissioning tests using manufactures instruction for the Air Conditioning system to ensure no aspects of the commissioning had been omitted. After completing the visual inspection, the candidate evacuated and charged the system according to the manufacturer's instructions, with refrigerant leakages kept to an absolute minimum. Before commissioning started the candidate zeroed the gauges and checked the operation and calibration of all temperature sensors. Candidate measured the pressure and temperatures confidently without reference to the assessor ensuring all of the installation was commissioned to industry standards before handing over to customer. **Handover to customer** Candidate interacts well with customer using eye contact and open body language. Candidate gives information about the systems and adjusting the temperature controller, ensuring the customer was aware of the temperature limits of the system and its cooling capacity. Candidate provides detail of maintenance requirements e.g. cleaning processes and how to load and distribute produce ensuring maximum airflow. Candidate makes reference to manufactures instructions at relevant stages of the task.

Assessor signature	**Date**
Assessor A	26.02.21

Commentary

Commissioning tests are completed and follow a logical sequence. Reference is made to manufacturer's guidance at relevant stages during the task. Handover and demonstration of the system with the customer were accurate and detailed which included a thorough explanation of the maintenance requirements. Customer care skills were apparent with the use of positive interaction throughout.

Task 4 – Service and maintenance

(Assessment themes: Health and safety, working with faults, systems and components, reports and information)

For task 4 candidates need to produce the following pieces of evidence:

- Maintenance report
- Pressure test certificate
- F-Gas log sheet
- Waste transfer note
- Assessor observations
  - Fault diagnosis
  - Decommissioning
  - Safe isolation
  - Fault rectification

For illustration, the guided exemplification materials (GSEM) for Task 4 contain examples of candidate evidence for the following assessment requirements only:

- Maintenance report
- Assessor observations
  - Fault diagnosis
  - Decommissioning
  - Fault rectification

The following task 4 candidate assessment requirements have not been included as example candidate evidence for this version of the guided standard exemplification materials

- Pressure test certificate
- F-Gas log sheet.
- Waste transfer note
- Assessor observation of the safe isolation process

Photographic evidence

Compressor Change (a photograph for each of the below)

- Disassembly of condensing unit demonstrating any damage, or no damage caused **(photograph 9)**
- Un-brazing and removal of compressor demonstrating damage, or no damage **(photograph 10)**
- Refitting and brazing of compressor showing damage, or no damage **(photograph 11)**
- Set up of pressure testing equipment and gauge reading **(photograph 12)**
- Leak testing to show correct safety procedures Inc. PPE and correct fluid/device. **(photograph 13)**
- Evacuation to 2 Torr – set up of equipment and gauge reading **(photograph 14)**
- Charging of system – set up of equipment **(photograph 15)**
- Final reassembly of condensing unit **(photograph 16)**

Maintenance (a photograph for each of the below)

- Removal and cleaning of air filter **(photograph 17)**
- Clean of coils (use of spray washer) **(photograph 18)**
- Leak testing of system **(photograph 19)**
- Run and testing of temperatures and air flow **(photograph 20)**

Candidate evidence

Maintenance report

Description of fault diagnosis

Before testing the 3 compressors I check the operation of the multimixer and insulation resistance tester. I set the insulation tester to 500V as the compressors were 230V units in accordance with the 18th Edition requirements. Using the insulation resistance tester first I connected one lead to earth and the other lead to each of the three terminal pins in turn, pressing the test button while making sure I was not in contact with any of the metal work. Compressor A gave a reading of 0 Megaohms so I concluded this compressor was down to earth. Compressor B had a zero Ohms reading across the start winding and Comp C showed the correct resistance for the start and run windings and no earth fault.

Possible solutions

Because of the limited space around the compressor I decided to cut the discharge line at a convenient place rather than un braze it at the compressor stub to avoid damaging any other components. The suction stub was more accessible, so I decided to unbraze that on directly

Actions taken to rectify fault

To repair the fault, I carried out the following sequence

- Isolate the electrical supply using a lock off kit and placed warning signs.
- Recover the refrigerant into a recovery cylinder.
- Recover the refrigerant down to -0.3 Bar to ensure all refrigerant is removed from the system.
- Unbraze the defective compressor and remove.,
- Form a replacement discharge line to the new compressor before refitting so any brazing will not damage adjacent components.
- Pressure and leak test all joints in accordance with BS EN378-2016
- Evacuate the system to 2 Torr.
- Perform a 20mminute vacuum rise test to ensure system is dehydrated and leak free.
- Recharge the system with the correct charge weight in liquid form into the high side of the system to prevent damage to the compressor.
- Let the system stand for 10 minutes so the liquid charge settles before starting the compressor to avoid flood back damage.
- Run the system for 15 minutes to allow the system to stabilise before recording all running pressure and temperatures.
- When system reaches design temperature tidy up tools and materials and hand over to client, explaining what I have done.

Actions taken to rectify fault

To repair the fault, I carried out the following sequence

- Isolate the electrical supply using a lock off kit and placed warning signs.
- Recover the refrigerant into a recovery cylinder.
- Recover the refrigerant down to -0.3 Bar to ensure all refrigerant is removed from the system.

- Unbraze the defective compressor and remove.,
- Form a replacement discharge line to the new compressor before refitting so any brazing will not damage adjacent components.
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- Evacuate the system to 2 Torr.
- Perform a 20mminute vacuum rise test to ensure system is dehydrated and leak free.
- Recharge the system with the correct charge weight in liquid form into the high side of the system to prevent damage to the compressor.
- Let the system stand for 10 minutes so the liquid charge settles before starting the compressor to avoid flood back damage.
- Run the system for 15 minutes to allow the system to stabilise before recording all running pressure and temperatures.
- When system reaches design temperature tidy up tools and materials and hand over to client, explaining what I have done.

Commentary

Demonstrates a clear understanding of maintenance processes and underpinning knowledge. The candidate clearly knows the legislation that underpins activities within the process such as the British standard for pressure and leak and testing.

Maintenance report is clear and detailed. The process is accurate and supported by reasoning for the method taken to rectify the fault.

Candidate evidence

Practical Observation Form – Fault diagnosis, decommissioning and fault rectification

Assessment ID	Qualification number
8710-351	8710-38
Candidate name	**Candidate number**
Candidate A	12345
Centre name	**Assessment themes**
City & Guilds	Health and Safety Systems and components Working with faults

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do **not** allocate marks at this stage.

Task	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Fault diagnosis	Candidate displays very good customer interaction with positive body language and asked questions with appropriate tone along with good use of eye contact that put the customer at ease The candidate asked various meaning questions to gain an insight into the fault and explained well to the customer that the responses to the questions were allowing an insight into the possible fault and diagnostic assessments of the issue. The candidate used and set the multimeter and insulation tester correctly and in the correct sequence taking a necessary precaution to prevent electric shock. By this method the candidate was able to identify the compressor faults quickly and confidently reassuring the customer at all times. The candidate selected an appropriate repair method and was focused and methodical in their approach to the maintenance repair carrying out the task confidently explained the process that they would carry out in good time and no damage to customer property.
Decommissioning	Candidate follows a logical sequence for decommissioning. Candidate purged all lines and recovery unit minimizing the loss of refrigerant to the atmosphere and self-cleared the recovery unit on completion. The candidate checked the maximum fill weight of the cylinder before recovery and labeled the cylinder with the refrigerant type. The waste transfer note and F-Gas log sheet were completed without prompting by the assessor.

Task	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
	Candidate made good the working area with the use of appropriate fillers and sands back completely resulting in a good quality surface before applying a top coat of paint to restore the work area to pre-installation condition.
Fault rectification	Candidate implemented all the health and safety preparations required to take care of components and customer property, ensuring warning notices and barriers were in place as appropriate to eliminate any trips/slips or falls. Candidate follows a methodical and logical sequence, recovering and storing the waste refrigerant correctly, prior to selecting the correct tools to remove and replace the defective component. The candidate completed the repair efficiently without error and in good time, checking the completed repair.

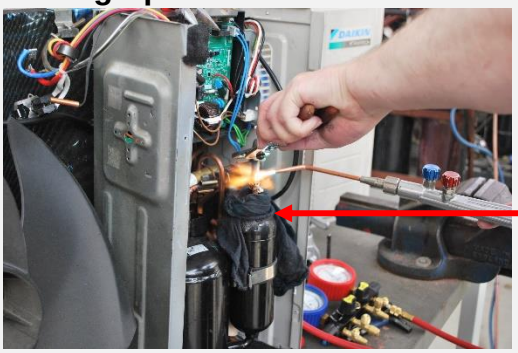
Assessor signature	**Date**
Assessor A	**26.02.21**

Photographic evidence

Photograph 9

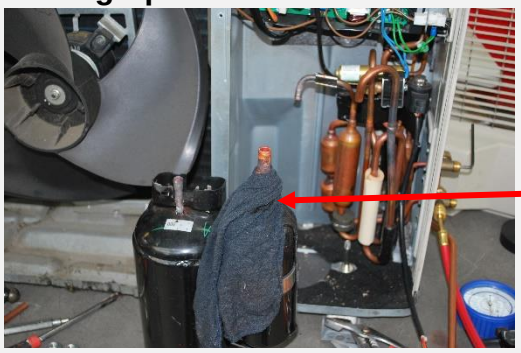
Disassembly of condensing unit showing original condition of the unit prior to disassembly.

Photograph 10



Un-brazing and removal of compressor demonstrating precaution taken to prevent any damage to the unit.

Photograph 11.



Refitting and brazing of compressor showing precautions made to prevent damage to compressor and the unit.

Photograph 12

Demonstrates the correct set up of pressure testing equipment and the safety precaution made, and the initial and final gauge reading.

Photograph 13

Leak testing showing the correct safety procedures (PPE and correct fluid/device)

Photograph 14

Evacuation to 2 Torr – demonstrates correct set up of equipment and final gauge reading of 2 Torr or below

Photograph 15

Charging of system – shows correct set up of equipment to weigh charge into system.

Photograph 16

Final reassembly of condensing unit demonstrating that the unit is back to its original condition with no additional damage.

Photograph 17

Removal and cleaning of air filter demonstrating correct use of PPE and safety measures to contain dust whilst cleaning.

Photograph 18

Cleaning of coils using of spray washer demonstrating correct use of PPE and equipment and cleaning fluids to prevent damage to surrounding surfaces and others.

Photograph 19.

Leak testing of system showing correct use of electronic leak gun or leak testing fluids to check the system.

Photograph 20	Run and testing of temperatures and air flows demonstrating correct use of test instruments to verify that the system is working correctly.

Commentary

Candidate was confident during the discussion with the customer, maintaining eye contact and open body language throughout.

Candidate asked appropriate questions to determine the cause of the fault.
The fault diagnosis and repair tasks followed a methodical order. Candidate was able to work independently throughout the tasks.

Candidate followed current F Gas legislation for decommissioning and commissioning of the system and completed legislative paperwork in detail.

Candidate follows correct process for the decommissioning and demonstrates an ability to sequence tasks logically. Process for safe disposal of waste was carried out with consideration to customer property and all components were recycled correctly. Reference is made to manufacturer's guidance at all relevant stages during the task.

The T Level is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.