T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Building Services Engineering for Construction

Ventilation Engineering

Guide standard exemplification material

Distinction – Sample 2021

City & Guilds | eal

Contents

Introduction

The sample assessment materials within this document refers to the ventilation 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 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 task and 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

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, fabricating, fixing ductwork and installing components that is in line with industry standards.

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

Work safely and make informed and appropriate use of tools, materials and equipment within the ventilation environments that they are working in.

Competently and independently interpret information and apply the technical skills to practical tasks and procedures to an exemplary standard as recognised by industry, producing an excellent quality of work that meets acceptable tolerances, regulations and standards.

Confidently attempt some complex tasks and the level of performance meets an exemplary level.

Identify causes and diagnose ventilation faults and have a thorough understanding and the skills to be able to repair and rectify them.

Consistently use accurate industry terminology in both written and verbal contexts.

Task 1 – Planning the installation

(Assessment themes: Health and Safety, Design and planning, Systems and components)

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

- Risk assessment
- Method statement with justifications
- Schematic drawing annotated with air volume calculations
- Materials list

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

- Risk assessment
- Method statement with justifications
- Schematic drawing annotated with air volume calculations
- Materials list

Candidate evidence

Schematic drawing annotated with air volume calculations

Air Changes Per Hour (CIBSE Guide A Environmental Design Criteria Table 1.5) = 5 ACH

Male WCroom volume flow rate $= 2.5 \times 1.5 \times 3 = 11.25m^3$

Grille 001 design volume flow rate $= \frac{(5 \times 11.25)}{3600} 0.015m^3/s$

GRILLE 001 – MALE WC

ROOM VOLUME (m^3)	11.25m^3	
	DESIGN	ACTUAL
FLOW (m^3/s)	0.015m^3/s	As measured

GRILLE 002 – FEMALE WC

ROOM VOLUME (m^3)	11.25m^3	
	DESIGN	ACTUAL
FLOW (m^3/s)	0.015m^3/s	As measured

Female WC room volume $= 2.5 \times 1.5 \times 3 = 11.25m^3$

Grille 002 design volumeflow rate $= \frac{(5 \times 11.25)}{3600} 0.015m^3/s$

GRILLE 002 – ACCESSIBLE WC

ROOM VOLUME (m^3)	22.5m^3	
	DESIGN	ACTUAL
FLOW (m^3/s)	0.031 m^3/s	As measured

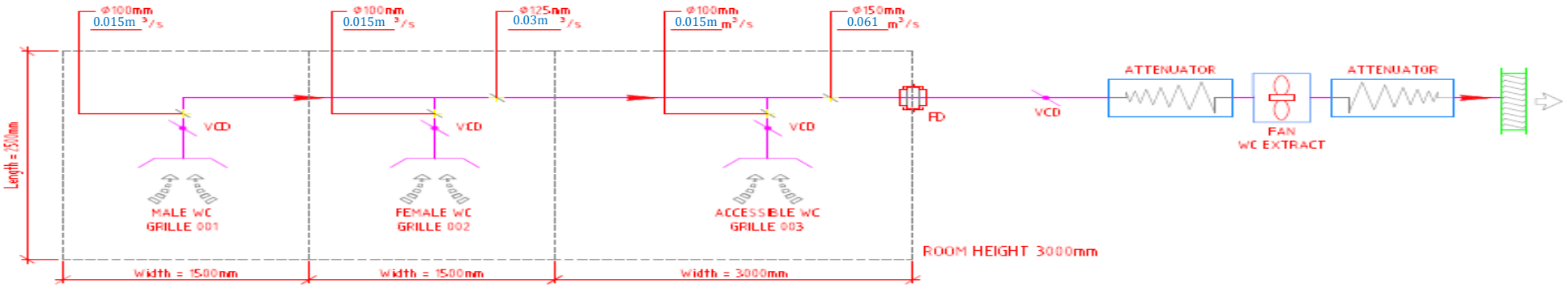
Accessible WC room volume $= 2.5 \times 1.5 \times 3 = 22.525m^3$

Grille 003 design volume flow rate $= \frac{(5 \times 22.5)}{3600} 0.031m^3/s$

EXTRACT FAN

	DESIGN	ACTUAL
FLOW (m^3/s)	0.061 m^3/s	As measured
TOTAL PRESSURE (Pa)		As measured

Extract fan design volume flow rate $= 0.015 + 0.015 + 0.031 = 0.061m^3/s$



Commentary

Candidate demonstrates excellent knowledge and understanding of the requirements of a schematic drawing in relation to the assignment brief. Candidate has annotated the schematic drawing with accurate air volume calculations. Drawing is clear and well-presented and includes detail and clear working out of all calculations.

Candidate evidence

Risk assessment

Activity: Installation of pipework **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	Cutting ductwork sections	Skin cut from steel ductwork edges	Self	Handle ductwork cutting tools and equipment with care, using appropriate PPE	1	2	2	Yes
2	Bending duct edges	Skin cut	Self	Use correct bending tools and appropriate PPE	1	1	1	Yes
3	Projecting screws in ductwork	Skin cut	Self	Be aware and use appropriate PPE	1	1	1	Yes
4	Loose cables	Tripping	Self Others	Stick all cables down	2	2	4	Yes
5	Working with power tools	Electrocution	Self	PAT tests in date and visual inspection	3	1	3	Yes
6	Manual handling of ductwork and ventilation components	Personal injury	Self	Use appropriate PPE and lifting assistance when required, correct kinetic lifting techniques	1	1	1	Yes

Activity: Decommissioning 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	Dust and dirt in system	Airborne particles affecting breathing	Self	Correct use of PPE	1	2	2	Yes
2	Removing ductwork	Cuts and grazes	Self	Handle ductwork cutting tools and equipment with care, using appropriate PPE	1	2	2	Yes
3	Manual handling	Personal injury	Self	Correct kinetic lifting techniques	1	1	1	Yes
4	Working with power tools	Electrocution	Self	PAT tests in date and visual inspection	3	1	3	Yes

Activity: Maintenance 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	Ventilation system components	Skin cut; damage to components	Self	Take care and use assistance when handling and removing the system components (e.g. VCD, attenuator)	1	1	1	Yes

				as ductwork exposed could be sharp and components can be difficult to handle				
2	Wet surfaces because of system cleaning	Slips and trips	Self Others	Watch out for any wet surfaces around the working area and take appropriate action when required. Affix warning notice (slippery or wet floor if appropriate)	2	1	2	Yes
3	Loose system components including sections of ductwork	Slips and trips	Self Others	Organise the work area correctly to keep all tools, equipment and components in an orderly arrangement	1	1	1	Yes

Commentary

The candidate demonstrates a thorough knowledge and understanding of the different types of risk and hazards associate with ventilation activities. The candidate has identified all hazards and associated risks for each of the tasks.

The candidate demonstrates excellent understanding of the mitigations that can be used to minimise the identified risks and hazards, and has identified and provided thorough detail for the identified control/s.

The probability of each of the hazards/ risks occurring has been identified for each of the hazards.

Candidate evidence

Method statement

Ensure you have the correct PPE which includes steel toe cap boots, boiler suit, goggles, gloves and 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 ductwork cutting positions (using a marker pen) and component locations to the correct measurements in line with the schematic drawing and ensuring the use of a datum line and spirit level to ensure all measurements are accurate.

Collect all ductwork, 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 main components (fan and variable control damper VCD) and the VCD flange position according to the schematic drawing and install all the appropriate hangers at equal distancing to both provide support and ensure the installation is secure. Carefully and accurately fit and secure the duct lengths and system components.

If an actuator is to be fitted to a motorised damper, carry out the installation wiring after confirming with assessor it is okay to proceed making sure to follow the correct and safe procedure.

Once the system installation is complete, test for air leakage according to the DW143 standard procedure.

Commentary

The candidate demonstrates a comprehensive understanding of the sequencing of activities in relation to the given tasks, detailing all aspects of the install for example, marking out tasks, collecting materials and installing the ductwork and components clearly demonstrating excellent understanding of system installation processes.

The methods given follow the logical and methodical stages of the installation, for example, checking the installation for tightness before the DW143 test.

The method statement is detailed and accurate, and reasoning has been provided to support the methods and process given.

Candidate evidence

Materials list

Equipment/Materials	Quantity
TOOLS	
Marker pen	1
Spirit levels (long and short)	2
Tape measure	1
Metal snips	1
Grinder	1
Power drill with assorted drill bits	1
Power screwdriver with assorted screw bits	1
Manual screwdrivers	2
Adjustable spanners	2
Open and box spanners	2
Hacksaw	1
MATERIALS	
Circular ductwork	8.5 meters approx
Ductwork branches	Centre discretion
Extract grilles	3
Plenum box	3
Flexible ductwork	1.5 meters approx
Volume control dampers	3 100mil
Circular bends and branches	1 bend, 2 branches, 3 reducers
Unistrut	Centre discretion
Assortment of 8mm/10 mm threaded bar, nuts and washers	Centre discretion
Dust sheets	1
Clean cloths	2
PPE	
Boiler suit/protective clothing	
Steel toe capped boots	
Goggles	
Gloves	

Commentary

The candidate shows excellent knowledge and understanding of the different resources required to carry out the tasks and meet the requirements of the assignment brief.

The quantities listed are accurate and relevant to the task.

The candidate has selected all of the materials and equipment required to meet the requirements of the toilet block, consideration has been given to the finished aesthetics of the installations, with the inclusion of cleaning cloths to allow the cleaning of the ductwork to be carried out without evidence of work damage.

The candidate demonstrates a good understanding of health and safety and listed the PPE required to carry out the tasks safely, as well as including dust sheets and floor protection which demonstrates consideration to customer property

The candidate has considered aspects of health and safety and listed the PPE required to carry out the tasks safely.

The candidate identifies individual fittings such as threaded bar, nuts and washers, with quantities of each, showing an excellent knowledge and understanding of the different fixing methods, fitting types and jointing methods.

Task 2 – Installation and commissioning

(Assessment themes: Health and Safety, Systems and components, Reports and information, Inspecting and testing systems and components, Handover and communication)

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

- Air leakage pro forma test sheet
- Commissioning certificate
- Schematic drawing with calculated and measured data
- Assessor observations:
    - Measure and mark out position of ductwork and components
    - Installation of ductwork and components
    - Commissioning checks
    - Handover to customer

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

- Commissioning certificate
- Assessor observations:
    - Measure and mark out position of ductwork and components
    - Installation of ductwork and components
    - Commissioning checks
    - Handover to customer

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

- Air leakage test sheet
- Schematic drawing with measured data

Photographic evidence
Installation of components

Photographic evidence which shows:

- Tolerances have been met for the measurement of ductwork. Photos may show any excess/ waste materials caused by inaccurate measurements – **Photograph 1**
- Finished installation showing finished ductwork and component positioning which demonstrates the aesthetics of the completed installation. Visible signs of ductwork damage. None of which stops the system operating correctly – **Photograph 2**
- Use of tools (bending and cutting equipment) and ductwork skills. Photos may show ductwork cut offs – **Photograph 3**
- Tolerances have been met for the installation of the toilet block – **Photograph 4**
- Results of tool usage. Photos may show tooling marks – **Photograph 5**

Candidate evidence not included within this GSEM:

- Air leakage test sheet
- Schematic drawing with measured data

Candidate evidence

Practical Observation Form – Measure and mark out position of ductwork and components

Assessment ID	Qualification number
8710-359	8710-35
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Systems and components

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.*
Measure and mark out position of ductwork and components	The candidate followed the correct and logical process for marking the lines for cutting the steel ductwork. The candidate installed a datum line to work from and this enabled them to establish the correct levels and positions for the installation and system components (e.g. VCD, fan, attenuator). This approach resulted in all dimensions being taken and recorded accurately and free from errors.

Assessor signature	Date
Assessor A	31/01/2021

Commentary

The candidate demonstrates that they can take measurements from an allocated space/ work area in line with their installation diagram.

The candidate used measuring equipment which was best practice for this task, which resulted in measurements that were accurate.

The measuring and marking out of position of all components and ductwork were accurate, showing an excellent consideration to the aesthetics of the finished installation.

The measurements were recorded accurately and clearly.

Candidate evidence

Practical Observation Form – Installation of ductwork and components

Assessment ID	Qualification number
8710-359	8710-35
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Systems and components

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.*
Installation of ductwork and components	Candidate prepared the work space with consideration to health and safety and good housekeeping, by putting dust sheets on floor, collecting all the correct components and storing tools and materials in safe location. Candidate maintained workspace throughout and adhered to the risk assessment throughout the installation. Candidate set about the task in a highly organized manor and prefabricated lengths of ductwork to ensure accuracy, consistency and efficiency. Candidate prepared the work space using accurate spacing distances for the ductwork system supports (bearers and hangers). These were installed with appropriate spacing (set by the duct section size) with attention to aesthetics and ensuring ductwork was level and secured. VCD was installed at a suitable position for correct operation and when measured was accurate and within 10 mm tolerance. Candidate has effectively marked out and measured ductwork to suitable lengths to carry out the installation, with no excessive wastage of materials. All tolerances met throughout the installation producing a piece of work that was showed a high level of competence. The candidate demonstrates excellent sills with the selection and use of tools resulting in no tooling marks and an aesthetically pleasing finish.

Assessor signature	**Date**
Assessor A	31/01/2021

Photographic evidence

Tolerances have been met for the measurement of ductwork. Photos may show any excess/ waste materials caused by inaccurate measurements.

Photograph 1 [to be added]

Tolerance of (+/-2mm) have been met during the installation of pipework.

Finished installation showing finished ductwork and component positioning which demonstrates the aesthetics of the completed installation. Visible signs of ductwork damage. None of which stops the system operating correctly.

Photograph 2 [to be added]

Finished installation of the toilet block and ductwork to tolerances/standards.

Overall aesthetics of the installation have been met.

Use of tools (bending and cutting equipment) and ductwork skills. Photos may show ductwork cut offs.

Photograph 3 [to be added]

Use of tools (bending and cutting equipment) and ductwork skills.

Tolerances have been met for the installation of the toilet block.

Photograph 4 [to be added]

Tolerances have been met for the installation of the toilet block.

Results of tool usage. Photos may show tooling marks.

Photograph 5 [to be added]

Component fitted correctly with no signs of tool marks from installation.

Commentary

Candidate demonstrates a thorough understanding of the installation requirements of the toilet block. The correct process is followed, and the candidate demonstrates an ability to sequence tasks logically as set out in their method statements.

The candidate prepares the workstation with dust sheets and stores tools safely, showing a good consideration and understanding of health and safety throughout the duration of the task.

The candidate is confident in the practical elements of the task and is able to correctly select and use appropriate tools and components, for the given tasks. The candidate demonstrates excellent skills throughout the installation, for example ductwork skills result in no wasted materials, use of tools result in no tooling marks, showing an excellent consideration of the aesthetics of the finished installations.

The candidate prefabricates all the ductwork and meets all tolerances to produce and installation piece that was accurate first time.

Candidate evidence

Practical Observation Form – Commissioning

Assessment ID	Qualification number
8710-359	8710-35
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Inspecting and testing of systems and components/ reports and information

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.*
Commissioning	Candidate followed the correct procedure for an air leakage test using DW143 to ensure no aspects of the commissioning had been missed. After completing the visual inspection the candidate carried out operational checks on all the components including testing air flow rates at grilles, air leakage in the ductwork and the correct operation of the system VCD, ensuring these met the standards required. Candidate completed the commissioning with a performance test on the extract fan ensuring all of the installation was commissioned to industry standards before handing over to customer. Candidate completed commissioning records in line with industry requirements.

Assessor signature	Date
Assessor A	31/01/2021

Commentary

The candidate demonstrates an excellent understanding of commissioning and completes the required commissioning tests and checks for the installation in a logical sequence, beginning with the visual inspection and then carrying out all operational and performance tests and checks accurately and efficiently.

Candidate makes reference to manufacturer's guidance at all relevant stages during the task.

Candidate records all relevant information from the commissioning checks accurately on the commissioning checklists.

Candidate evidence

Practical Observation Form – Handover to customer

Assessment ID	Qualification number
8710-359	8710-35
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Handover & communication

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.*
Hand over to customer	Candidate interacts well with customer using eye contact and open body language. Candidate gives information about location of the extract fan and explains its operating principles along with those of the VCD. Candidate provides detail of maintenance requirements e.g. cleaning processes and about the limitation of the system, specifically excessive system vibration noise at some fan speeds and what can be done about this if it persists. Candidate made reference to manufacturer instructions at relevant stages of the task.

Assessor signature	Date
Assessor A	31/01/2021

Commentary

The candidate demonstrates an excellent understanding of the handover process and the operating principles of the systems and these were explained to the customer as part of the handover. The handover of the system to the customer was clear and accurate, and all details were covered.

The candidate displayed excellent customer care skills, ensuring eye contact and positive interaction with the customer throughout the handover.

Candidate evidence

Commissioning checklist

Project: Office Building Extension 8710 (359)	Drawing. Refs: Candidate pack Figure 1; Figure 2
System: Extension toilet block extract ventilation	

Air Tightness	Test Pressure: +100 Pa	Duration of Test: 15 minutes	Pressure loss: • Measured against maximum allowable flow rate drop from BESA (formerly HVCA) DW/144 • Max. loss 0.54 l/sec per sq.m. of duct surface area (for +100 Pa pressurisation) **Pass** ✔ Fail

COMMENTS

- The ductwork section was assembled for an airtightness (air leakage) test
- CIBSE Guide B section 3.3.8.1 states that air leakage from a duct will increase in proportion to the duct air pressure
- Ductwork assembly was to be as airtight as possible to maximise system performance
- This test was carried out in accordance with the BESA DW/143 test procedure: Guide to Good Practice: Ductwork Air Leakage Testing
- Ductwork was handled with care during assembly and installation to avoid breaking joint seals
- Excessive use of mastic sealant to fill gaps would not be as effective as tightly fitted steel sheets at the assembly stage
- A smoke pellet could be set inside a duct to easily see leakage points
- Alternatively, a leakage point could be located by listening to the air escaping, by feeling the escaping air by hand or, finally, by using soapy water
- A ventilation duct is typically under a positive pressure relative to the air surrounding it, which means that leakage from sheet metal ductwork can occur at connection joints between section lengths and at seams
- Other weak points include damper, filter and fan fixing penetrations, control sensors, test holes, access panels etc.
- Ventilation performance will be adversely affected by excessive air leakage and this is more likely to occur in a high air pressure ductwork construction
- It follows that medium-pressure and low-pressure ducts are less at risk of air leakage performance problems compared to high-pressure
- Therefore, 100% airtightness is not considered likely in most ventilation design and construction situations, but special circumstances such as in extract systems in highly controlled environments may require a completely airtight duct system (e.g. fully welded ductwork connections)
    - e.g. hospital laboratories, disease control research facilities, pharmaceutical manufacturing, micro-electronics manufacturing etc.

- Construction to the standards in DW/144 ensures acceptable air leakage rates in most non-specialised building environments
- Acceptable air leakage rates from ductwork are noted here from CIBSE Guide B Table 3.10. (P = the differential pressure between the duct and ambient air):
    - $0.027 \times P^{0.65}$ for low pressure ductwork (litres/sec per m^2 of duct surface area)
    - $0.009 \times P^{0.65}$ for medium pressure ductwork (litres/sec per m^2 of duct surface area)
    - $0.003 \times P^{0.65}$ for high pressure ductwork (litres/sec per m^2 of duct surface area)
- The loss from a duct was estimated as follows:
    - Determine the duct operating pressure **e.g. +100 Pa** (a low-pressure system)
    - The allowable loss was calculated from the above figures in l/sec per m^2 of duct surface area **e.g. for 100 Pa in a low-pressure duct, $0.027 \times 100^{0.65} = 0.54$ l/sec** per m^2 of duct surface area
    - The surface area of the ductwork section being assessed was calculated to find the leakage rate in l/sec (surface area = duct length × perimeter)
    - T Level BSE (8710) Practical Assignment example, **100 mm dia. ductwork, 6-m length**
    - Therefore, duct surface area = (0.1×3.14×6) = **1.9 m^2**
    - Therefore, allowable loss = 0.54 × 1.9 = **1.03 l/sec**
- Test result notes:
    - At the beginning of the test, the duct was pressurised to +100 Pa using air pressurisation equipment (rig)
    - The air pressure rig was then switched off at +100 Pa and the test time of 15 minutes was started
    - Air flow rate 1 (l/sec) was measured at the start time of the test
    - Air flow rate 2 (l/sec) was measured at 15 minutes
    - If the air flow **loss** at 15 minutes was **not more than** 1.03 l/sec the system was **passed**
    - If the air flow loss at 15 minutes was **more than** 1.03 l/sec the system was **not passed**
    - If required, leakage positions were located, corrected and a **re-test** carried out

	Design		**Test**
Fan	Flow Rate 0.038	m^3 /s	0.0285 m^3 /s
	Pressure, suction	Pa	Pa
	Pressure, discharge	Pa	Pa

INSTRUMENTS USED/ COMMENTS

- The building regulations Part F requires mechanical fans to provide adequate ventilation flow rates in certain types of rooms including toilets
- Every building must be designed and constructed in such a way that ventilation is provided for the health and of occupants
- A ventilation standard for toilets in commercial office buildings is set at 5 air changes per hour (ach), which means that room air is completely refreshed every 12 minutes
- The volume flow rate for this project was calculated to be 0.038 m^3/s or 38 l/sec
- The fan installed for this target flow rate was 150 mm in diameter, which had a design extraction rate of 81 l/sec
- The reason for the 150 mm diameter rather than 100 mm was that 100 mm has an extraction rate of 34 l/sec, which just too low for this project's required rate
- This also allows for a future expansion of the toilet block facilities if needed in the future
- The initial start of the fan was set for a low extraction rate to allow for checks of motor operation, vibration etc.
- The main check after the fan starting was that the test volume flow rate was at 100% of the design flow rate
- Also that the test fan pressures were as expected

	Extract grille number	Extract grille size mm	Design volume m^3 /s	Actual volume m^3 /s	% design	Comments
Air Extraction System	001 (Male WC)	200×200	0.0094 m^3/s (33.75 m^3/h)	0.005 m^3/s	53%	Room volume = 1.5×1.5×3.0 = 6.75 m^3 = 33.75 m^3/h @ 5 ach minimum from CIBSE Guide A Table 1.5, referred in fig. 2 notes
	002 (Female WC)	200×200	0.0094 m^3/s (33.75 m^3/h)	0.0075 m^3/s	80%	Room volume = 1.5×1.5×3.0 = 6.75 m^3 = 33.75 m^3/h @ 5 ach minimum from CIBSE Guide A Table 1.5, referred in fig. 2 notes
	003 (Accessible WC)	300×300	0.019 m^3/s (67.5 m^3/h)	0.016 m^3/s	84%	Room volume = 3.0×1.5×3.0 = 13.5 m^3 = 67.5 m^3/h @ 5 ach minimum from CIBSE Guide A Table 1.5, referred in fig. 2 notes

INSTRUMENTS USED/ COMMENTS

- Instrumentation: Rotating vane anemometer; hot-wire anemometer
- The commissioning included an inspection of ductwork cleanliness and section joints integrity
- The minimum standard of extraction flow rate to be achieved is 5 ach from each of the three toilet spaces. For the simulated room dimensions from the assignment fig. 2
- After investigating the fan operation and considering the problem of the actual flow rate being only 53% of the design flow rate at extract grille number 001, but the other two actual flow rates being 80% and 84% of the design target values, I concluded that there must be a fault on the VCD above grille 001. The damper blades were stuck, which reduced the extraction flow rate at that position. Therefore, the VCD will need to be replaced to achieve the required extraction rate at the ductwork terminal and meet the requirements of CIBSE Guide A Table 1.5 and the Building Regulations Part F: Ventilation
- More than the minimum ventilation extract rate required by the building regulations (6 l/s per WC = 18 l/s in this construction) is actually achieved for the system as a whole (5 l/s + 7.5 l/s + 16 l/s = 28.5 l/s), but the individual room minimum of 6 l/s per WC room is not achieved at grille 001.

Candidate Name:	Candidate Signature:	Date:
Tutor Name:	Tutor Signature:	Date:

Commentary

The candidate shows an excellent understanding of the principles and requirements of the commissioning test and checks. The checklist is detailed and accurate with correct terminology throughout. All calculations are correct and working out is clear and thorough. The candidate demonstrates an excellent knowledge of building regulations and these are referenced accurately in the relevant sections.

Task 3 – Carry out maintenance

(Assessment themes: Reports and information, Handover and communication, Working with faults)

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

- A written report of the maintenance activity
- Assessor observations:
    - Fault diagnosis
    - Rectification of fault
    - Discussion with customer

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

- A written report of the maintenance activity
- Assessor observations:
    - Fault diagnosis
    - Rectification of fault
    - Discussion with customer

Photographic evidence

Fault diagnosis and rectification of fault

Photographic evidence which shows:

- Results of tool usage. Photos may show tooling marks – **Photograph 6**
- Sequence of photos which show the replacing and removal of the faulty component, and reinstallation of the new component – **Photograph 7, 8 and 9**
- System on completion of all works – **Photograph 10**

Candidate evidence

Written report of maintenance activity

Maintenance activity

FAULT Report of a volume control damper (VCD) not operating correctly

Description of fault diagnosis

I checked if the air flow at the ductwork terminal (e.g. grille) matched the design flow rate. The terminal in the workshop simulated an external wall or rooftop extract grille from a toilet block in a commercial office building. This check confirmed that there was an air extraction problem in the system. After also investigating the fan operation and discussing the system operation with my assessor I confirmed that there was a fault on the VCD. The damper blades were stuck, which reduced the extraction flow rate. The VCD would need to be replaced.

Possible solutions

When planning to consider the best possible method of repair I considered the following.

The damper blades may have opened and closed manually but not automatically because the actuator (motorised controller) connected to the damper was not working. It may be that the actuator was the only part that needed to be replaced. However, I decided not to opt for this as I was concerned about only changing the actuator and then finding that the damper still did not work properly. I decided the best solution was to remove the existing damper and replace it with a completely new unit. A decision was taken to re-use the existing actuator once the new VCD was in place.

Actions taken to rectify fault

To repair the fault, I carried out the following sequence:

- Isolate the power supply to the system and check that fan and damper motor are not ‘live’
- Locate the faulty VCD
- Remove the existing actuator from its connecting position to the damper
- Remove the VCD from the ductwork connection flange (fixing bolts to be located and removed)
- Fit the new VCD in position
- Re-connect the actuator
- Ensure all fixing bolts are tightened properly and test the system air flow at the terminal when the damper should be open and closed

Commentary

The maintenance report completed is clear and detailed.

The candidate demonstrates excellent understanding of the maintenance requirements, for the given task. The planned process for carrying out the repair is accurate, and reasoning has been given to support the methods selected to rectify the fault.

The candidate shows thorough consideration for industry processes of maintenance activities, for example reference has been made to informing the customer and to the use of manufacturer instructions.

Candidate evidence

Practical Observation Form – Fault diagnosis and fault rectification

Assessment ID	Qualification number
8710-359	8710-35
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment themes**
City & Guilds	Working with faults/ handover and communication/ reports and information

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 and customer discussion	Candidate displayed 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 meaningful 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. Through the asking of appropriate questions, including: • How long has the fault been happening? • Is the damper fixed closed or fixed open? • Does the damper operate sometimes? By expanding on the customer responses the candidate as able to make some judgments and confirm the faulty component (VCD) quickly and confidently. The candidate selected an appropriate repair option and was focused and methodical in their approach to the task, confidently explaining the procedure throughout.
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 followed a methodical and logical sequence, safely identifying and isolating the faulty VCD, prior to selecting the correct tools to remove it from its ductwork location (connection flange) and replacing it with the new component.

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.*
	The candidate completed the repair efficiently without error and in good time, checking the completed repair.

Assessor signature	Date
Assessor A	31/01/2021

Photographic evidence

Results of tool usage.
Photograph 6 (to be added)

Component fitted correctly with no signs of tool marks from installation of the replacement component.

Sequence of photos which show the replacing and removal of the faulty component, and reinstallation of the new component.
Photograph 7 (to be added)

Loosening of faulty component.

Photograph 8 (to be added)

Removal of faulty component.

Photograph 9 (to be added)

Replacement of component.

System on completion of all works.
Photograph 10 (to be added)

Repair completed and work area left tidy.

Commentary

The candidate displayed confidence when carrying out the discussion with customer, ensuring eye contact and positive interaction and body language throughout the discussion.

Then candidate asked relevant questions to the customer and was able to determine the cause of the fault, with confidence and efficiency, demonstrating an excellent knowledge and understanding of the operating principles/ service requirements of the faulty VCD.

The candidate demonstrates a thorough understanding of the methods and techniques used to diagnose faults on ventilation systems/ components and the diagnosis of the fault followed a logical sequence.

The candidate shows excellent understanding of the techniques used to repair/ rectify faults in relation to the component that has been identified as being faulty.

The fault repair tasks followed a methodical order, and is carried out confidently/ independently and free from errors.

The candidate is able to select the correct tools for the task. The use of tools is excellent and re-installed components is aesthetically pleasing.

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