

# **Unit 5051: Heating, Ventilation and Air Conditioning (HVAC)**

**Unit code** H/615/1524

**Unit level** 5

**Credit value** 15

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## **Introduction**

The buildings we use in everyday life to live, work, study and socialise are becoming increasingly more complex in their design. As well as being subject to more stringent environmental emission targets, within these buildings the heating, ventilation and air conditioning (HVAC) systems play a vital role in maintaining the comfort of the occupants within the built environment.

This unit will introduce students to some of the most important HVAC systems and their supporting elements, and the underpinning science that is currently used in many different buildings around the world.

Subjects covered include: ventilation rates, systems, legislation, strategies and associated equipment. Also explored are topics such as air conditioning systems, cooling loads, psychrometric principles and processes, heating systems, fuels, combustion processes, boiler efficiency calculations and Building Management Systems (BMS).

On successful completion of this unit students will be able to explain the fundamental principles of HVAC systems and discuss the operational advantages of using BMS for maintaining the careful balance between ergonomic climate control and maximum economic efficiency.



## **Learning Outcomes**

By the end of this unit students will be able to:

- LO1 Explain the operating principles of non-domestic ventilation systems
- LO2 Explore the range of air conditioning systems
- LO3 Investigate the operational characteristics of non-domestic heating systems
- LO4 Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems.



## Essential Content

### LO1 Explain the operating principles of non-domestic ventilation systems

#### *Ventilation systems:*

Ventilation requirements: approved documents, requirements for occupants or processes

Ventilation strategies: local or centralised systems, natural ventilation, extract only, supply only and balanced systems

Ventilation system components and typical system layouts.

#### *Ventilation rates:*

Calculation of ventilation rates, supply for occupants or processes, supply to achieve required room air change rate

Mass and volumetric flow rates to maintain design room conditions.

#### *Fans:*

Fan types and operational characteristics

Fan selection and Fan Laws.

### LO2 Explore the range of air conditioning systems

#### *Air conditioning systems:*

Air conditioning requirements: requirement for comfort cooling or close control

Air conditioning strategies: types of air conditioning plant.

#### *Cooling loads:*

Estimation of heat gains and cooling loads

Factors affecting the cooling load requirements, building/room use, shading, building construction and orientation, internal heat gains.

#### *Psychrometrics:*

Psychrometric principles: psychrometric terms and properties

Plotting psychrometric processes using charts

Use of psychrometric charts to determine cooling coil, heater battery, frost coil and humidifier duties.



### **LO3 Investigate the operational characteristics of non-domestic heating systems**

#### *Heating systems:*

Heating requirements: approved documents, occupant's comfort

Heat loss calculations: heat losses through a structure, U values and their use in calculating heating load requirements

Heating strategies: local or centralised systems

Heating system components and typical system layouts.

#### *Fuels:*

Properties and characteristics of common solid, liquid and gaseous fuels.

#### *Combustion:*

Combustion principles

Products of complete and incomplete combustion and their implications

Minimum air requirements for stoichiometric combustion

Causes of incomplete combustion.

#### *Boiler efficiency:*

Boiler efficiency calculations.

### **LO4 Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems.**

#### *Requirement of the BMS:*

Client/end user requirements and operational needs, energy efficiency concerns.

#### *Function of a BMS:*

Systems controlled by BMS: heating, lighting, ventilation, air conditioning, security/access

Energy monitoring and reporting.

#### *BMS hardware:*

Types of BMS hardware available, advantages and disadvantages, performance and cost. Controlling software, remote access and control.



## Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<b>LO1</b> Explain the operating principles of non-domestic ventilation systems		<b>LO1 and LO2</b>  <b>D1</b> Evaluate and compare a number of passive and active methods used to help cool buildings giving suitable examples.
<b>P1</b> Explain and compare two alternative ventilation strategies for a non-domestic building and recommend the most suitable.  <b>P2</b> Using the information from P1, calculate the ventilation requirements for the rooms in a non-domestic building.	<b>M1</b> Discuss the types of fans used in non-domestic ventilation systems and analyse their characteristics.	
<b>LO2</b> Explore the range of air conditioning systems		
<b>P3</b> Explain the requirement for air conditioning in a variety of non-domestic buildings.  <b>P4</b> Estimate the cooling load requirements for rooms in non-domestic buildings using a recognised 'rule of thumb' method.	<b>M2</b> Analyse the factors affecting the cooling loads in buildings.	



Pass	Merit	Distinction
<b>LO3</b> Investigate the operational characteristics of non-domestic heating systems		<b>LO3 and LO4</b>  <b>D2</b> Calculate the minimum air requirements for a given fuel and distinguish between complete and incomplete combustion, predicting the possible consequences of incomplete combustion.
<b>P5</b> Explain and compare two alternative heating strategies for a non-domestic building and recommend the most suitable.  <b>P6</b> Estimate the heating load requirements for rooms in non-domestic buildings using a recognised 'rule of thumb' method.	<b>M3</b> Discuss the combustion properties of common fuels used in non-domestic heating systems.	
<b>LO4</b> Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems.		
<b>P7</b> Describe the requirements of a building management system in non-domestic buildings.  <b>P8</b> Describe the functions performed by a building management system in a non-domestic building.	<b>M4</b> Evaluate the advantages of a building fitted with a full Building Management System.	



## Recommended Resources

*Note: See HN Global for guidance on additional resources.*

### Print Resources

- Chadderton, D. (2013) *Building Services Engineering*. 6th Ed. Abingdon: Routledge.
- Cibse (2016) *Guide B: Heating, Ventilating, Air Conditioning and Refrigeration*. London.
- Cibse (2016) *Guide F: Energy Efficiency in Buildings*. London.
- Cibse. (2009) *CIBSE Guide H: Building control systems*. CIBSE, London.
- Hall F. and GREENO R. (2023) *Building Services Handbook*. 10th Ed. Routledge.
- Porges F. (2020) *HVAC Engineer's Handbook*. 11th Ed. Blackwells.