Unit 41: Air Conditioning for Industrial and Commercial Buildings

Unit code: H/601/1330
QCF level: 4
Credit value: 15

Aim
This unit provides learners with an opportunity to develop the skills needed to select and design suitable ventilation and air conditioning systems for industrial and commercial buildings.

Unit abstract
This unit will develop learner skills in applying the principles of design and operation of air conditioning equipment and installations. Learners will have an opportunity to experience the process of completing air conditioning designs in complex industrial and commercial applications. This unit will also enable learners to interpret the air conditioning requirements of buildings, develop practical air conditioning schemes for a range of environments, and evaluate the effectiveness of alternative schemes.

Learning outcomes
On successful completion of this unit a learner will:

1. Be able to carry out appraisals of the ventilation and air conditioning requirements for industrial and commercial buildings
2. Be able to determine cooling loads for buildings and peak summertime temperatures for spaces without air conditioning
3. Be able to produce designs to satisfy the ventilation and air conditioning needs of industrial and commercial buildings
4. Be able to select cooling plant and equipment for air conditioning systems.
Unit content

1 Be able to carry out appraisals of the ventilation and air conditioning requirements for industrial and commercial buildings

Appraisals: client and building operational requirements; possible strategies

Client and building operational requirements: ventilation and air conditioning design standards; publications for industrial and commercial buildings; balance between client needs, commercial constraints, health and safety requirements, aesthetic issues and energy efficiency considerations

Possible strategies: mechanical air conditioning or ventilation systems; use of natural ventilation (for cooling); interrelationship of ventilation and air conditioning with other mechanical and electrical building services

2 Be able to determine cooling loads for buildings and peak summertime temperatures for spaces without air conditioning

Cooling loads due to solar radiation: solar geometry and terminology; direct and diffuse solar radiation; calculation of solar irradiance on vertical, horizontal and pitched surfaces; transmission of solar radiation (through glass and building structures)

Total cooling load and cooling plant capacity: factors contributing to cooling plant capacity (air conditioned building); assessment of total heat gains to the interior; selection and verification of parameters (determining realistic casual gains); effect of building construction and orientation (thermal inertia and cooling load); use of tables, reference data and computer software to determine cooling loads for rooms, zones and buildings

Strategies for reducing cooling loads: effect of shadows and shading; impact of alternative design temperature indices; method of cooling loads

Peak summertime temperatures: assessment of peak summertime temperatures (anticipated in the absence of air conditioning); use of tables, reference data and computer software
3 Be able to produce designs to satisfy the ventilation and air conditioning needs of industrial and commercial buildings

Ventilation systems: application of natural and mechanical ventilation systems; mixed flow and displacement ventilation systems; fume and dust extraction systems; combination of ventilation and commercial air conditioning systems

Air conditioning systems: properties, characteristics, psychometric cycles and selection of ‘all air,’ air, water and packaged refrigerant air conditioning systems (single duct, terminal reheat, variable air volume (VAV) multi-zone, fan-coil, perimeter induction, chilled ceilings/beam, variable refrigerant volume (VRV), other single and multi-zone packaged refrigeration systems); choice of air conditioning systems to meet buildings’ needs

Ventilation and air conditioning design: control systems for air conditioning systems; sizing and selection of plant, ductwork and pipework; use of manufacturers’ data and software selection; design implications of space; maintenance and commissioning requirements; capital and operating costs; comparisons between centralised and packaged equipment

Commissioning and testing requirements: application of current standards and procedures (for commissioning air conditioning and refrigeration systems); instruments and procedures (measurement of volumetric flow, temperature, humidity, pressure and noise); commissioning schedules and documentation

4 Be able to select cooling plant and equipment for air conditioning systems

Selection of plant and equipment: vapour compression refrigeration cycles; cooling plant and associated equipment; refrigerants

Vapour compression refrigeration cycles: construction; major components of refrigeration heat pump installations and commercial air conditioning systems (operation characteristics and features); lubrication requirements and principles

Cooling plant and associated equipment: equipment and networks; use of tables, charts, computer software and manufacturers’ data; basic control systems (refrigeration and heat pump systems)

Refrigerants: properties; characteristics; thermodynamic performance; health, safety and welfare implications; environmental implications of commercially available refrigerants; legislation and standards (for use, handling and disposal of refrigerants and plant); compatibility of refrigerants with lubrication oils; criteria for selection; procedures for charging and evacuating systems
# Learning outcomes and assessment criteria

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<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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<td>On successful completion of this unit a learner will:</td>
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| **LO1** Be able to carry out appraisals of the ventilation and air conditioning requirements for industrial and commercial buildings | 1.1 establish client and building requirements for ventilation and air conditioning  
1.2 present alternative strategies for providing ventilation and air conditioning systems |
| **LO2** Be able to determine cooling loads for buildings and peak summertime temperatures for spaces without air conditioning | 2.1 determine cooling loads due to solar radiation  
2.2 identify factors that contribute to total cooling load and cooling plant capacity  
2.3 formulate strategies for reducing cooling loads for buildings  
2.4 determine peak summertime temperatures for non-air conditioned buildings |
| **LO3** Be able to produce designs to satisfy the ventilation and air conditioning needs of industrial and commercial buildings | 3.1 compare ventilation systems for industrial and commercial buildings  
3.2 demonstrate appropriate air conditioning solutions  
3.3 design appropriate ventilation and air conditioning systems  
3.4 produce guidelines for commissioning and testing requirements |
| **LO4** Be able to select cooling plant and equipment for air conditioning systems | 4.1 explain the role of the major components involved in the vapour compression refrigeration cycle  
4.2 outline the characteristics and environmental implications of refrigerants used in a cooling plant  
4.3 design a cooling plant and associated equipment |
Guidance

Links

This unit links with other Edexcel BTEC HN Construction and the Built Environment units, for example:

- Unit 2: Science and Materials for Construction and the Built Environment
- Unit 40: Thermofluids and Acoustic Criteria for Building Services Engineering
- Unit 42: Low Pressure Hot Water Heating for Non-domestic Buildings
- Unit 44: Air Conditioning for Complex Industrial and Commercial Buildings
- Unit 45: Heating Systems for Industrial and Specialist Applications
- Unit 58: Application of Scientific Principles to Building Services Engineering.

The content of this unit has been designed and mapped against the current CIC National Occupational Standards and the current NVQs at levels 4 and 5. Completion of the learning outcomes will contribute knowledge, understanding and skills towards the evidence requirements of the NVQs.

- See Annexe B for summary of mapping information to NVQs.

This unit has also been mapped to illustrate the links to the NQF units.

- See Annexe D for summary of mapping information to NQF units.

Essential requirements

Learners require access to a wide range of publications, reference data, manufacturers’ product information, computer facilities and air conditioning design software.

It is essential that a culture of health and safety is embedded in all the units to ensure that the learners understand the importance and relevance of health and safety issues. Therefore there should be clearly signposted aspects of current legislation and health, safety and welfare implications throughout the delivery and assessment of this unit.

Employer engagement and vocational contexts

Tutors should organise site visits as part of delivery for this unit. To ensure site visits are successful tutors should outline the aims and objectives of the visits and conduct preparatory briefings. Tutors should use real-life case studies, based on site visits, to demonstrate the application of air conditioning in industrial and commercial buildings.