Refrigeration Air Conditioning and Heat Pump (RACHP)
System Design and/or Applications Engineer Occupation Map

The purpose of this document is to describe the occupation and map the skills, knowledge and behaviours that are required for those working in any application, sector or role as a Systems Design and/or Applications Engineer. The content is deliberately generic (ie not specific to any one function) to provide employers, engineers and those developing training courses with an industry recognised standard against which to map their training and development.. It identifies where those skills, knowledge and behaviour areas are fundamental to this occupation as well as including others that should be considered in order to provide a broader context of requirements for those working in this occupation at different levels and functions.

It is considered that this is a Level 5 occupation due to the managerial responsibilities and extensive knowledge and application of advanced engineering practice required.

1. Examples of typical job titles currently in use

Refrigeration and/or Air Conditioning and Heat Pumps: Design Engineer, Applications Engineer, Technical Sales Engineer, Project Engineer, Technical Support Engineer, Research & Development Engineer, Consulting Engineer, Systems Engineer, Environmental Engineer. This list is not exclusive, there may be many other relevant job titles.

2. Occupational profile

A. The RACHP System Design and/or Applications Engineer is a specialist occupation responsible for the selection of components, design of systems and technologies in a range of engineering applications (eg production, distribution, storage or display of products and food and building or process climate control).
B. Engineers are responsible for interpreting customers' cooling requirements, taking into account changing technologies and regulatory requirements. They are responsible for ensuring a system delivers efficient, reliable, safe and low environmental impact cooling.
C. This requires practical experience and advanced knowledge of complex technologies and their use within a wide range of manufacturing and design applications.
D. Engineers at this level often work internationally and may have to specify equipment or manage contracts working across local, national or international design standards and legislation.
E. This occupation requires rigorous and substantial training to achieve full competence in order to demonstrate specialist knowledge and experience gained by seeing projects through to completion. This may involve off-the-job training in association with third parties.

3. Knowledge and What is required

A. Legislation, Regulations and Standards

Thorough knowledge of how to design systems in accordance with relevant local, national or international technical and environmental legislation and standards including health & safety, environmental protection, working with pressurised systems, electrical circuits and flammable substances.

Working knowledge and commitment to complying with industry Codes of Practice and other sources of up to date information and advice on technical safety and legislation related to their work.

B. Underpinning principles

Sound understanding of impact on systems design of thermodynamics, gas laws, psychrometrics, fluid flow, heat transfer, heating and cooling integration, electricity, properties of refrigerant fluids and lubricants, mechanical fluid handling and local conditions/requirements.

Sound understanding of refrigeration cycles.

Awareness of issues and opportunities of integrated utilities, acoustics and vibration, materials properties, and balancing heating and cooling demands.

C. Data analysis

How diagrams, calculations, tools, charts, tables and formulae are used in the design process. Appreciation of data use in commissioning, and fault finding.

D. System design fundamentals

Understanding how individual components should be integrated into an effective system including hydraulic pipework.

Integration with specialist consultants involved in the design process including architects, building services, heating and ventilation and structural engineers

E. Planning

Critical path project planning, resourcing, costing & financial awareness.

F. Sustainability

Understanding of total environmental impact of RACHP systems, including total life cycle costing, direct and indirect carbon emissions.

Maximises the opportunity for heat recovery, the integration of heating and cooling, and minimising cooling/heat loads.

Awareness of the need to design for long term sustainability and future environmental impact reduction targets where feasible.

Up to date knowledge of new and emerging technologies and design principles within the RACHP industry to reduce the environmental impact of equipment/systems.

Awareness of how emerging and existing technology within other industries can be interfaced within RACHP systems to reduce the environmental impact, improve sustainability and reduce operating costs. For example, energy storage, power, smart grid technology etc.

Awareness of how whole life environmental impact of systems and refrigerants can be measured, and how to advise owners on responsibilities of recycling/waste disposal at equipment end of life and opportunities for a circular economy.

Awareness of national carbon reduction targets and end user carbon reduction programmes.

F. Supply Chain

Understanding of supply market dynamics and how each node in the supply chain interacts both for components or equipment used in the final design and where relevant products or processes are being cooled.

4. Skills and What is required

A. Safe working practices
Works with all members of a design team to contribute to safe working practices and assessment of all risks.

B. Computer literacy
Uses software (e.g. Excel, CAD), charts, tables for modelling, component and pipe sizing, preparing load calculations, preparing and interpreting design drawings.

C. Project and team management
Interprets end user requirements, applications and processes to prepare, propose and adjust suitable design options and specifications. Participates in multidisciplinary teams involved in the design process. Uses appropriate communications and presents data effectively.

D. Application of design process
Follows through on the design process to ensure the delivery to meet customer requirements. Use of control strategies, troubleshooting methodology, control logic and sequencing.

E. Sustainable system operation
Interprets system operating parameters to ensure efficient performance against design expectations and to achieve measurable and sustained reductions in carbon emissions.

F. Visualisation and interpretation
Ability to take ownership of the design process from concept to reality, seeking input where necessary. Can interpret customer needs clearly and articulate an appropriate design solution to meet those requirements.

G. Commercial skills
Understands the requirement for good procurement practices. Ability to understand commercial models and the commercial impact of certain decisions on suppliers, subcontractors and customers (for example may be required to prepare and issue quotations to customers). Can use negotiation skills, and articulate a strategy and points of leverage. Acts as a liaison with key suppliers and contractors, to contribute to management of suppliers' performance.

5. Behaviours and What is required

A. Safety management
Manages and applies safe working practices - take responsibility for assessing, managing, mitigating and avoiding risk throughout the design process to themselves, colleagues, the public and the environment.

B. Ethical
Positive ethical approach and behaviours in line with professional engineering Codes of Conduct and procedures for reporting of unethical behaviours. Manages projects and their own work in an ethical manner.

C. Personal responsibility
Takes responsibility for work and interactions with colleagues, customers, suppliers or subcontractors. Attention to detail, following procedures, planning and preparation, verifying compliance. Applies an evidence based approach to problem solving and addressing technical challenges. Able to adapt to changes in conditions, technologies, situations and a wide variety of different working environments.

D. Communicates at all levels - Uses a range of communications methods effectively. Able to present and discuss problems with work colleagues, customers and interdisciplinary teams.

E. Personal and social skills - Committed to high personal standards at work; to their own continuous professional development and to applying principles of sound engineering and sustainability of engineering systems.

7. Additional recommendations

A. Qualifications
No qualifications specifically related to the training and assessment of individuals carrying out this occupation are currently known to be available.

Typically engineers would be expected to have already achieved a Level 3 (equivalent to A Level) Maths or technical qualification before starting in this role. Where this is not the case, they should expect to have achieved at least Level 2 (equivalent to GCSE at A,B,C) English and Level 3 Maths equivalent by the end of their training.

B. Professional Registration

This occupation map is designed to align with the professional standards of the Engineering Council for registration at Incorporated Engineer (IEng) level. Registration whilst not mandatory is encouraged strongly, this is available through the Institute of Refrigeration or another relevant Professional Body

C. Competence standards

Reference should also be made to relevant aspects of competence standards of Personnel in Refrigerating systems and heat pumps.
International BS EN ISO 22712.
European BS EN 13313:2010

D. Delivery of training

It is recognised that one job role may not provide engineers with the opportunity to develop all of the knowledge, skills and behaviours listed, and that flexible training delivery may be required such as off the job training or work placements in different types of organisation to ensure this transferability of skills.

E. Duration of training

The duration of training is not prescriptive as this will depend on the entry level of engineers, their previous experience and relevant qualifications. In order to gather sufficient practical experience and follow design projects through to completion, it is anticipated that training may take between 12 to 48 months.

Note: this Occupational Map forms part of the development of an industry Careers and Skills roadmap to encourage planned progression throughout various roles in the RACHP sector. An Occupational Standard for the role of RACHP Engineering Technician (Level 3) is already in existence.

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