



Group Award Specification for:

SQA Advanced Certificate in Electrical Engineering

Group Award code: GP6D 47

and

SQA Advanced Diploma in Electrical Engineering

Group Award code: GP6C 48

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1 Introduction

This document was previously known as the Arrangements Document. The purpose of this document is to:

- ◆ assist centres to implement, deliver, and manage the qualification
- ◆ provide a guide for new staff involved in offering the qualification
- ◆ inform course managers, teaching staff, assessors, learners, employers, and Higher Education institutions of the aims and purpose of the qualification
- ◆ provide details of the range of learners that the qualification is suitable for and the progression opportunities

This document has been written in order to assist centres in preparing for approval of the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and maintaining the awards thereafter. These two awards were developed under the new SQA Design Principles, were validated in March 2005, and replace the existing SQA Advanced Certificate in Engineering: Electrical and the SQA Advanced Diploma in Engineering: Electrical.

This document includes details on the background to the development of the new awards, their aims (both general and specific), recommended access requirements, information about the structure of the awards, recommendations on delivery and assessment and other guidance for centres.

2 Rationale for the revisions of the awards

2.1 Electrical Engineering

The term Electrical Engineering in the context of this document covers the range of subjects traditionally included in SQA Advanced Qualifications in Electrical Engineering, namely power, plant and electrical installation. The title Electrical Engineering is intended to provide candidates, lecturers, Higher Education, employers and professional bodies with a clear, unambiguous title.

Electronics has not been included in the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering titles as only sufficient electronics has been included in both awards to underpin studies in the various branches of electrical engineering.

2.2 SQA Advanced Engineering Frameworks

In 1996 the SQA validated nationally a large number of new SQA Advanced Engineering awards including two awards entitled SQA Advanced Certificate in Engineering: Electrical and SQA Advanced Diploma in Engineering: Electrical. A major difference between these and previous awards were that they all sat within an SQA Advanced Engineering Framework which in general terms consisted, for both SQA Advanced Certificates and SQA Advanced Diplomas, of a common core of units (units common to all SQA Advanced Certificate and SQA Advanced Diploma in Engineering awards), a principles/technology and optional sections. The benefits of this Framework structure were seen to include the following:

SQA Advanced Certificate and Diploma in Electrical Engineering

- ◆ provide a wide range of SQA Advanced Engineering qualifications to meet the needs of different engineering sectors
- ◆ improve the credibility and esteem of individual SQA Advanced Engineering awards
- ◆ clarify those competencies that were general to all incorporated engineers and those that were specific to particular engineering disciplines
- ◆ provide opportunities for the efficient delivery of SQA Advanced Engineering units by, for example, incorporating units that were common to a number of different SQA Advanced awards
- ◆ facilitate better progression between SQA Advanced Certificate, SQA Advanced Diploma and degree engineering awards

Prior to the development of any SQA Advanced Engineering awards a major consultation exercise was undertaken on the overarching SQA Advanced Engineering Framework to test the validity of the Framework. This consultation comprised of the following five strands:

- ◆ a questionnaire survey with stakeholders of SQA Advanced Engineering awards
- ◆ a series of meetings with various interested stakeholders of SQA Advanced Engineering awards
- ◆ desk based research
- ◆ discussions (followed by endorsement) of a proposed SQA Advanced Engineering Framework at an SQA Advanced Engineering Steering Group meeting
- ◆ a major consultation event with FE colleges on 24 May 2002 which included a questionnaire survey

The consultation revealed continuing strong support for an overarching SQA Advanced Engineering Framework but with the following modifications:

- ◆ a reduction in the number of common core units
- ◆ a strengthening of the Principles/Technology section with an even stronger emphasis on the teaching of core engineering principles and technologies

Optional sections are retained in all SQA Advanced Certificate and SQA Advanced Diploma Engineering awards.

The revised SQA Advanced Certificate and SQA Advanced Diploma in Engineering Frameworks are shown in block diagram form in Figures 2.1 and 2.2. It should be noted that the PDAs shown in both diagrams may be developed as more SQA Advanced units come on stream; currently none of these PDAs exist.

SQA Advanced Certificate in Engineering Framework

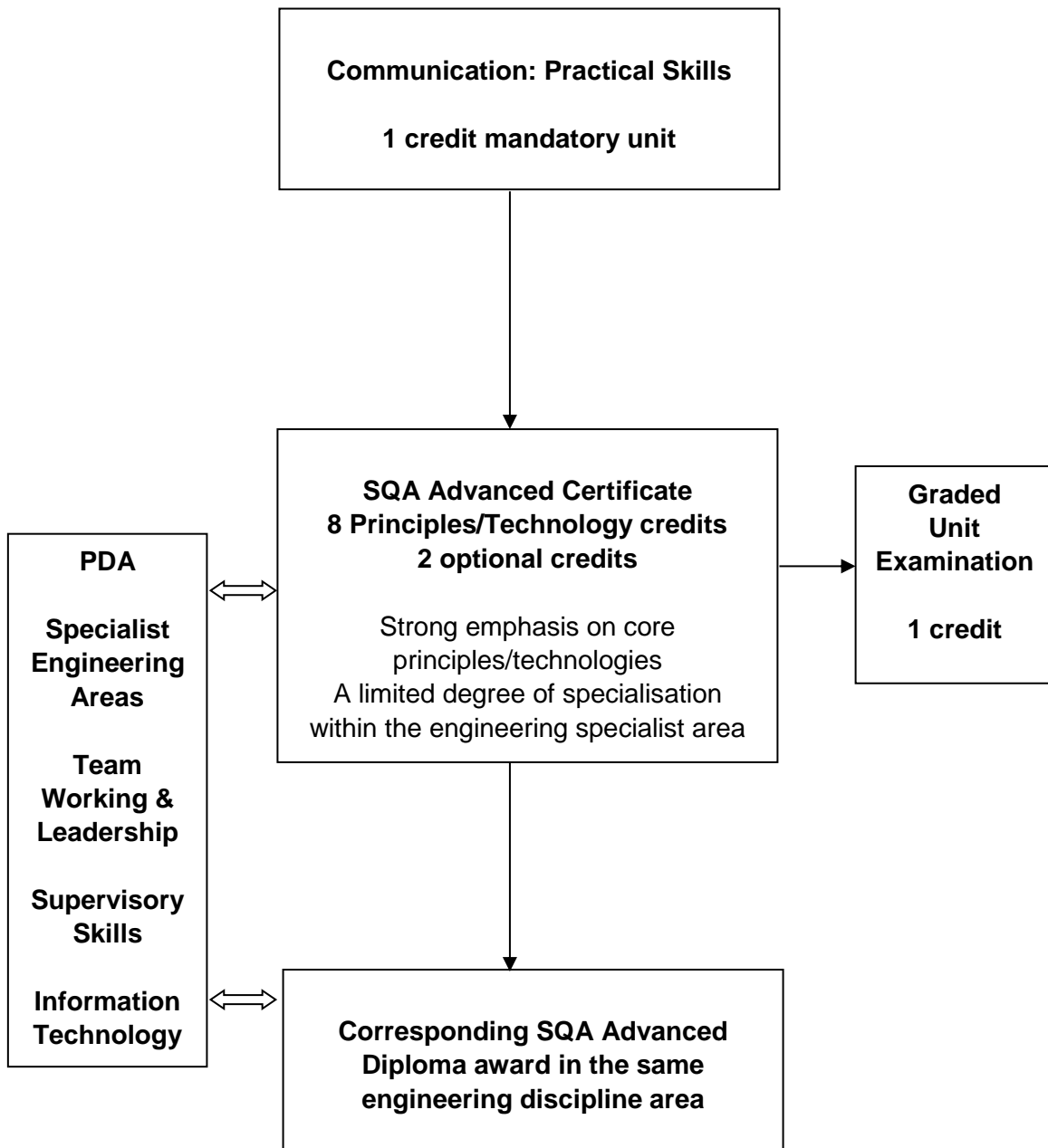


Figure 2.1

SQA Advanced Diploma in Engineering Framework

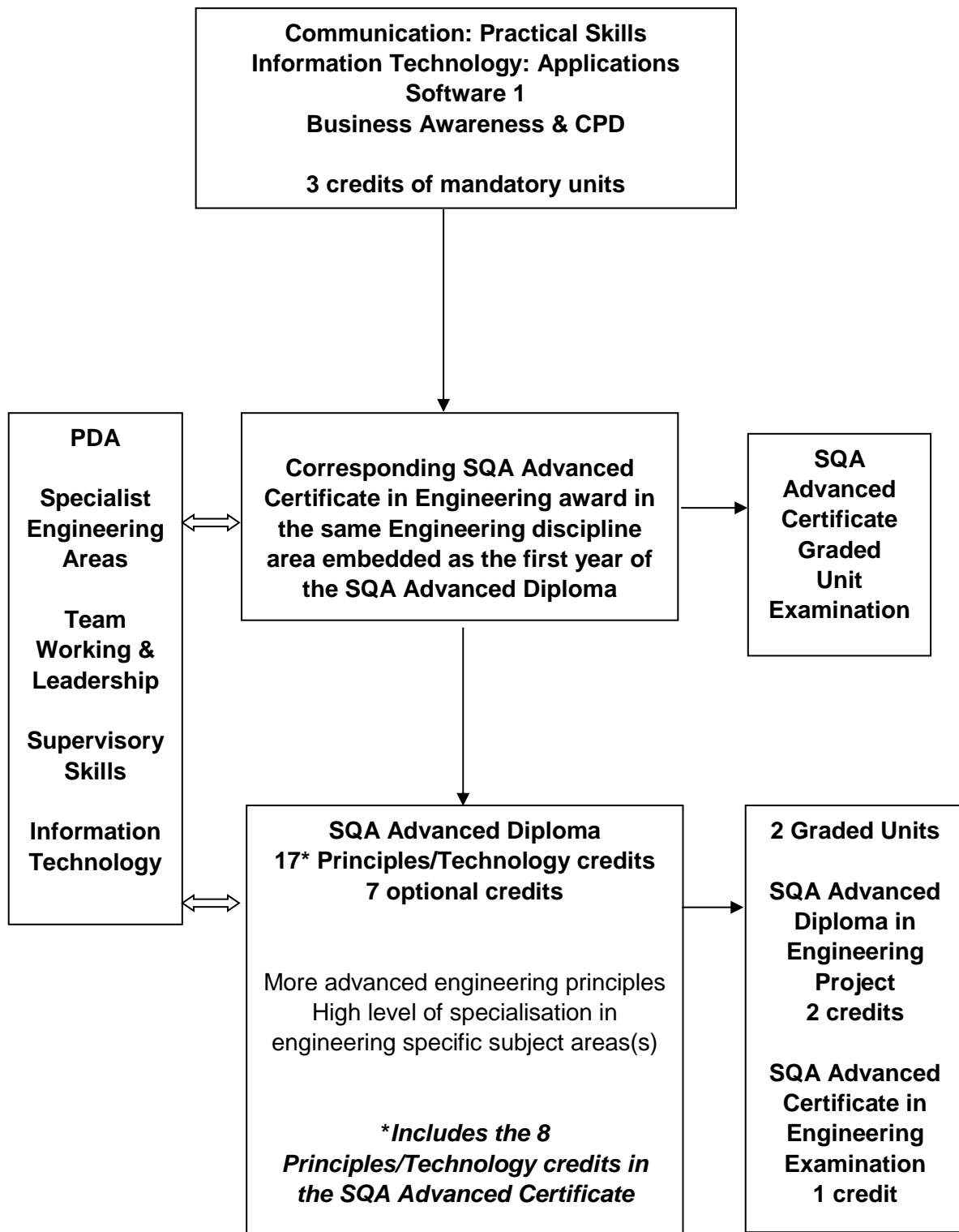


Figure 2.2

2.3 History and market research to support the SQA Advanced Certificate and Diploma in Electrical Engineering

2.3.1 History of the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards

The introduction of the SCOTVEC Advanced Courses Development Programme led to the replacement of the 132 SQA Advanced Diploma in Electrical and Electronic Engineering award by a competence based SQA Advanced Diploma in Electronic and Electrical Engineering in 1989. Shortly after an SQA Advanced Certificate in Electronic and Electrical Engineering was introduced as part of a national development and replaced the 101 SQA Advanced Certificate in Electrical and Electronic Engineering. However, there continued to be little commonality between the new SQA Advanced Certificate and SQA Advanced Diploma awards. The first attempt to harmonise the two awards took place as part of a consortium development in the early nineties. In 1995 and 1996 the two awards were totally harmonised (eg the SQA Advanced Certificate in Electrical Engineering becoming effectively the first year of the SQA Advanced Diploma) as part of a major SCOTVEC national development which saw the introduction of an overarching SQA Advanced Engineering Framework. The two new awards represent a further development of SQA Advanced Engineering awards taking full account the new SQA Advanced Design Principles and providing an opportunity to update the awards in light of technological and educational developments.

2.3.2 Market research

The development of the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards included extensive market research which is summarised below in Table 2.3.

Table 2.3

Stakeholder	Method
All	Major desk based research gathering and analysing data from various sources (eg SEMTA, FutureSkills Scotland, etc).
Delivery Centres	Initial postal survey of all delivery centres followed by two National seminars. Draft units, assessment exemplars and outlines of graded units were made available to centres.
Employers	Surveys of employers were carried out at the commencement of the development of the two awards and when the two award structures and units were nearing finalisation. Information obtained from employers helped to inform both structure and unit development.
Higher Education	Letters of support for articulation between the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering and degree awards

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	were received from seven Higher Education institutions.
Professional Bodies	The Chair of the Institute of Incorporated Engineers was a member of the Validation Panel and provided a broad measure of support for the two new developments at the Validation Event which was later confirmed in writing.
Health and Safety Executive	A representative from the Health and Safety Executive provided some invaluable input into the development of the Electrical Safety Unit and other units with significant safety content.
Students	While not consulted directly the student experience of the current SQA Advanced Certificate and SQA Advanced Diploma in Engineering: Electrical was taken fully into account in the new developments.

2.4 Candidates

2.4.1 SQA Advanced Certificate Candidates

Candidates at SQA Advanced Certificate level may already be in employment and will attend centres on a day-release or other part-time basis. The SQA Advanced Certificate framework structure is flexible enough to allow centres to deliver the SQA Advanced Certificate award by various modes of delivery for example, two-year day-release, evening attendance etc.

The options chosen by employed candidates may reflect the branch of industry in which they are employed or may be used to gain knowledge of other areas within electrical engineering in order to improve their career opportunities in the employment market. Part-time candidates may also use the SQA Advanced Certificate award to gain entry to degree level studies.

Full-time SQA Advanced Certificate candidates may be school leavers intending to articulate to a university degree course, or candidates who wish to progress from an appropriate National Certificate qualification. Full-time candidates may also be more mature persons who are seeking a change of employment.

Since the SQA Advanced Certificate award forms an integral part of the SQA Advanced Diploma award, full-time candidates will complete 15 unit credits in the first year of the course, 12 of these meeting the SQA Advanced Certificate requirements.

In addition to university entrance, successful full-time SQA Advanced Certificate candidates have enhanced their prospects of gaining employment in the Electrical Engineering industry.

2.4.2 SQA Advanced Diploma Candidates

The SQA Advanced Diploma award programme will normally be delivered on a two-year full-time basis, although this does not preclude other delivery patterns. This being

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the case, SQA Advanced Diploma candidates may be school leavers who have an interest in some aspect of electrical engineering and wish to include this in their career path. This may be candidates who wish to progress from an appropriate National Certificate qualification or candidates who have previously completed the SQA Advanced Certificate award and wish to progress to the SQA Advanced Diploma. The typical SQA Advanced Diploma candidate will therefore be a young person intending to articulate to a university degree course. The units of the SQA Advanced Certificate/Diploma framework have been designed to introduce candidates to electrical engineering and to take topics to a more advanced level than is possible in the SQA Advanced Certificate.

Mature candidates may also embark on the SQA Advanced Diploma programme. The SQA Advanced Electrical Development Team and unit writers were aware that such candidates may not have studied for some time and will require additional support in developing their learning skills. The SQA Advanced Electrical units have been designed as far as possible to provide candidates with opportunities to develop critical knowledge and understanding of theory and practical hands-on skills required by practising electrical incorporated engineers.

3 Aims of the qualification(s)

3.1 General Aims of the qualification(s)

The general aims of this award are to:

- 3.1.1** enhance candidates' employment prospects
- 3.1.2** support candidates' Continuing Professional Development and career development
- 3.1.3** enable progression within the SCQF (Scottish Credit and Qualifications Framework)
- 3.1.4** develop candidates' ability to apply analysis and synthesis skills to the solution of electrical engineering problems
- 3.1.5** develop learning and transferable skills (including Core Skills)

3.2 Specific Aims of the qualification(s)

The specific aims of this award are to:

- 3.2.1** provide an award that will allow candidates to work now, or in the future, as electrical technicians or incorporated electrical engineers
- 3.2.2** provide an award that creates a route towards meeting the academic requirements for Incorporated Engineer status

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- 3.2.3** develop an award that on successful completion will allow candidates to progress to SQA Advanced Diploma Electrical Engineering and/or a degree in Electrical Engineering or related subject discipline area

The development of this new SQA Advanced Certificate award will also allow candidates to:

- 3.2.4** develop a range of Communication knowledge and skills relevant to the needs of electrical incorporated engineers
- 3.2.5** develop knowledge, understanding and skills in a range of core electrical principles, electrical power systems, electrical machine principles and electrical safety at SQA Advanced level (these studies in core electrical principles and technologies are underpinned by a mandatory unit in Mathematics)
- 3.2.6** develop knowledge and skills in the use of electrical and electronic instruments
- 3.2.7** achieve a degree of specialisation within the following areas: Electrical Principles, Information Technology, Three Phase Induction Motors, Power Electronics, Inspection and Testing of Low Voltage Electrical Installations, Programmable Logic Controllers, Electrical Systems in Hazardous Environments, Control Systems, further Mathematical studies, Electrical Installation Skills and Engineering Quality
- 3.2.8** on successful completion of the award, achieve the Core Skill Communication at Higher level and the component Using Number of the Core Skill Numeracy at Higher level. The candidate will also be provided with opportunities to develop the following Core Skills: Information Technology at Higher level, the component Using Graphical Information of the Core Skill Numeracy at Higher level, Problem Solving at Higher level and Working with Others at Intermediate 1 level

3.3 General Aims of the SQA Advanced Diploma in Electrical Engineering

The same as for the SQA Advanced Certificate in Electrical Engineering award but with the addition of the following:

- 3.3.1** develop candidates' knowledge and skills in planning and project management
- 3.3.2** develop investigation skills

3.4 Specific Aims of the SQA Advanced Diploma in Electrical Engineering

The same as for the SQA Advanced Certificate in Electrical Engineering award but with the addition of the following:

- 3.4.1** develop an award that on successful completion will allow candidates' to progress to a degree in Electrical Engineering or related subject discipline area

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The development of this new SQA Advanced Diploma award will also allow candidates to:

- 3.4.2** develop knowledge and understanding of the external and internal factors that influence the performance of modern companies
- 3.4.3** recognise the important role continuing professional development plays in career development
- 3.4.4** expand on the range of knowledge, understanding and skills in core electrical principles, electrical machines and systems and electrical installation
- 3.4.5** allow for further specialisation within the following subject areas:
Inspection and Testing of Low Voltage Installations, Programmable Logic Controllers, Electrical Systems in Hazardous Environments, Analogue and Digital Electronics, Quality Management, Electrical Installation Skills, Industrial Plant Maintenance, Synchronous Machines, Electrical Motor Drive Systems, Three Phase Induction Motors, High Level Engineering Software, additional Control Systems studies, Power Supply Circuits, Switchgear and Protection, Standby Systems, Electrical Installation Design: Computer Aided, advanced Mathematical studies and Employment Experience
- 3.4.6** on successful completion of the award, achieve the Core Skills in Communication at Higher level, Information Technology at Higher level, Problem Solving at Higher level and the Using Number component of the Core Skill Numeracy at Higher level. Candidates will be provided with opportunities to develop the Core Skill Using Graphical Information component of the Numeracy Core Skill at Higher level and the Working with Others Core Skills at Intermediate 1 level

3.5 How the General Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Award Structures and Content

Aim no.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.1.1	For many years, SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering qualifications have equipped candidates to seek employment in a wide range of manufacturing, service and public sector organisations. Market research indicates that SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards are still regarded as the minimum qualifications required by many organisations to work at electrical technician or incorporated engineer level.
3.1.2	There has been a long tradition of candidates in employment taking SQA Advanced Certificate in Electrical and Electronic awards on a part-time basis to increase their knowledge of Electrical and Electronic Engineering and enhance their career development. In recent years, with increased commonality between SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and greater flexibility in the way these awards are delivered, candidates in employment have increasingly taken SQA Advanced Diplomas on a part-time basis to expand their knowledge and skills in Electrical and Electronic Engineering and improve their career prospects. The two new awards contain a balance of core principles and up-to-date knowledge and skills in Electrical Engineering which lends themselves to the Continuous Professional Development and career development of candidates working at electrical technician and incorporated engineer levels. Furthermore, the award structures have been designed to allow for easy progression between SQA Advanced Certificate and SQA Advanced Diploma awards.
3.1.3	All units within the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards have been levelled at SCQF levels 6, 7 or 8. The two new awards also conform to the SQA levelling requirements for SQA Advanced Certificate and SQA Advanced Diploma awards. Thus, successful completion of one or both awards will allow progression within the SCQF.
3.1.4	The nature of Electrical Engineering as a discipline lends itself to both the analysis and synthesis of problems. For example, when a complex electrical and electronic system is analysed (using, say, a block diagram approach) by breaking it down into separate functional parts or alternatively the synthesis of a complex system from simpler electrical and electronic systems. The two new awards allow these important skills to be developed further both in the technical subjects and in the core Communication, Information Technology and Business Awareness and Continuing Professional Development units.

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Aim no.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.1.5	<p>The new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards provide centres with an opportunity to enhance learning skills not least by creating opportunities for candidates to combine theory and practice to achieve a real understanding of a subject. For example, some units recommend significant use of practical work and/or computer simulation to reinforce learning. It is also anticipated that centres will use innovative delivery approaches that may make use of sophisticated electrical and electronic laboratory equipment and/or online delivery and/or Virtual Learning Environments to enhance candidate learning.</p> <p>By their very nature Engineering courses require the transfer of technical knowledge and skills from one area to another. For example, a significant level of Electrical Principles and Mathematics has been included in both SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards because these subjects provide underpinning knowledge, understanding and skills which are used elsewhere in both awards. Candidates will also have an opportunity to use the Communication and Information Technology knowledge and skills developed in the mandatory core units in other parts of the awards to support such activities as report writing, presentation and the application of specialist software packages. Core Skills in general, and problem solving in particular, have been regarded as very important by the SQA Advanced Electrical Development Team since it is recognised that a good level of competence in these is essential in the work of an incorporated electrical technician.</p>
3.3.1	<p>The double credit (16 SCQF points) Engineering Project Graded Unit in the SQA Advanced Diploma in Electrical Engineering award provides opportunities for candidates to develop both their planning and project management knowledge and skills.</p>
3.3.2	<p>The Business Awareness and Continuing Professional Development Unit provides candidates with the opportunities to develop their investigative skills by exploring the external and internal factors that affect the performance of a modern company and the different ways that people learn. The Engineering Project also requires candidates to undertake some investigations into the background to and a range of solutions for their engineering project.</p>

3.6 How the Specific Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Award Structures and Content

Aim no.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.2.1	<p>An SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering award has been recognised for many years by employers and other stakeholders of these awards as appropriate qualifications for persons wishing to work at electrical technician or senior technician levels. Market research indicates that there is a growing demand for people with technician level skills in electrical and electronic engineering especially as companies automate a lot more of their processes. Thus, it is confidently anticipated that those achieving the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards will find employment as electrical technicians and incorporated electrical engineers in a wide range of small, medium and large companies.</p>
3.2.2 & 3.2.3	<p>An SQA Advanced Certificate and SQA Advanced Diploma in no longer satisfies fully the academic requirements for Incorporated Engineer status although these qualifications continue to completely satisfy Engineering Technician requirements. The minimum qualification for Incorporated Engineer is an ordinary degree.</p> <p>Given the clear progression routes that have been established between existing SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and degree courses by many FE colleges and universities, it is strongly anticipated that similar progression routes will also be developed between the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and degree courses. Thus, SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards will continue to form very important 'stepping stones' towards candidates achieving degrees (and, thus, satisfy fully the academic requirements for Incorporated Engineer status). Progression arrangements between SQA Advanced Certificates, SQA Advanced Diplomas and degrees can only be strengthened with the full implementation of the SCQF. Seven letters have been received from Scottish Universities confirming articulation arrangements between the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and degree programmes.</p>

4 Recommended entry to the qualification(s)

4.1 Access requirements

Entry to this qualification is at the discretion of the centre. The following information on prior knowledge, skills, experience, or qualifications that provide suitable preparation for this qualification has been provided by the Qualification Design Team as guidance only.

Learners would benefit from having attained the skills, knowledge, and understanding required by one or more of the following or equivalent qualifications and/or experience:

- ◆ One Higher from Physics, Technological Studies or Higher Mathematics and at least three Standard Grades 1-2/ Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- ◆ National Certificate Group Award in Electrical Engineering or Electronic Engineering.
- ◆ Qualification comparable to the above, gained through other awarding bodies such as GSCE, City & Guilds, Edexcel etc.
- ◆ At the discretion of the Principal of the presenting centre for applicants with a different experiential background who could benefit from taking the award(s) or units within the award(s), eg adult returners, overseas students with relevant work and/or work experience.

4.2 Alternative access arrangements

The presenting centre may operate alternative access arrangements in cases where the candidate is convinced that she/he already has the required competences in a given area. These arrangements are as follows:

- ◆ assessment on demand
- ◆ credit transfer
- ◆ accreditation of prior learning
- ◆ relevant work experience

Individual presenting centres will require to outline their systems for each of these as a part of any approval procedure.

5 Structure of the qualifications

This qualification was designed to meet a specific purpose and what follows are details on how that purpose has been met through mapping of the units to the aims of the qualification. Through meeting the aims, additional value has been achieved by linking the unit standards with those defined in National Occupational Standards and/or trade/professional body requirements. In addition, significant opportunities exist for learners to develop more generic skills, known as Core Skills, through this qualification.

5.1 SQA Advanced Certificate in Electrical Engineering Structure: GP6D 47 — 12 unit credits

Mandatory units (9.0 credits required)

Unit no.	Unit title	Credit value	SCQF level
HP4A 47*	Communication: Practical Skills	1	7
HP48 46*	Engineering Mathematics 1	1	6
HT7K 47	Three Phase Systems	1	7
HV3L 47	Electricity Power Systems	1	7
HT83 47	Electrical Machine Principles	2	7
HV3A 47	Electrical Safety	1	7
HP46 47	DC and AC Principles	1	7
HV2H 46	Application of Electrical and Electronic Instruments	1	6

SQA Advanced Certificate and Diploma in Electrical Engineering

Optional units (2.0 credits required)

Unit no.	Unit title	Credit value	SCQF level
HP3J 47	Electrical Networks and Resonance	1	7
HP6L 47	Information Technology: Applications Software 1	1	7
HT1W 47	Power Electronics	1	7
HV2L 47	Inspection and Testing of Low Voltage Electrical Installations	1	7
HT1K 47	Applications of Programmable Logic Controllers	1	7
HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments	1	7
HT1R 47	Fundamentals of Control Systems and Transducers	1	7
HP49 47*	Engineering Mathematics 2	1	7
HV3M 47	Electrical Installation Skills	1	7
HV3G 48	Three Phase Induction Motors	1	8
HT7A 47	Quality Management: An Introduction	1	7
HP6M 47	Personal Development Planning	1	7
HR1C 46*	Workplace Communication in English	1	6
J1PL 47	Promoting Energy Efficiency in the Workplace	1	7
HV2W 47	Electrical Design Systems: An Introduction	1	7
HV2X 47	Electrical Installation Design (Computer Aided): An Introduction	1	7
HT1Y 47*	Energy Overview	1	7
J1CH 47*	Computer Programming	1	7
J1S1 47*	Data Security	1	7

*Refer to History of Changes for revision changes.

Graded Unit (1.0 credit)

Unit no.	Unit title	Credit value	SCQF level
HV4C 47	Electrical Engineering: Graded Unit 1 (Examination)	1	7

**5.2 SQA Advanced Diploma in Electrical Engineering Structure:
GP6C 48 — 30 unit credits**

Mandatory units (20.0 credits required)

Unit no.	Unit title	Credit value	SCQF level
HP4A 47*	Communication: Practical Skills	1	7
HP6L 47	Information Technology: Applications Software 1	1	7
HP3H 48	Business Awareness and Continuing Professional Development	1	8
HP48 46*	Engineering Mathematics 1	1	6
HP46 47	DC and AC Principles	1	7
HT7K 47	Three Phase Systems	1	7
HV3L 47	Electricity Power Systems	1	7
HT83 47	Electrical Machine Principles	2	7
HV3A 47	Electrical Safety	1	7
HV2H 46	Application of Electrical and Electronic Instruments	1	6
HP3J 47	Electrical Networks and Resonance	1	7
HT1W 47	Power Electronics	1	7
HT1R 47	Fundamentals of Control Systems and Transducers	1	7
HP49 47*	Engineering Mathematics 2	1	7
HT1H 48	Transmission Lines and Complex Waves	1	8
HV5X 48	Electrical Installation Design	1	8
HT7M 48	Electrical Motor Drive Systems	1	8
HV4X 48	Transformers	1	8
HV4Y 48	Utilisation of Electrical Energy in Buildings	1	8

*Refer to History of Changes for revision changes.

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Optional units (7.0 credits required)

Unit no.	Unit title	Credit value	SCQF level
HV2L 47	Inspection and Testing of Low Voltage Electrical Installations	1	7
HT1K 47	Applications of Programmable Logic Controllers	1	7
HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments	1	7
HT7J 46	Analogue Electronics: An Introduction	1	6
HT7L 47	Digital Electronics	1	7
HT7A 47	Quality Management: An Introduction	1	7
HV3M 47	Electrical Installation Skills	1	7
HV2K 47	Industrial Plant Maintenance	1	7
HP41 47	High Level Engineering Software	1	7
HV51 48	Control Systems Behaviour	1	8
HT1E 48	Mathematics for Engineering 3	2	8
HP3T 48	Power Supply Circuits	1	8
HV4V 48	Switchgear and Protection of High Voltage Systems	1	8
HV50 48	Applications of Power Electronics in Electrical Motor Drive Systems	1	8
HV3G 48	Three Phase Induction Motors	1	8
HV4W 48	Synchronous Machines	1	8
HV53 48	Electrical Standby Systems	1	8
HV52 48	Electrical Installation Design: Computer Aided	1	8
HP6M 47	Personal Development Planning	1	8
HR1C 46*	Workplace Communication in English	1	6
J1PL 47	Promoting Energy Efficiency in the Workplace	1	7
HV2W 47	Electrical Design Systems – An Introduction	1	7
HV2X 47	Electrical Installation Design (Computer Aided): An Introduction	1	7
HT7H 47*	Project Management: An Introduction	1	7
HT1M 47*	Engineering Mathematics 3	1	7
HT03 48*	Engineering Mathematics 4	1	8
HT1N 48*	Engineering Mathematics 5	1	8
HR0M 47	Work Role Effectiveness	3	7
	OR		
HR0P 48	Work Role Effectiveness	3	8
HP47 47	Analogue Electronic Principles	2	7
HP3G 47	Combinational Logic	1	7
HP3Y 47	Sequential Logic	1	7
HP42 47	MCU/MPU Assembly Language Programming	1	7
HT1Y 47*	Energy Overview	1	7
HT1L 48*	Energy Technologies	1	8
J1CH 47*	Computer Programming	1	7
J1S1 47*	Data Security	1	7

*Refer to History of Changes for revision changes.

SQA Advanced Certificate and Diploma in Electrical Engineering

Graded unit (3.0 credits required)

Unit no.	Unit title	Credit value	SCQF level
HV4C 47	Electrical Engineering: Graded Unit 1 (Examination)	1	7
J1RC 48	Electrical Engineering: Graded Unit 2 (Project)	2	8

5.3 Graded Units

The purpose of the Graded Unit for both the SQA Advanced Certificate and SQA Advanced Diploma awards is to assess the candidate's ability to apply and integrate knowledge and/or skills gained within individual units. By this means candidates will demonstrate that they have achieved the specific aims of the awards as detailed in Sections 3.2 and 3.4. The Graded Units also provide the means by which a candidate's achievement can be graded.

SQA Advanced Certificate in Electrical Engineering candidates will undertake a **one** Credit Graded Unit at level 7. This will be in the form of a 3-hour written examination.

SQA Advanced Diploma in Electrical Engineering candidates will also do the SQA Advanced Certificate Graded Unit but, in addition, will undertake a **two** Credit Graded Unit at level 8. This will take the form of a practical assignment/project.

5.3.1 Types of Graded Units

SQA Advanced Certificate in Electrical Engineering: Graded Unit 1 — Examination

It will be noted that the Graded Unit draws on Outcomes in the mandatory section of the award which are studied by all SQA Advanced Certificate in Electrical Engineering candidates.

The assessment for the Electrical Engineering: Graded Unit 1 consists of an examination paper which should last three hours.

It is recommended that candidates do not sit the Graded Unit examination until the end of the SQA Advanced Certificate (1st Year of the SQA Advanced Diploma), given the range of units that it draws from.

SQA Advanced Diploma Electrical Engineering: Graded Unit 2 — Project

The nature of the project activity is such that it is likely that centres will wish their candidates to embark on it from the start of the second year of the SQA Advanced Diploma in Electrical Engineering programme. As it is anticipated that centres will deliver the SQA Advanced Certificate in Electrical Engineering as part of the first year of the SQA Advanced Diploma, it is recommended that candidates have completed all SQA Advanced Certificate in Electrical Engineering units, including the SQA Advanced Certificate Graded Unit, before commencing the project.

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In principle, the project can draw on any units in the SQA Advanced Diploma in Electrical Engineering framework although the majority of units should be at SCQF level 8. The project can be taken from one Electrical Engineering area (eg Electrical Machines) or it can span more than one technical area. However, its principal purpose is not to integrate technical content (this is covered in Electrical Engineering: Graded Unit 1) but rather to combine such knowledge and skills as planning, construction, testing, evaluating and reporting.

5.3.2 Rationale for the Graded Units Assessment

The assessment methods ie an examination for Graded Unit 1 and a project for Graded Unit 2 were decided through consultation with industry and delivering centres during initial consultation on the overarching SQA Advanced Engineering Framework (see SQA Advanced Certificate and SQA Advanced Diploma in Electronics Validation Document for more details).

The consultation indicated that an 'examination' provided a more accurate way of assessing candidates' abilities to apply and integrate knowledge and understanding from various technical and related areas, such as Communication. Furthermore, it was considered that during their SQA Advanced Certificate studies candidates will not normally develop fully the necessary knowledge and skills to complete a project.

A project was preferred at the SQA Advanced Diploma level because a project-based assignment provides candidates with opportunities to demonstrate not only their knowledge and skills in a technical area(s) but also in areas such as planning, construction, testing, evaluating and reporting which are important aims within the SQA Advanced Diploma in Electrical Engineering award.

5.4 Core Skills

The SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards have been designed using the new SQA Advanced Design Principles and therefore the importance of Core Skills has been recognised and been incorporated, where appropriate, throughout the awards.

5.4.1 SQA Advanced Certificate in Electrical Engineering

Core Skills Exit Profile

A candidate who successfully achieves an SQA Advanced Certificate in Electrical Engineering will automatically obtain the following Core Skills exit profile:

- ◆ Communication Higher (fully embedded in the unit Communication: Practical Skills)
- ◆ Numeracy Using Number component of Numeracy Core Skill at Higher (embedded in the unit Mathematics for Engineering 1: Electronics and Electrical)

Core Skills Entry Profile

Given the information on Core Skills provided in the previous section the following candidate Core Skills entry profile is recommended:

- ◆ Communication Intermediate 2
- ◆ Information Technology Intermediate 2
- ◆ Numeracy Intermediate 2
- ◆ Problem Solving Intermediate 2
- ◆ Working with Others Intermediate 1

Unit writers have also identified in individual units opportunities to develop Core Skills. These development opportunities are summarised in Figure 5.4.1.

Figure 5.4.2 SQA Advanced Electrical Units — Core Skills Development Opportunities

Note 1: Units that were originally developed as part of the new SQA Advanced Certificate/Diploma in Electronics awards are not shown in this table. Refer to the new SQA Advanced Certificate/Diploma in Electronics Arrangements Document and the individual unit specifications for the Core Skills development opportunities.

Note 2: *CT = Critical Thinking; P&O = Planning & Organisation and R and E = Reviewing & Evaluating*

Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Three Phase Systems (HT7K 47)				Higher	Higher		Higher			
Electricity Power Systems (HV3L 47)	Higher	Higher		Higher	Higher	Higher	Higher			
Electrical Machine Principles (HT83 47)				Higher	Higher		Higher			Intermediate 1 Working co-operatively with others in a group when analysing constructional features of machines and when undertaking laboratory work

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Electrical Safety (HV3A 47)	Higher Reading complex Health & Safety documentation	Int 1 Completing work permit					Higher			Intermediate 2 Work with others in a role play scenario: eg issuing a Permit to Work, identifying risk factors
Application of Electrical and Electronic Instruments (HV2H 46)	Higher				Int 2	Int 2 Searching for manufacturers' data on instruments on the Internet	Int 2		Int 2	

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Power Electronics (HT1W 47)	Higher	Higher		Higher	Higher	Int 2 Simulation of circuits plus search of manufacturers' data on power electronic devices	Higher		Int 2	
Fundamentals of Control Systems and Transducers (HT1R 47)	Higher	Higher			Higher		Higher			Int 1 Opportunities to work in groups for laboratory investigations
Electrical Installation Design (HV5X 48)	Higher	Higher		Higher	Int 2		Higher	Higher		Int 2 Scope for Working with Others within Installation Learning Design Exercises (eg planning and organising role)
Electrical Motor Drive Systems (HT7M 48)	Higher	Higher			Higher		Higher		Higher	

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Transformers (HV4X 48)	Higher			Higher	Higher		Higher			
Utilisation of Electrical Energy in Buildings (HV4Y 48)	Higher	Higher		Higher	Higher		Higher	Higher	Higher	
Inspection and Testing of Low Voltage Electrical Installations (HV2L 47)	Higher	Int 2					Higher	Int 2	Int 2	
Electrical Systems in Potentially Explosive and Gas Hazardous Environments (HV3K 47)	Higher					Int 2 Searching on the Internet for manufacturers' data on apparatus to provide explosion protection or intrinsically safe equipment	Higher			

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Analogue Electronics: An Introduction (HT7J 46)	Int 2			Int 2	Int 2	Int 2 Simulation of circuits plus search of manufacturers' data on electronic devices	Int 2			Int 1 Opportunities to work in groups for laboratory investigations
Digital Electronics (HT7L 47)	Int 2			Int 1	Int 2	Int 2 Simulation of circuits plus search of manufacturers' data on electronic devices	Int 2			Int 1 Opportunities to work in groups for laboratory investigations
Quality Management: An Introduction (HT7A 47)		Int 2			Int 2		Higher			
Control Systems Behaviour (HV51 48)	Higher	Higher		Higher	Higher	Higher	Higher		Higher	
Switchgear and Protection of High Voltage Systems (HV4V 48)	Higher	Higher		Higher	Higher		Higher			

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Applications of Power Electronics in Electrical Motor Drive Systems (HV50 48)	Higher	Higher		Higher	Higher	Int 2 Opportunities to search on the Internet for manufacturers' information	Higher	Higher	Higher	
Three Phase Induction Motors (HV3G 48)	Higher	Higher		Higher	Higher		Higher	Higher	Higher	
Synchronous Machines (HV4W 48)	Higher			Higher	Higher	Int 2 Use of software packages to simulate synchronous machine operation	Higher		Higher	
Industrial Plant Maintenance (HV2K 47)	Higher	Higher			Int 2	Int 2 Use of CMSS software	Higher	Higher	Higher	Int 1 Opportunities to work in groups to develop maintenance strategies for different scenarios

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Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Electrical Standby Systems (HV53 48)	Higher	Higher		Int 2	Higher	Int 2 Opportunities to search on the Internet for manufacturers' information	Higher		Higher	
Electrical Installation Skills (HV3M 47)					Int 1			Int 2		
Electrical Installation Design: Computer Aided (HV52 48)	Higher	Higher			Higher	Higher	Higher	Higher		Int 1 Working in small groups for learning how to use the software

5.5 Conditions of the Award

The conditions of award for SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering qualifications are as follows:

5.5.1 SQA Advanced Certificate in Electrical Engineering

A candidate will be awarded SQA Advanced Certificate in Electrical Engineering on successful completion of 11 unit credits plus 1 Graded Unit based on the SQA Advanced Certificate in Electrical Engineering award structure shown in Section 5.1. More specifically this award structure requires that a candidate achieves the following:

- ◆ the 1 unit credit Communication: Practical Skills within the mandatory section
- ◆ the remaining eight unit credits from the mandatory section
- ◆ two unit credits from the optional section
- ◆ Electrical Engineering: Graded Unit 1 Examination

5.5.2 SQA Advanced Diploma in Electrical Engineering

A candidate will be awarded SQA Advanced Diploma in Electrical Engineering on successful completion of 27 unit credits plus 3 Graded Unit Assessment credits based on the SQA Advanced Diploma in Electrical Engineering award structure shown in Section 5.2. More specifically this award structure requires that candidates achieve the following:

- ◆ the 3 unit credits Communication: Practical Skills, Information Technology: Applications Software 1 and Business Awareness and Continuing Professional Development within the mandatory section
- ◆ remaining 17 unit credits from the mandatory section
- ◆ seven unit credits from the optional section
- ◆ Electrical Engineering: Graded Unit 1 and Electrical Engineering: Graded Unit

5.6 SCQF levels

Figures 5.6.1 and 5.6.2 show the distribution of SCQF levels in the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards respectively in the mandatory sections. It can be seen from Figure 5.6.1 that all units in the SQA Advanced Certificate Electrical Engineering mandatory section are at level 7 except for two, the Mathematics for Engineering 1: Electronic and Electrical Unit and the Application of Electrical and Electronic Instruments Unit, which are both at level 6. The Table shows that the number of SCQF level 7 units substantially exceeds the minimum of 48 SCQF credit points required to be in an SQA Advanced Certificate to satisfy the new SQA Advanced Design Principles.

From the outset of developments, the SQA Advanced Electrical Development Team recognised that the level of Mathematics achieved by the average candidate entering the current SQA Advanced Certificate in Engineering: Electrical award was around Intermediate 2 (Standard Grade Credit level) and there was a need to include a SCQF level 6 Mathematics Unit in the SQA Advanced Certificate] (and the first year of the SQA Advanced Diploma in Electrical Engineering) which consolidated candidates' existing

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knowledge and understanding of Mathematics particularly in the areas of transposing and solving equations and trigonometry, skills that are so important in the field of Electrical Engineering.

The Application of Electrical and Electronic Instruments Unit was originally levelled at SCQF level 7, but was relevelled at SCQF level 6 as a result of the validation process.

As noted above, the SQA Advanced Electrical Development Team has levelled the remaining units in the mandatory section of the SQA Advanced Certificate in Electrical Engineering at SCQF level 7. The SQA Advanced Electrical Development Team used as their benchmarks for levelling, the Highers in Electrical and Electronic Engineering and various NQ Electronic and Electrical Engineering units and their knowledge of the content of existing degree courses in Electronic and Electrical Engineering.

It can be seen from Figure 5.6.2 that the minimum number of SCQF level 8 units a candidate has to take in the SQA Advanced Diploma in Electrical Engineering is 64 SCQF credit points which meets the minimum requirement of 64 SCQF credit points as stated in the SQA Advanced Design Principles. However, it is anticipated that most candidates will undertake some optional units at level 8 which will mean that they will comfortably exceed this minimum requirement. The case for the two level 6 units in the SQA Advanced Diploma in Electrical Engineering has already been presented above. A number of the SCQF level 8 units in the SQA Advanced Diploma follow on from corresponding level 7 units and are, therefore, appropriately levelled at SCQF level 8. The SQA Advanced Electrical Development Team also used their knowledge of existing second year degree courses to level units in the SQA Advanced Diploma in Electrical Engineering award.

Figure 5.6.1
Distribution of SCQF levels in the SQA Advanced Certificate in Electrical Engineering

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirements for level 7 units
16 SCQF c.p.	64 SCQF c.p.	0 SCQF c.p.	80	48 SCQF c.p.

c.p. = credit points

Figure 5.6.2
Distribution of SCQF levels in the SQA Advanced Diploma in Electrical Engineering

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirements for level 7 units
16 SCQF c.p.	104 SCQF c.p.	64 SCQF c.p.	184	64 SCQF c.p.

c.p. = credit points

6 Approaches to delivery and assessment

6.1 Content and context

Throughout the design and development of the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards the SQA Advanced Electrical Development Team has placed a high priority on producing awards that allow candidates to develop appropriate technical and practical skills. As indicated earlier, it is not possible to quantify such technical and practice skills in exact detail. However, the Development Team has taken the view that the best way to prepare candidates to meet the changing technical and practical requirements of the modern Electrical industry is to ensure candidates have a solid foundation of theory and practice upon which they can build new knowledge, understanding and skills. Thus, the mandatory section of the SQA Advanced Certificate in Electrical Engineering contains fundamental studies in Electrical Principles, Electrical Machines, Power Systems, Electrical Safety and Application of Instruments. The SQA Advanced Diploma in Electrical mandatory section builds on and extends these studies. The studies in Electrical Engineering are underpinned by the inclusion of a core Mathematics Unit in the SQA Advanced Certificate and two core Mathematics units in the SQA Advanced Diploma. The SQA Advanced in Electrical Development Team believes that a good grasp of mathematics is essential to the understanding of Electrical Engineering.

The optional sections of both the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering provide candidates with the opportunity to specialise in technical and/or non-technical subjects. In line with normal good practice centres are encouraged to advise candidates to choose those options that best meet their future career and educational aspirations.

The SQA Advanced Electrical Development Team has also ensured that the two new awards contain opportunities for candidates to develop a range of related skills which would make the holder of the awards better prepared for employment and/or degree studies. For example, the Communication: Practical Skills Unit has been included within the mandatory sections of both SQA Advanced Certificate and SQA Advanced Diploma awards to provide candidates with the opportunity to develop their written and group discussion skills about complex vocational issues.

While a discrete Information Technology unit is no longer included within the SQA Advanced Certificate mandatory section centres will still have the opportunity to access such a unit via the optional section of the SQA Advanced Certificate (Information Technology: Applications Software 1). Even where centres choose not to select this unit from the optional section there are a number of opportunities to develop Information Technology knowledge and skills within individual units. The Information Technology: Applications Software 1 unit has been included within the core of the SQA Advanced Diploma to allow centres to concentrate on business applications, such as word processing, spreadsheets, databases, or engineering specific applications or a combination of the two.

A new type of Business Studies unit, entitled Business Awareness and Continuing Professional Development, has been included within the mandatory section of the SQA

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Advanced Diploma in Electrical Engineering. This unit focuses on two areas which the SQA Advanced Electrical Development Team considered important to working in the modern electrical industry: namely the external and internal factors that affect business performance and the need for continuing learning and development if candidates are to have sustainable and rewarding employment in the future.

6.2 Delivery

The new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards can be delivered on a full-time, block-release, part-time day or part-time evening basis.

In timetabling the two new awards, centre staff should take account of information contained in the recommended prior knowledge and skills statement in unit specifications in sequencing the delivery of units. For example, the Single Phase AC Circuits unit would normally be delivered before the Electrical Networks and Resonance. Examples of a full-time SQA Advanced Certificate in Electrical Engineering and 2nd Year SQA Advanced Diploma in Electrical Engineering timetables are shown in Appendix 1.

One of the key reasons the SQA Advanced Electrical Development Team has sought to reduce the time candidates have to spend on summative unit assessment is to provide lecturers with more time to deliver units. Lecturers are encouraged, in particular, to use this additional time to reinforce learning in core electrical principles and technologies and enhance the development of candidates' practical electrical skills.

Lecturers may use a variety of teaching and learning approaches in delivering the units in the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate software packages), project work and case studies. The use of open and distance learning and online materials may help to supplement and support the learning that takes place in the classroom, laboratory or workshop.

Industrial visits are encouraged wherever possible to provide 'real life' industrial examples of the application of the theory and practice learned in the classroom, laboratory or workshop.

The SQA Advanced Electrical Development Team recognises the very important role computer simulation, such as electrical installation software, plays in the modern electrical industry. The Team would actively encourage the use of computer simulation wherever appropriate but not at the expense of candidates doing practical work. The Team believe it is very important that candidates get as much exposure as possible to practical electrical hand skills, the use of electrical and electronic test equipment and other practical electrical activities if they are to be suitably prepared to work in industry.

Lecturers should also seek opportunities to integrate Core Skills within their teaching and learning programmes. Such opportunities may include the following:

Communication

- ◆ Providing candidates opportunities to develop their oral skills by allowing them to give full answers to questions asked by the lecturer and by giving an oral presentation in the SQA Advanced Diploma in Electrical Engineering Graded Unit project
- ◆ Develop complex, vocationally specific reading skills (eg Electrical Safety, Industrial Plant Maintenance etc)
- ◆ Develop report writing skills in a number of units (eg Electrical Power Systems, Three Phase Induction Motors etc)
- ◆ Allowing candidates to develop their Communication skills in group work activities (eg Communication: Practical Skills, Electrical Safety)

Numeracy

- ◆ Reinforcing Numeracy and Mathematical skills when teaching electrical engineering topics (eg Electrical Machine Principles, Electrical Networks and Resonance, Synchronous Machines etc)
- ◆ Reinforcing Using Graphical information skills by use of a range of graphical representations (eg Power Electronics, Fundamentals of Control Systems and Transducers etc)

Information Technology

- ◆ Develop Information Technology skills through the application of IT within an Electrical Engineering context (eg Control Systems Behaviour, Electrical Installation Design: Computer Aided etc)

Problem Solving Skills

- ◆ Develop Critical Thinking Skills through the application of electrical engineering principles and technologies to solve electrical engineering problems
- ◆ Develop Planning and Organisational skills (eg Utilisation of Electrical Energy in Buildings, Industrial Plant Maintenance etc)
- ◆ Develop reviewing and evaluation skills through, for example, the review and evaluation of the Outcomes of assignments and project work (eg Applications of Power Electronics in Electrical Motor Drive Systems, Electrical Standby Systems etc)

Working with Others

- ◆ Develop Working with Others skills through group discussion on the solution to electrical engineering problems (eg Electrical Safety — role play scenario: eg issuing a Permit to Work, identifying risk factors) and laboratory and project work (eg Analogue Electronics: An Introduction, Digital Electronics etc)

6.3 Assessment

From the outset of developments the SQA Advanced Electrical Development Team recognised the need to have an appropriate assessment strategy in place for the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards. Such a strategy was developed and is shown below:

Aims

To ensure that:

- (1) consistent, rigorous and efficient approaches are adopted to the development and administration of SQA Advanced Electrical Engineering assessment instruments at both Unit and Graded Unit levels, which satisfy nationally agreed standards
- (2) the assessment load on candidates and staff is sensible and that assessment does not unduly detract from teaching and learning
- (3) as far as possible reliable and rigorous moderation processes are put in place in order to ensure that consistent national standards are achieved for all SQA Advanced Electrical Engineering assessments

Objectives

Listed below are the measures that have been put in place to meet the aims:

- (1) Develop nationally at least one assessment exemplar pack for each mandatory unit, which clearly sets out the standards of assessment expected in the unit.
- (2) Adopt a holistic approach to unit assessment. The implications of this are as follows:
 - (i) Assessment instruments will normally be designed only to sample knowledge and skills in a unit (this is consistent with the new SQA Advanced Unit format).
 - (ii) A unit assessment strategy will be adopted, where possible, to produce a single assessment instrument for the whole unit. Where this is not possible the assessment strategy will seek to ensure that the minimum number of assessment instruments required are consistent with maintaining agreed national standards.
- (3) While not seeking to be entirely prescriptive with regard to the time spent on assessment in each SQA Advanced Unit, over assessment should be avoided. Assessment times are clearly stated in the individual unit specifications.
- (4) Produce assessment exemplar packs for the two Graded Units. For the Graded Unit examination produce at least one sample exam paper to show the standards expected in such a paper. Likewise, for the 2 Credit Graded Unit Electrical Engineering Project produce a set of materials which clearly set out the standards of candidate response required to achieve a Grade A and a Grade C.
- (5) Actively encourage centres to work in partnership in producing Graded Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual colleges.

- (6) Ensure that consistent and rigorous internal and external moderation procedures operate through both SQA Advanced Unit level and Integrative Assessment processes. This places a clear responsibility on both centres and the SQA.

As far as has been practical the above objectives have been adhered to when developing assessment exemplar and Graded Unit materials.

Assessment Loading Grid

An Assessment Loading Grid showing the type and duration of assessment in each unit is shown in Appendix 2. It is hoped that course planners will find this grid helpful in timetabling the two awards.

Assessment Exemplar Materials

Assessment exemplar packs are in the process of being produced for all mandatory units, and the Graded Units in the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards.

Graded Unit Assessment Exemplars

It is recommended that candidates do not sit the Graded Unit examination until the end of the SQA Advanced Certificate (1st Year of the SQA Advanced Diploma) given the range of units that it draws from. It is recommended that, given the size and complexity of the project, that the Graded Unit project is started at the beginning of the second year of the SQA Advanced Diploma.

Formative Assessment

Formative assessment should be used throughout the delivery of units to reinforce learning, build candidates' confidence and prepare candidates for summative assessment.

6.4 Re-assessment

The way in which centres reassess candidates is integral to the way they manage the award assessment process as a whole. Re-assessment should be subject to rigorous internal moderation in exactly the same way as assessment is.

Candidates may require to be reassessed on only a part of an assessment where their evidence has been generated over a period of time and/or a discrete part of the unit, such as an Outcome, has been assessed originally. On other occasions it may not be possible to reassess candidates on parts of their performance which are unsatisfactory. Situations where candidates may have to re-do a whole assessment include:

- ◆ assessments which test knowledge and understanding and where it may not be possible to extract some of the items for re-assessment purposes
- ◆ where parts of several Outcomes are involved

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- ◆ where a project has been designed as an integral assessment and where there is requirement to complete the project as a single complex task

Re-assessment Opportunities

Re-assessment should operate in accordance with a centre's assessment policy and the professional judgement of the assessor. SQA advises that there should normally be one, or in exceptional circumstances two, re-assessment opportunities. Please refer to SQA's *Guide to Assessment and Quality Assurance for Colleges of Further Education, August 2003 revisions*.

Developing Alternative Assessments

The design of original assessments should inform the re-assessment process to a large extent, as the original determines the type of assessment instruments used and the purpose of the assessment. It is normal practice for centres to build up a bank of assessments which can be used in whole or in part for re-assessment purposes.

Assessment writers should always refer to the unit specification when developing an alternative assessment to ensure that it is of equal demand to the original assessment and that it covers all the necessary criteria. Where candidates have not provided satisfactory evidence for knowledge and/or skills items which have been sampled, they should be reassessed on a different sample.

Re-assessing SQA Advanced Graded Units

Re-assessment of the Electrical Engineering: Graded Unit 1 should be based on an alternative examination paper. Re-assessment of Electrical Engineering: Graded Unit 2 should normally entail a candidate undertaking a completely new project. Where a candidate marginally fails the Electrical Engineering: Graded Unit 2 the centre may wish to reassess her/him on that part(s) of the performance which was unsatisfactory. Such re-assessment would be at the discretion of the centre and should be subject to rigorous internal moderation.

7 General information for centres

7.1 Equality and inclusion

The unit specifications making up this group award have been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners will be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website
www.sqa.org.uk/assessmentarrangements.

7.2 Internal and external verification

All instruments of assessment used within these group awards should be internally verified using the appropriate policy within the centre and the guidelines set by SQA.

External verification will be carried out by SQA to ensure that internal assessment is within the national guidelines for these qualifications.

Further information on internal and external verification can be found in *SQA's Guide to Assessment* (www.sqa.org.uk).

7.3 Assessment moderation

All assessment instruments used within the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards should be internally moderated, including assessment exemplar materials, using appropriate policies within the centre and guidelines provided by SQA. This will ensure the validity and reliability of the instruments of assessment used within the centre.

External moderation will be carried out by SQA to ensure that internal assessment is within the national guidelines for these qualifications.

For further information on internal and external moderation refer to the *SQA Guide to Assessment and Quality Assurance for Colleges of Further Education*, August 2003 revision.

7.4 Open and Distance Learning

Advice on the use of open and distance learning is given in individual unit specifications. However, where it is used with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that the assessment or assessments were conducted under the conditions specified in the unit specification. For example, in the case of a unit which involved a unit end test a centre would have to make arrangements for the test to be conducted under

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controlled, supervised conditions. Likewise, where a unit involves a practical based assessment, a centre would have to make arrangements for candidates to come into the centre to undertake the assessment under the conditions specified in the unit specification.

It should be noted that the same requirements as specified in the previous paragraph apply where part or all of a unit is delivered online.

7.5 General information for candidates

The new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards have been designed by an expert team of educators and industrialists with a view to allowing you to meet the educational requirements to work as an electrical incorporated engineer. The two new qualifications contain up-to-date and relevant electrical subject content and skills and have also been designed to satisfy the new SQA Higher National Design Principles.

The SQA Advanced Electrical Development Team has designed the two new awards so that you will have opportunities to learn and understand the core principles and technologies that underpin Electrical Engineering. Learning these will be essential in providing you with a platform for tackling many electrical tasks and in allowing you to develop a more in-depth knowledge of Electrical Engineering. At the same time studying the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards will provide you with opportunities to develop sound practical electrical investigation, construction, testing and project skills which are critical to being a good electrical technician and/or incorporated engineer.

As well as studying Electrical subjects you will also take Communication with an option to do Information Technology as part of the SQA Advanced Certificate. Good Communication skills are essential to understanding technical material, and when communicating with others whether on an individual basis or when working as part of a team. Information Technology underpins much of the work in Electrical Engineering whether this is through computer simulation of electrical and electronic circuits or systems or in preparing a written report on the work you have been involved in.

Opportunities to develop Information Technology knowledge and skills are available in a number of units in the SQA Advanced Certificate, but an optional unit on Information Technology Applications is also available if you wish to consolidate your skills in this area.

The Communication and Information Technology units are mandatory within the SQA Advanced Diploma in Electrical Engineering award although you will not need to study these units if you have already done so as part of the SQA Advanced Certificate. There is an additional mandatory core unit in the SQA Advanced Diploma in Electrical Engineering award entitled Business Awareness and Continuing Professional Development. This unit will provide you with an awareness of the business pressures on modern electrical companies and what strategies they are adopting to meet these pressures. The unit will also provide you with the opportunity to develop your own career and education action plan for the next five years or so.

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As already mentioned Electrical Engineering is very much about learning and understanding core principles and technologies while also doing practical work such as constructing and testing circuits and project work. Thus, while taking the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical electrical and electronics work, inspection and testing, computer simulation of circuits and installations and project work.

The Electrical Development Team has ensured that assessments in the two awards meet national standards. The two awards have been designed to optimise assessment so that sufficient time is available for you to learn the electrical principles and technologies and the practical skills that are essential to being a good electrical technician and incorporated engineer.

You can expect to do assessment at individual unit level and at qualification level. At unit level, assessment will consist of some form of written end test, or a combination of short written test and practical exercise or a purely practical exercise. Your lecturer should tell you at the start of the unit what form the unit assessment will take. In addition, to unit tests there will also be a 3-hour examination at SQA Advanced Certificate level and a 2-credit project at SQA Advanced Diploma level. Both these assessments have been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learned in the two awards as a whole.

The SQA Advanced Electrical Development Team does not wish to place any artificial barriers in the way of potential candidates wanting to study the two awards. However, it would be unfair to enrol a candidate into the SQA Advanced Certificate and SQA Advanced Diploma who did not have a realistic chance of successfully achieving either or both awards. The SQA Advanced Electrical Development Team would therefore recommend that a candidate had one of the following qualifications before entering the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering:

- (1) One Higher from Physics, Technological Studies or Higher Mathematics and at least three Standard Grades 1-2/Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- (2) A National Certificate in Electrical Engineering or Electronic Engineering.
- (3) Equivalent qualifications or experience to those shown in (1) and (2).

An SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering award no longer satisfies the full academic requirements to become an incorporated engineer (a degree is now required). However, the new SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards provide a very solid platform for candidates to proceed to the advanced stages of a degree programme in Electrical Engineering. Ask your lecturer about progression arrangements your college has with any universities.

7.6 Relationship to other awards

An SQA Advanced Certificate and SQA Advanced Diploma in Electronics were validated in 2004. Since a number of units are common between SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering and Electronics awards candidates will have opportunities to transfer a significant number of units between the various awards. More limited opportunities will exist for candidates to transfer units between the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and awards in Mechanical Engineering, Manufacturing Systems, Mechatronics, General Engineering and Fabrication and Welding and vice versa.

7.7 Articulation arrangements

All the universities in Scotland were contacted regarding possible articulation routes between the SQA Advanced Certificate and SQA Advanced Diploma in Electrical Engineering awards and degree courses offered by the universities. In general terms, universities indicated that they will allow candidates with an SQA Advanced Certificate to enter the first year of their electrical engineering (or related engineering) degree programmes. Candidates with an SQA Advanced Diploma will normally be allowed to enter the second year of a degree programme provided they have the unit, Mathematics for Engineering 3.

8 Glossary of terms

Embedded Core Skills: The assessment evidence for the unit also includes full evidence for complete Core Skill or Core Skill components. A learner successfully completing the unit will be automatically certificated for the Core Skill. (This depends on the unit having been successfully audited and validated for Core Skills certification.)

Finish date: The end of a group award's lapsing period is known as the finish date. After the finish date, the group award will no longer be live and the following applies:

- ◆ Candidates may not be entered for the group award.
- ◆ The group award will continue to exist only as an archive record on the Awards Processing System (APS).

Graded unit: Graded units assess learners' ability to integrate what they have learned while working towards the units of the group award. Their purpose is to add value to the group award, making it more than the sum of its parts, and to encourage learners to retain and adapt their skills and knowledge. **(Note to writer: delete if not applicable to product type).**

Lapsing date: When a group award is entered into its lapsing period, the following will apply:

- ◆ The group award will be deleted from the relevant catalogue.
- ◆ The group award specification will remain until the qualification reaches its finish date, at which point it will be removed from SQA's website and archived.

SQA Advanced Certificate and Diploma in Electrical Engineering

- ◆ No new centres may be approved to offer the group award.
- ◆ Centres should only enter candidates whom they expect to complete the group award during the defined lapsing period.

SQA credit value: The credit value allocated to a unit gives an indication of the contribution the unit makes to an SQA group award. An SQA credit value of 1 given to an SQA unit represents approximately 40 hours of programmed learning, teaching, and assessment.

SCQF: The Scottish Credit and Qualification Framework (SCQF) provides the national common framework for describing all relevant programmes of learning and qualifications in Scotland. SCQF terminology is used throughout this guide to refer to credits and levels. For further information on the SCQF, visit the SCQF website at www.scqf.org.uk.

SCQF credit points: SCQF credit points provide a means of describing and comparing the amount of learning that is required to complete a qualification at a given level of the framework. One National Unit credit is equivalent to 6 SCQF credit points. One National Unit credit at Advanced Higher and one SQA Advanced Unit credit (irrespective of level) is equivalent to 8 SCQF credit points.

SCQF levels: The level a qualification assigned within the framework is an indication of how hard it is to achieve. The SCQF covers 12 levels of learning. SQA Advanced Certificates and SQA Advanced Diplomas are available at SCQF levels 7 and 8, respectively. SQA Advanced units will normally be at levels 6–9 and graded units will be at level 7 and 8. National Qualification Group Awards are available at SCQF levels 2–6 and will normally be made up of National Units which are available from SCQF levels 2–7.

Subject unit: These contain vocational/subject content and are designed to test a specific set of knowledge and skills.

Signposted Core Skills: These refer to opportunities to develop Core Skills in learning and teaching, but are not automatically certificated.

9 History of changes

It is anticipated that changes will take place during the life of the qualification, and this section will record these changes. This document is the latest version and incorporates the changes summarised below. Centres are advised to check SQA Connect to confirm that they are using the most up-to-date qualification structure.

NOTE: Where a unit is revised by another unit:

- ◆ No new centres may be approved to offer the unit which has been revised.
- ◆ Centres should only enter candidates for the unit which has been revised where they are expected to complete the unit before its finish date.

Version number	Description	Date

Acknowledgements

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

Further information

Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#)

Appendix 1: SQA Advanced Certificate and SQA Advanced Diploma Timetables

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Certificate: Guidelines for the delivery of mandatory units

(Also Year 1 of the SQA Advanced Diploma Award)

Centre Year	Block 1	Block 2	Block 3	Block 4
Unit Title				
Communication: Practical Skills				
Single Phase AC Circuits OR DC and AC Principles				
Three Phase Systems				
Electricity Power Systems				
Electrical Machine Principles				
Electrical Safety				
Mathematics for Engineering 1: Electronics and Electrical				
Application of Electrical and Electronic Instruments				
Electronic Instruments				
Electrical Engineering: Graded Unit 1				
Option 1				
Option 2				

It is recognised that timetabling in a four block system is not done by every centre. The above grid is therefore only a guide indicating the order of delivery of units.

The SQA Advanced Certificate units will normally make up the first year of the SQA Advanced Diploma timetable.

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Certificate: Guidelines for the delivery of mandatory units

(Year 2 of the SQA Advanced Diploma Award)

Centre Year	Block 1	Block 2	Block 3	Block 4
Unit Title				
IT: Applications Software				
Business Awareness and CPD				
Electrical Networks and Resonance				
Power Electronics				
Fundamentals of Control Systems and Transducers				
Mathematics for Engineering 2				
Transmission Lines and Complex Waves				
Electrical Installation Design				
Electrical Motor Drive Systems				
Transformers				
Utilisation of Electrical Energy in Buildings				

As with the previous SQA Advanced Certificate grid, it is recognised that timetabling in a four block system is not done by every centre. The above grid is therefore only a guide indicating the order of delivery of units.

Centres may wish to spread the delivery of units over more than one block which would allow more units to be delivered in parallel.

Whichever delivery arrangement is used, it is important to complete the delivery of **ALL** the SQA Advanced Diploma units over the two years of a full-time programme.

Appendix 2: Assessment Loading Grid

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Certificate/SQA Advanced Diploma in Electrical Engineering Group Award

Summary Assessment Loading: SQA Advanced Certificate in Electrical Engineering mandatory units

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HP4A 47	Communication: Practical Skills	Summary/Evaluation Assignment	---	Business Document Assignment	---	Spoken Communication Assignment	---
HP48 46	Mathematics for Engineering 1: Electronics and Electrical	Written Question Paper	1 hour 40 mins				
HP46 47	DC and AC Principles	Written Question Paper	1 hour 30 mins				
HT7K 47	Three Phase Systems	Written Question Paper	2 hours				
HV3L 47	Electricity Power Systems	Industrial Assignment	---	Written Question Paper	1 hour 30 mins		
HT83 47	Electrical Machine Principles	Written Question Paper	2 hours	Written Question Paper	2 hours		
HV3A 47	Electrical Safety	Written Question Paper	1 hour 30 mins	Permit to work Assignment	---		
HV2H 46	Application of Electrical and Electronic Instruments	Written Question Paper	1 hour	Practical Assignment & Report	6 hours		
HV4C 47	Electrical Engineering: Graded Unit 1	Examination (1 credit)	3 hours				

SQA Advanced Certificate and Diploma in Electrical Engineering

Mandatory Section Assessment Summary:

Eight Written Question Papers (Total assessment time = 13 hours 10 mins) + Graded Unit 1 (Total assessment time = 3 hours) + six assignments: SQA Advanced Certificate in Electrical Engineering optional units

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HP3J 47	Electrical Networks and Resonance	Written Question Paper	1 hour 30 mins				
HP6L 47	Information Technology: Applications Software 1	Project/Case Study Assignment					
HT1W 47	Power Electronics	Written Question Paper	1 hour 30 mins	Laboratory exercise	1 hour 30 mins		
HV2L 47	Inspection and Testing of Low Voltage Electrical Installations	Written Question Paper	1 hour 30 mins	Practical Testing and Certification Assignment	---		
HT1K 47	Application of Programmable Logic Controllers	Written Question Paper	1 hour 30 mins	PLC Simulated Assignment	---		
HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments	Written Question Paper	1 hour	Written Question Paper	1 hour		
HT1R 47	Fundamentals of Control Systems and Transducers	Written Question Paper	2 hours	Laboratory exercise	2 hours		
HP49 47	Mathematics for Engineering 2	Written Question Paper	1 hour 30 mins				
HV3M 47	Electrical Installation Skills	Identification/ Application Assignment	---	Practical Assignment	---	Practical Assignment	---
HT7A 47	Quality Management: An Introduction	Written Question Paper	1 hour	Case Study Assignment	---	Case Study Assignment	1 hour
HV3G 48	Three Phase Induction Motors	Written Question Paper	2 hours	Assignment Report	---		

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Diploma in Electrical Engineering mandatory units

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HP4A 47	Communication: Practical Skills	Summary/Evaluation Assignment	---	Business Document Assignment	---	Spoken Communication Assignment	---
HP6L 47	Information Technology: Applications Software 1	Project/Case Study Assignment	---				
HP3H 48	Business Awareness and Continuing Professional Development	Case Study Assignment	---	CPD Action Plan Assignment	---		
HP48 46	Mathematics for Engineering 1: Electronics and Electrical	Written Question Paper	1 hour 40 mins				
HP46 47	DC and AC Principles	Written Question Paper	1 hour 30 mins				
HT7K 47	Three Phase Systems	Written Question Paper	2 hours				
HV3L 47	Electricity Power Systems	Industrial Assignment	---	Written Question Paper	1 hour 30 mins		
HT83 47	Electrical Machine Principles	Written Question Paper	2 hours	Written Question Paper	2 hours		
HV3A 47	Electrical Safety	Written Question Paper	1 hour 30mins	Permit to work Assignment	---		
HV2H 46	Application of Electrical and Electronic Instruments	Written Question Paper	1 hour	Practical Assignment and Report	6 hours		
HP3J 47	Electrical Networks and Resonance	Written Question Paper	1 hour 30 mins				

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Diploma in Electrical Engineering mandatory units (continued)

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HT1W 47	Power Electronics	Written Question Paper	1 hour 30 mins	Laboratory exercise	1 hour 30 mins		
HT1R 47	Fundamentals of Control Systems and Transducers	Written Question Paper	2 hours	Laboratory Exercise	2 hours		
HP49 47	Mathematics for Engineering 2	Written Question Paper	1 hour 30 mins				
HT1H 48	Transmission Lines and Complex Waves	Written Question Paper	2 hours				
HV5X 48	Electrical Installation Design	Written Question Paper	2 hours	Project-based Assignment	---		
HT7M 48	Electrical Motor Drive Systems	Written Question Paper	2 hours	Investigation Assignment	---		
HV4X 48	Transformers	Written Question Paper	2 hours	Laboratory/Case Study Investigation Assignment	1 hour		
HV4Y 48	Utilisation of Electrical Energy in Buildings	Design Scheme Assignment	---	Design Scheme Assignment	---	Design Scheme Assignment	---
HV4C 47	Electrical Engineering: Graded Unit 1	Examination (1 credit)	3 hours				
J1RC 48	Electrical Engineering: Graded Unit 2	Project (2 credits)	---	---	---	---	---

Mandatory Section Assessment Summary:

- 16 Written Question Papers (Total assessment time = 27 hours 40 mins)
- + Graded Unit 1 (Total assessment time 3 hours)
- + 17 Assignments
- + Graded Unit 2 (2 credit project)

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Diploma in Electrical Engineering optional units

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HV2L 47	Inspection and Testing of Low Voltage Electrical Installations	Written Question Paper	1 hour 30 mins	Practical Testing and Certification Assignment	---		
HT1K 47	Application of Programmable Logic Controllers	Written Question Paper	1 hour 30mins	PLC Simulated Assignment	---		
HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments	Written Question Paper	1 hour	Written Question Paper	1 hour		
HT7J 46	Analogue Electronics: An Introduction	Written Question Paper	1 hour 30 mins	Practical Assignment	2 hours 30 mins		
HT7L 47	Digital Electronics	Written Question Paper	2 hours	Practical Assignment	2 hours		
HT7A 47	Quality Management: An Introduction	Written Question Paper	1 hour	Case Study Assignment	---	Case Study Assignment	1 hour
HV3M 47	Electrical Installation Skills	Identification/ Application Assignment	---	Practical Assignment	---	Practical Assignment	---
HV2K 47	Industrial Plant Maintenance	Written Question Paper	1 hour 30 mins	Maintenance Plan Assignment	---		
HP41 47	High Level Engineering Software	Log/Portfolio Assignments	---				
HR1D 47	Employment Experience 2	Portfolio Assignments	---				

SQA Advanced Certificate and Diploma in Electrical Engineering

SQA Advanced Diploma in Electrical Engineering optional units (continued)

Product Code	Product title	Assessment 1		Assessment 2		Assessment 3	
		Type	Time	Type	Time	Type	Time
HV51 48	Control Systems Behaviour	Written Question Paper	1 hour	Simulated Control Assignment	6 hours		
HT1E 48	Mathematics for Engineering 3	Written Question Paper	2 hours 30 mins				
HP3T 48	Power Supply Circuits	Written Question Paper	1 hour 30 mins	Practical Assignment	---		
HV4V 48	Switchgear and Protection of High Voltage Systems	Written Question Paper	2 hours	Assignment Report	---		
HV50 48	Applications of Power Electronics in Electrical Motor Drive Systems	Written Question Paper	1 hour 30 mins	Assignment Report	---		
HV3G 48	Three Phase Induction Motors	Written Question Paper	2 hours	Assignment Report	---		
HV4W 48	Synchronous Machines	Written Question Paper	2 hours				
HV53 48	Electrical Standby Systems	Written Question Paper	2 hours				
HV52 48	Electrical Installation Design: Computer Aided	Design Assignment	---				