-SQA-SCOTTISH QUALIFICATIONS AUTHORITY

HIGHER NATIONAL UNIT SPECIFICATION

GENERAL INFORMATION

-Unit Number- **2550887**

-Superclass- **XA**

-Title- **ENGINEERING PROJECT**

-DESCRIPTION-

GENERAL COMPETENCE FOR UNIT: Completing a project involving the integration and application of technological, organisational, communication and interpersonal skills.

OUTCOMES

1. plan the project;
2. implement the project safely within given parameters;
3. evaluate the project within given parameters;
4. present project information.

CREDIT VALUE: 2 HN Credits

ACCESS STATEMENT: Access to this unit is at the discretion of the centre. However, it is essential that the candidate has sufficient competence in the main technology required by the Project to meet its objectives. Similarly candidates should have competence in personal organisation, communications and customer awareness.

For further information contact: Committee and Administration Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ.

Additional copies of this unit may be purchased from SQA (Sales and Despatch section). At the time of publication, the cost is £1.50 (minimum order £5.00).

HIGHER NATIONAL UNIT SPECIFICATION

STATEMENT OF STANDARDS

UNIT NUMBER: 2550887

UNIT TITLE: ENGINEERING PROJECT

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME

1. PLAN THE PROJECT

PERFORMANCE CRITERIA

(a) The customer's needs in terms of a brief and specification are clearly identified.
(b) A list of objectives is complete and in keeping with the customer's requirements.
(c) A schedule for the progression of the project is realistic and appropriate relative to known restraints.

RANGE STATEMENT

Customer's needs: technical requirements; cost; time restraints; statutory regulations.

Known restraints: time; cost; facilities available.

EVIDENCE REQUIREMENTS

Written evidence, in the form of a brief, specifications, cost estimate and list of objectives should be provided, as specified in performance criteria (a) to (c). Graphical evidence is required to show that the candidate can plan the project, as specified in performance criterion (c).

OUTCOME

2. IMPLEMENT THE PROJECT SAFELY WITHIN GIVEN PARAMETERS

PERFORMANCE CRITERIA

(a) An optimum solution is selected following an investigation of a range of systems which may meet the customer's needs.
(b) The chosen option is implemented to meet the needs of the customer.
(c) Progress reports to the project supervisor are clearly made at appropriate times and the resulting supervisor's feedback is recorded and acted upon.

RANGE STATEMENT

The range for this outcome is fully expressed in the performance criteria.

EVIDENCE REQUIREMENTS

Written evidence is required of the investigation, the implemented option in its finished form, at least five log book entries recording progress reports and the outcomes of the supervisor's recommendations.

OUTCOME

3. EVALUATE THE PROJECT WITHIN GIVEN PARAMETERS

PERFORMANCE CRITERIA

(a) A verification strategy is proposed which is appropriate to the implemented solution.
(b) The proposed verification is correctly conducted and its results are accurately recorded.
(c) The interpretation of the results is correct.
(d) Appropriate actions are taken in accordance with the results.

RANGE STATEMENT

The range for this outcome is fully expressed in the performance criteria.

EVIDENCE REQUIREMENTS

A written verification strategy, a record of the results with their interpretation and associated actions.

OUTCOME

4. PRESENT PROJECT INFORMATION

PERFORMANCE CRITERIA

(a) A written log is consistently maintained as a progress record of the project activities.
(b) A clear, concise and coherent written report is prepared to an agreed standard.
(c) A short oral presentation of the project to peer group and supervisors is clear and concise.

RANGE STATEMENT

Agreed standard: title page; summary; contents; introduction; technical description; project organisation description; conclusions; acknowledgments; appendices.

EVIDENCE REQUIREMENTS

Written evidence in the form of a log and a report. A supervisor's checklist should be provided for the oral presentation.

MERIT To gain a pass in this unit, a candidate must meet the standards set out in the outcomes, performance criteria, range statements and evidence requirements.

To achieve a merit in this unit, a candidate must demonstrate a superior or more sophisticated level of performance. This may be demonstrated by:

(i) applying innovative solutions or methods;
(ii) self motivation;
(iii) research outwith the normal course content.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

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HIGHER NATIONAL UNIT SPECIFICATION

SUPPORT NOTES

UNIT NUMBER: 2550887

UNIT TITLE: ENGINEERING PROJECT

SUPPORT NOTES: This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH: SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 80 hours. The use of notional design length for programme design and timetabling is advisory only.

PURPOSE This is an integrative unit designed to be part of the core units for HNC/HND Engineering programmes. Candidates taking the unit are given an opportunity to demonstrate competence in their chosen technology, its application in a practical context, project organisation and communications. It meets Engineering Council requirements and is strongly supported by both teaching and practising engineers as a method of training and assessing engineering candidates.

CONTENT/CONTEXT It is intended that project competence is demonstrated by applying a combination of individual competencies to create a product or explore a technical problem within the framework of customer needs and supervisory demands.

In the interests of motivation a project topic should be selected which allows the candidate to develop competence in their chosen technical area. This generally means that candidates in employment should be encouraged to seek a project topic directly related to their work with the approval of their immediate superior. College based candidates should be directed towards project topics which will either allow them to pursue specific competencies which they wish to develop or a technical topic which is of special interest. In the latter situation it is generally useful to build up a portfolio of suitable project topics with associated support material from which candidates make a selection.

Both individual and group projects may be considered. In the context of a group project care must be taken to identify clearly the individual contributions made by each participant. Each candidate within the group must produce a full set of evidence to meet the criteria of the unit.

A wide range of project categories are suitable for this unit, including but not constrained to the following:

Category	Description
Design, make and test	A new product is created by the candidate, manufactured, tested and modified until functional.
Modify and test	An existing product, process or system is modified and tested until functional.
Research and analyse (new for old)	A product, process or system is researched and analysed. The analysis is approached from a variety of directions to test its integrity.
Design and Evaluate	A product is designed and the design is evaluated without it being implemented.

Projects should be conducted with safety as a prominent feature. The candidate should be required to demonstrate safe working practices, identify the relevant safety legislation, comment on both and be proactive in the pursuit of lifelong safety attitudes.

In a similar manner to statutory safety regulations projects may be subject to non-statutory regulations. Due regard must be taken of this during the project and the candidate's awareness of the implications of the non-statutory regulations should be a feature of the project's context.

Outcome 1

The work required to overtake this outcome must take place at the outset of the project to allow both the supervisor and the candidate to clarify the project and assess its suitability. This process must give due consideration to the candidate's abilities, the resources available and the time allocated.

Candidates should be discouraged from proceeding beyond the early project stages without completing a brief, initial specification and an initial plan. The specification and plan will inevitably be the subject of further development as the project matures and should reflect this in the final report.

Outcomes 2 and 3

The work of these outcomes must be conducted with safety clearly evident.

The candidate should be encouraged to be self motivating and the supervisor should only give help and support when required to ensure the satisfactory progression of the project.

Outcome 4

Candidates must maintain the log book throughout the project and so should be encouraged to commence it at the outset.

The oral presentation should be an adequate performance of technical content, verbal clarity, visual clarity, preparation and question handling.

APPROACHES TO GENERATING EVIDENCE The candidate must conduct a project activity which provides opportunities to generate evidence for the performance criteria. At the early planning stages the candidate should be made aware of the requirements of the unit specification in terms of the performance criteria and be reminded of them as the project progresses.

At the earliest possible stage in the project the candidate should start making entries in a log book on either a weekly basis or at every point when progress is to be recorded. The contents of the final report should also be considered from the outset and the candidate encouraged to collect material for it as the project matures.

Outcome 1

The work of this outcome may be developed through the presentation of material on the preparation of briefs, specifications and plans. Candidates should have encountered such items during their previous experiences but inevitably will require to be reminded of the main features of each. Tutorial examples may be helpful in developing the necessary competences but it is more likely that the candidate will wish to proceed directly with the project documents. The candidates should then be encouraged to individually prepare each document and discuss it with the supervisor. Comments from the supervisor to the candidate should result in improvements being made followed by further discussion with the supervisor and so on until a satisfactory outcome is achieved.

Outcome 2

This outcome relies on the implementation and evaluation of the project as a means of evidence generation. The plan can be used by the supervisor to motivate the candidate and to keep the project within reasonable bounds as it develops. There is no substitute for the candidate diligently working through the stages covered by the performance criteria. Similarly the log book and progress reports are powerful tools to help the supervisor to focus quickly on the current status and details of any one of several projects for which they are responsible at one time.

As the alternative systems which might meet customer's needs are explored they should be documented as future evidence for inclusion in the final report. Along with this should be recorded the rationale for the chosen option when this decision is made.

Outcome 3

In either class groups or individually the candidate should be advised of the requirements of a verification strategy. Teaching notes with examples can be provided for reference. They should then produce a documented strategy for discussion with the supervisor and modification until it is satisfactory. The implementation of the strategy and the resulting outcomes should be recorded along with their interpretation. The actions taken should also be noted and combined with the strategy, results and their interpretation to form a comprehensive section for inclusion in the report. It is also anticipated that parallel log book entries will be made recording progress.

Outcome 4

At the earliest possible stage in the project the candidate should start making entries in a log book on either a weekly basis or at every point when progress is to be recorded. Candidates should be asked to produce the log book at each meeting with the supervisor who should use it to monitor progress and identify actions undertaken as a result of feedback.

The written report has to conform to a suitable format. This can be easily taught to groups of candidates by presentation of an exemplar followed by a discussion of its essential features. Candidates should be encouraged to give thought to the report as soon as the brief, specification and plan have been created. This enables them to gather material for the report as they proceed and greatly eases the burden of report writing at the project's conclusion.

The oral presentation should not be the candidate's first attempt at such an activity since the teaching and practice of this should have occurred elsewhere prior to the project presentation. In some situations it may be useful to provide an opportunity for the candidates to practice presentation skill within a project group by encouraging them to give short talks on a topic of their choice.

ASSESSMENT PROCEDURES All the performance criteria for this unit should be assessed from the following:

- The final report
- The log book
- The oral presentation
- The product if appropriate or site visits supported by photographs

As the project develops the supervisor will have adequate opportunity to observe the candidate in action. This eases the task of assessment from the report at the conclusion since the supervisor will already be familiar with many aspects of the project. Only a supervisor who has been closely following the candidate's progress throughout the project's development is likely to be sufficiently well informed to make the necessary judgements.

EXEMPLARS The following projects would be considered as suitable for the unit:

Title	**Brief Description**
Static Inverter (College Based)	Overview A static inverter is required which will produce the equivalent of about 60 watts of electrical mains power from a 12 V car battery. Starting Information A sample circuit diagram and brief description of its operation. Main Activities Research the circuit's operation, research safety aspects, agree requirements with supervisor, modify design to suit available components and facilities, build and test a prototype, build and test a final version with suitable enclosure, complete report, talk and log book.

	Merit Example Design modification uses a new microchip whose functions the candidate has had to learn.
Gas Flow Sensor Upgrade (Industry Based)	Overview The flow sensor used to measure the volume of liquefied hydrocarbon gas being loaded into a tanker requires to be modernised. Starting Information A job sheet with details of the replacement sensor to be used, company safety manual and associated training, company procedures manual and training. Main Activities Research the technology of the new sensor, clarify all safety issues, plan the job, fit and commission the sensor, prove communications with control room, prove accurate operation, complete report, talk and log book. Merit Example The candidate conducted the installation and commissioning safely without intervention of the work supervisor who specifically commented on this aspect.
Conservation Village Street Lighting Upgrade (Local Authority Based)	Overview A conservation village requires new street lighting to be designed and installed as part of an upgrade stimulated by an increase in tourism. Starting Information A job sheet. Plans of the village, street lighting design requirements, specifications and regulations. Main Activities Research the regulations, research the conservation village planning requirements, prepare a new design, consult villagers and interested authorities, modify design, raise installation contracts, overview installation, resolve problems, test and commission lighting system, complete report, talk and log book. Merit Example The candidate performed the design calculations using traditional methods and then confirmed them using a new design package having had to learn to utilise the package without the help of others.
Motor Speed Control (College Based)	Overview A speed control is required for a universal motor. Starting Information A basic circuit diagram, no description of the circuit's operation. Main Activities Research the operation of the circuit, clarify safety requirements, modify the circuit to make use of locally available components, build and test a prototype, build and test a final version with printed circuit board and enclosure, complete report, talk and log book. Merit Example The candidate either finds another circuit or innovatively modifies the one provided.

Steam Generation Plant Upgrade (Industry Based) (cont)	Overview A factory raises steam using oil delivered in road tankers. The steam raising plant is to be upgraded to generate steam from mains gas. Starting Information The existing plant, specifications for the existing plant, designs for the new plant, installation plans. Main Activities Research the performance parameters of the existing plant, clarify the case for its replacement, planning of dismantling of old plant, site preparation, installation and commissioning of new plant, establish the performance parameters of the new plant, develop clear technical justifications for the main features of the new plant, establish a test strategy to prove the performance of the new plant and apply it, complete report, talk and log book. Merit Example The candidate demonstrates a deep understanding of the new plant and its technicalities having taken a special interest in it during its commissioning.
Upgrade of Machinery (Industry Based)	Overview A new production machine is required to replace old machines which have low output and high maintenance costs. This has become essential due to the application of new technology. Starting Information The existing machines, production demands, maintenance cost information. Main Activities Establish productivity of existing machines, research replacement machines, select suitable replacements, justify the selection, study training requirements, give examples of parts produced on the new machine, check safety requirements, clarify installation requirements, prepare a test strategy and pilot it with either the existing machines or the new one, complete report, talk and log book. Merit Example The candidate demonstrates an extensive knowledge of the new machine and its potential within the company's production processes.
Car Trailer Design (College Based)	Overview A car trailer is required to carry specified loads. Due consideration has to be given to the loading of the trailer, relevant regulations and safety. Starting Information A design brief giving loading figures, a budget and the timescale. Main Activities Research the relevant regulations, select and develop all parts of the trailer including suspension, wheel bearings, vehicle hitch, trailer body, brake system, electrical system, complete report, talk and log book. Merit Example The candidate finds a new type of suspension technique which becomes an innovative feature of the design.
A Comparison of Hyperbaric Welding Methods (Industry Based)	Overview A comparison of subsea welding methods for use on steel pipes is required. Starting Information Background information of welding processes, limited experience of techniques

	used in the North Sea, suggested sources of further information. Main Activities Research of Shielded Metal Arc Welding, Gas Tungsten Arc Welding and Mechanised Gas Tungsten Arc Welding processes. Study of non-destructive testing requirements and safety for underwater welding. Comparison and analysis of manual and automatic methods of welding. Complete report, talk and log book. Merit Example The candidate demonstrates self motivation and self education by the depth and extent of the information found during the project and by the precision of the subsequent analysis.
Comparison of Steel Plate Cutting Processes (College Based)	Overview A comparison is required of plasma arc and oxy-acetylene cutting processes. Starting Information Basic knowledge of the two processes. Main Activities Research plasma arc and oxy-acetylene cutting processes. Experiment with each process and analyse it in terms of ease of use, portability, skill factor, cutting speed, edge quality, edge hardness, width of kerf, environmental considerations, safety, capital costs and consumable costs. Complete report, talk and log book. Merit Example The candidate demonstrates self motivation and self education by the depth and extent of the information found during the project and by the precision of the subsequent analysis.

The following would not be considered suitable for the unit:

Title	**Brief Description**
Power Supply (College based - for an electronics candidate)	Overview A 5V dc power supply is required which delivers 1 Amp. Starting Information Circuit diagram of a bridge rectifier based power supply with minimal regulation and protection, description of operation, parts list, printed circuit board layout. Main Activities Understand the circuit's operation, build and test a prototype, manufacture a printed circuit board, build and test the final circuit on the printed circuit board, complete report, talk and log book. Reasons for being unsuitable Too much of a construction project, lacks basic design content, low technical level, too narrow.
Digital Guitar Tuner (College based project - for electronics candidate)	Overview A guitar tuner is required which digitises the sound from an acoustic guitar's string and indicates if it is above, below or on pitch. Starting Information String vibration frequency table, analogue to digital converter circuit diagram, bar graph display specification. Main Activities Modify the analogue to digital converter circuit to suit the output of a string amplifier,

	design a string sound pickup amplifier with filter, design a comparator system to enable the string signal to be compared with the desired frequency, interface the comparator circuit output to the bar graph display, build and test prototype circuits, build and test a prototype system, build and test a final system, construct an enclosure for the final system, fit and test the final system or in its enclosure, complete report, talk and log book. Reasons for being unsuitable Too large, too high a technical content, would take too long, demotivating for the candidate, expensive.
Steerable Solar Collector Dish (College based)	Overview A solar collector dish has to be designed and built which will track the sun, focus its rays onto heat sensors and store the resulting electrical energy for use at night. Starting Information Output power requirements, budget, timescales. Main Activities Research tracking angle requirements, investigate reflective surfaces, establish dish size and shape, work out manufacturing technique, decide on sensors to be used, design electronics of sensor and power storage system, design mechanical aspects of control system, design electronic aspects of control system, check wind loading on dish, perform torque and inertia calculations for system, build and test prototype mechanical system, build and test prototype electronic systems, build and test complete prototype system, design, build and test final system, complete report, talk and log book. Reasons for being unsuitable This would be better tackled as a team project involving mechanical and electronic engineering candidates. It is too large, has too high a technical content, would take too long and be demotivating for one candidate. Due to its complexity it could be very expensive and absorb large amounts of supervisory effort as the candidate struggled from one major technical challenge to the next.
Component Alignment System (Industry Based)	Overview A system is required to align small plastic parts prior to automatic assembly. Starting Information The type of parts, the throughput rate, timescales and a budget. Main Activities Research possible methods, evaluate them, review existing machines available, compare their feature and select the best for the job, complete report, talk and log book. Reasons for being unsuitable While there is some technical content, this is more of a market research activity than an Engineering Project. This situation would be improved if the candidate had to adapt either the new machine or the existing process and performed the adaptation as part of the project.
Non Destructive Testing	Overview A cylinder head casting which is allowing

for Castings (Industry Based)	water seepage into the cylinder cavity is to be inspected for cracks. Starting Information Basic understanding of non destructive testing techniques. Main Activities Research the principles of magnetic particle inspection and liquid penetration inspection. Critically appraise and compare both methods using the headings: application, advantages, disadvantages, preparation and safety. Complete report, talk and log book. Reasons for being unsuitable The technical research for this project can be conducted by reference to a few texts on the subject of NDT. The candidate does not have to demonstrate the two techniques by examining the casting. The project as a consequence has no practical content other than a text book search for information.

PROGRESSION This unit forms part of the core of units for HNC/HND Engineering programmes. Candidates who have successfully completed the unit may progress to gain an award of HNC/HND Engineering in their chosen discipline by undertaking an appropriate programme of units in keeping with the requirements of the Engineering Course Framework.

RECOGNITION Projects are a common component of many engineering qualifications and so the Engineering Project Unit may form part of a qualification other than a SQA HNC or HND in an engineering discipline.

Candidates who are using their Engineering Project for purposes additional to the requirements of the Unit Specification should clarify their needs with the relevant awarding body and their supervisor prior to project commencement. An example of this is the Case Study outlines contained in section 4.11 of the European Welding Federation's 1993 guidelines of the minimum requirements for the education, examination and qualification of European Welding Technologists.

REFERENCES

1. Guide to unit writing.
2. For a fuller discussion on assessment issues, please refer to SQA's Guide to Assessment.
3. Information for centres on SQA's operating procedures is contained in SQA's Guide to Procedures.
4. For details of other SQA publications, please consult SQA's publications list.
5. Guideline of the European Welding Federation prepared by the Committee for Education and Training. European Welding Technologist-Minimum Requires for the Education, Examination and Qualification. Doc. 01-410-92 Accepted by the EWF on 20.4.1993.

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