

End-point assessment plan for Power and Propulsion Gas Turbine Engineer apprenticeship standard

Apprenticeship standard number	Apprenticeship standard level	Integrated end-point assessment
ST0790	7	No

Contents

Introduction and overview	2
EPA summary table	3
Length of end-point assessment period	4
Order of assessment methods	4
Gateway	5
Assessment methods.....	6
Reasonable adjustments	12
Grading.....	13
Re-sits and re-takes.....	14
Roles and responsibilities	15
Internal Quality Assurance (IQA).....	17
Affordability.....	17
Professional body recognition	17
Mapping of knowledge, skills and behaviours (KSBs)	18

Introduction and overview

This document sets out the requirements for end-point assessment (EPA) for the Power and Propulsion Gas Turbine Engineer apprenticeship standard. It is for end-point assessment organisations (EPAOs) who need to know how EPA for this apprenticeship must operate. It will also be of interest to Power and Propulsion Gas Turbine Engineer apprentices, their employers and training providers.

Full time apprentices will typically spend 36 months on-programme (before the gateway) working towards the occupational standard, with a minimum of 20% off-the-job training. All apprentices must spend a minimum of 12 months on-programme.

The EPA period should only start, and the EPA be arranged, once the employer is satisfied that the apprentice is deemed to be consistently working at or above the level set out in the occupational standard, all of the pre-requisite gateway requirements for EPA have been met and can be evidenced to an EPAO.

For level 3 apprenticeships and above apprentices without English and mathematics at level 2 must achieve level 2 prior to taking their EPA.

The EPA must be completed within an EPA period lasting typically 5 months, after the EPA gateway.

The EPA consists of 2 discrete assessment methods.

The individual assessment methods will have the following grades:

Assessment method 1: Workbased Project comprising of project report, presentation and questioning

- Fail
- Pass
- Distinction

Assessment method 2: Professional Discussion supported by a portfolio of evidence

- Fail
- Pass
- Distinction

Performance in the EPA will determine the overall apprenticeship standard grade of:

- Fail
- Pass
- Distinction

EPA summary table

On-programme (typically 36 months)	Training to develop the occupation standard's knowledge, skills and behaviours (KSBs).
End-point assessment gateway	<ul style="list-style-type: none"> • Employer is satisfied the apprentice is consistently working at, or above, the level of the occupational standard. • English and mathematics Level 2 • EPAO, employer and apprentice agree the subject title and scope of the project to be used in assessment method 1, and ensure it allows sufficient opportunity for the apprentice to demonstrate the KSBs mapped to this assessment method <p>Apprentices must submit:</p> <ul style="list-style-type: none"> • Portfolio of evidence for professional discussion. This must be signed by the employer to confirm that this is the apprentice's own work.
End-point assessment (which will typically take 6 months)	<p>Assessment method 1: Workbased Project comprising of project report, presentation and questioning</p> <p>With the following grades:</p> <ul style="list-style-type: none"> · Fail · Pass · Distinction <p>Assessment method 2: Professional Discussion supported by a portfolio of evidence</p> <p>With the following grades:</p> <ul style="list-style-type: none"> · Fail · Pass · Distinction
Professional recognition	<p>Aligns with recognition by:</p> <ul style="list-style-type: none"> • Royal Aeronautical Society • Institution of Power Engineers

Length of end-point assessment period

The EPA will be completed within an EPA period lasting typically of 5 months, after the EPA gateway.

Order of assessment methods

The assessment methods can be delivered in any order.

Gateway

The EPA period should only start once the employer is satisfied that the apprentice is consistently working at or above the level set out in the occupational standard, that is to say they are deemed to have achieved occupational competence. In making this decision, the employer may take advice from the apprentice's training provider(s), but the decision must ultimately be made solely by the employer.

For Workbased Project comprising of project report, presentation and questioning:

EPAO, employer and apprentice agree the subject title and scope of the project

For Professional Discussion supported by a portfolio of evidence, the apprentice will be required to submit a portfolio of evidence that meets the following requirements:

- The format and structure of the portfolio need to be agreed between the employer, the apprentice and the EPA (e.g. hard copy or on-line). However, the content must be sufficient to evidence the apprentice can apply the knowledge, skills and behaviours required as mapped to the Professional Discussion assessment method (AM2).
- There must be at least one piece of evidence relating to each knowledge, skill and behaviour mapped to AM2. One piece of evidence can be referenced against more than one knowledge, skill or behavioural requirement. It is expected that there will be a minimum of 6 pieces and a maximum of 12 pieces of evidence.
- The portfolio should contain written accounts of activities that have been completed and referenced against the knowledge, skills and behaviours, supported by appropriate evidence, including photographic evidence and work products, such work instructions, safety documentation, company policies and procedures as appropriate to the activities. Progress review documentation, witness testimonies, and feedback from colleagues and/or clients should also be included. The apprentice's Manager/Mentor will typically support the development of the portfolio in accordance with company policy and procedures, although the assessment organisation will provide further guidance on the content.
This is not a definitive list; other evidence sources are allowable.
- The portfolio of evidence should not include any methods of self-assessment. Any employer contributions should focus on direct observation of evidence (for example witness statements) of competence rather than opinions. The evidence provided must be valid and attributable to the apprentice; the portfolio of evidence must contain a statement from the employer confirming this.
- The portfolio of evidence is not assessed but is used to support the professional discussion.

Assessment methods

Assessment method 1: Workbased Project comprising of project report, presentation and questioning (This assessment method has 2 components.)

Overview

The project is compiled after the apprentice has gone through the gateway.

The work-based project should be designed to ensure that the apprentice's work meets the needs of the business, is relevant to their role and allows the relevant KSBs to be demonstrated for the EPA. Therefore the project's subject, title and scope will be agreed between the employer and the EPAO.

This assessment method includes two components:

- a project report
- a presentation with questioning

Evidence from the project, project report, presentation and questioning are assessed holistically.

The project may be based on any of the following:

- a specific problem
- a recurring issue
- an idea/opportunity

Typical project titles for Option 1, Aircraft Propulsion could include:

- Impact of Degradation on Components, Engine and Mission Performance
- Aerodynamic Design of Axial Compressor
- Design of Gas Turbine Combustor
- Airframe and Engine Integration

Typical project titles for Option 2, Rotating Machinery Applications could include:

- Impact of Degradation on Components and Engine Performance
- Gas Turbine Selection for Combined Cycle Operation
- Economic Viability of Retrofit Technologies
- Gas Turbine Operational Flexibility

The employer will ensure it has a real business application and the EPAO will ensure it meets the requirements of the EPA (including suitable coverage of the KSBs assigned to this assessment method). The EPAO must refer to the grading descriptors to ensure that projects are pitched appropriately. The EPAO should sign-off the project title and scope to confirm its suitability at the gateway.

The rationale for this assessment method is:

The rationale for this assessment method component is:

- This method allows the apprentice the opportunity to utilise their competencies and hard work in a practical environment, contributing to their employer's operational objectives.
- The preparation of a project report and presentation reflect typical tasks undertaken in this occupation.
- This allows a wide range of KSBs to be demonstrated holistically.

Assessment method 1 component 1: Project Report

Delivery

Apprentices will conduct a project in the form of a report.

The project is compiled after the apprentice has gone through the gateway process. The apprentice will conduct their project and submit it to the EPAO by the end of week 16 of the EPA period. The apprentice will typically spend 12 weeks working on the project work, and then will need to compile their report and presentation.

The employer will ensure the apprentice has sufficient time and the necessary resources, within this period, to plan and undertake the project.

Whilst completing the project, the apprentice should be subject to the supervision arrangements outlined below:

Regular and appropriate work-based supervision and support. Supervision should also include the allowance of the apprentice sufficient time away from regular duties to complete the written requirement of the project (e.g. report and presentation). Apprentices will also be allocated a mentor (it is usual business practice for fully trained but fairly inexperienced people in this occupation to have a mentor). Their role is to provide guidance on company best practice and boundaries, this is usual for fully competent people in this occupation. The mentor cannot give guidance on how to achieve successful outcomes for the project. The project report, presentation and questioning must be the apprentices own work and the mentor cannot play a part in preparing them.

As a minimum all projects reports must include:

- An introduction
- The scope of the project (including key performance indicators)
- How the outcomes were achieved
- A project plan
- Research and findings
- Project outcomes
- Recommendations and conclusions

The project report has a word limit of 10,000.

A tolerance of plus or minus 10% is allowed (at the discretion of the apprentice).

Appendices, references, diagrams etc. will not be included in this total.

The project must map, in an appendix, how it evidences the relevant KSBs for this assessment method.

The project will be conducted as set out here:

Apprentices will conduct a project in the form of an employment-based assignment or group of assignments (maximum of 3). This is to ensure this assessment method is suitable for large and small employers, where assignments may vary, to ensure consistency and opportunity are fair. Typically, the assignments will be undertaken over a 16-week period. The apprentice must complete the project report and submit this and the presentation before the end of week 16 of their EPA period. The EPAOs must ensure the presentation is scheduled during the apprentice's typical EPA period, after the submitted report and presentation have been reviewed. The independent assessor should have at least 2 weeks to review the project report and presentation and the apprentice should have at least 5 days notice of the presentation date.

When the project is submitted, the employer and the apprentice should verify the submitted work is that of the apprentice.

Supporting material

EPAOs will produce the following material to support this assessment method:

- Outline of the assessment method's requirements
- Marking materials
- Bank of questions (for component 2)
- Examples of projects
- Data capture forms for results and evidence including gaps, mapped against the KSBs
- Guidance document on how employers can assist in determining suitable project/activity
- Guidance document for both apprentices and employers as to how the assessment method will be administered, including timescales and deadlines.

Assessment method 1 component 2: Presentation and Questioning

Overview

Apprentices will prepare and deliver a presentation that appropriately covers the KSBs assigned to this method of assessment alongside the project report.

The presentation will be based on the project carried out in component 1 and will make reference to the project report. There will be a 60 minute presentation and questioning, split into typically 20 minutes for the presentation and typically 40 minutes questioning. This presentation requires the apprentice to illustrate the Knowledge, Skills and Behaviours that are mapped to this assessment method. The presentation must include:

1. Description of the scope of the presentation – which project is being presented
2. Description of the role of the apprentice in these activities
3. Summary of actions undertaken by the apprentice, including the outcomes of these activities
4. Processes used
5. Use of resources, including personnel
6. Achievements, difficulties faced and lessons learned.

The presentation will be completed and submitted after the gateway, alongside the project report, and will be presented to an independent assessor, either face-to-face or via online video conferencing. If using an online platform, EPAOs must ensure appropriate measures are in place to prevent misrepresentation and ensure the apprentice is not being aided in some way.

The rationale for this assessment method is:

This component complements the project report component as it allows the apprentice to provide more clarity around the report and the independent assessor the opportunity to probe and clarify issues through questioning. It is typical for engineers in this occupation to present the outcomes of their projects to stakeholders and be challenged on their decisions, so this component gives the apprentice the opportunity to demonstrate evidence in this way.

Delivery

The presentation and questioning will last for 60 minutes, with the presentation typically lasting 20 minutes and the questioning typically lasting 40 mins. The independent assessor has the discretion to increase the time of the presentation by up to 10% to allow the apprentice to complete their last point.

Further time may be granted for apprentices with appropriate needs, in-line with the EPAOs Reasonable Adjustments policy.

The independent assessor will ask a minimum of 4 questions at the end of the presentation. The questions will either be drawn from a question bank supplied by the EPAO or be written by the independent assessor pertinent to their review of the project and presentation. The questioning is to confirm the independent assessor's understanding of the presentation and how it demonstrates the relevant KSBs. They may ask follow-up questions where clarification is required.

To deliver the presentation, the apprentice will have access to:

- presentation software
- flip chart
- work products
- videos
- interactive demonstrations
- notes
- computer

The presentation will be conducted as follows:

The presentation will take place on a one-to-one basis between the independent assessor and the apprentice.

The way in which the content of the presentation is made is not prescriptive.

A copy of the project report and presentation must be sent to the EPAO at least 2 weeks in advance of the assessment. The presentation submission must be a hard copy and/or electronic slide deck. When submitted, this must outline details of any visual aids to be used and specify any equipment required. The EPAO must ensure these are available on the day of assessment.

The presentation must be formal in tone and be well-balanced in its use of visuals, text, and other supporting elements e.g. audio, documents, small scale demonstrations etc.

KSBs met and answers to questions, must be recorded by the independent assessor. The independent assessor will make all grading decisions based on all the components in the assessment method.

Marking

The independent assessor will review and mark the project report, presentation and questioning holistically and in a timely manner, as determined by the EPAO, and without extending the EPA unnecessarily. Similarly, all quality control processes will also be conducted in a timely manner, as determined by the EPAO.

Venue

EPAOs must ensure that the presentation and questioning elements are conducted in a suitably controlled environment in any of the following:

- employer's premises
- other suitable venue selected by the EPAO (for example a training provider)
- video conferencing can be used to conduct the presentation but the EPAO must have processes in place to verify the identity of the apprentice and ensure the apprentice is not being aided.

The venue should be a quiet room, free from distraction and external influence. The venue will also have access to presentation equipment (slide deck etc.) Presentation should be maintained confidentially and not shared beyond the EPAO and the employer/apprentice.

Supporting material

EPAOs will produce the following materials to ensure that this assessment method is marked consistently and accurately:

- outline of the assessment method's requirements
- marking materials

Other relevant information

A structured question bank must be developed by EPAOs. The 'question bank' must be of sufficient size to prevent predictability and the EPAO must review it regularly (at least once a year) to ensure that it, and its content, are fit for purpose. The questions relating to the underpinning KSBs, must be varied yet allow assessment of the relevant KSBs.

Apprentices do not need to complete a different project where a resit/retake is required but may need to either re-work their project report or presentation. EPAOs must ensure that apprentices have a different set of questions in the case of re-sits/re-takes.

Assessment method 2: Professional Discussion supported by a portfolio of evidence (This assessment method has 1 component.)

Assessment method 2 component 1: Professional Discussion

Overview

A professional discussion is a two-way discussion which involves both the independent assessor and the apprentice actively listening and participating in a formal conversation. It gives the apprentice the opportunity to make detailed and proactive contributions to confirm their competency across the KSBs mapped to this method. The apprentice leads the professional discussion. It must be appropriately structured to draw out the best of the apprentice's competence and excellence and cover the KSBs assigned to this assessment method with the portfolio of evidence being used to support the apprentice's responses.

The rationale for this assessment method is:

- It allows the apprentice to be assessed against KSBs that do not naturally occur in the project
- It allows for testing of responses where there are a number of potential answers that require discussion
- It is a cost-effective method for employers, as apart from a venue, it does not require additional resources

- It replicates the sort of discussion occupationally competent employees regularly undertake

Delivery

The independent assessor will conduct and assess the professional discussion.

The professional discussion must last for 60 minutes. The independent assessor has the discretion to increase the time of the professional discussion by up to 10% to allow the apprentice to complete their last answer. Further time may be granted for apprentices with appropriate needs, in-line with the EPAOs Reasonable Adjustments policy.

During this method, the independent assessor must combine questions from the EPAO's question bank and those generated by themselves.

The professional discussion will be conducted as set out here:

EPAOs must make arrangements for this assessment method with the apprentice's employer. Independent assessors must conduct and assess the professional discussion on a one-to-one basis.

The independent assessor must ask a minimum of five open questions. The bank of questions created by the EPAO should be used as a basis for question development, but questions should then be adapted taking into account the content of the portfolio; follow up questions are allowed to further probe the responses. The portfolio will be used by the apprentice to refer to exemplify a point. Questioning will be used to authenticate evidence, experience and competence. Apprentices are expected to understand and use relevant occupational language.

Video conferencing can be used to conduct the professional discussion, but the EPAO must have processes in place to verify the identity of the apprentice and ensure the apprentice is not being aided in some way.

The independent assessor must use the assessment tools and procedures that are set by the EPAO to record the professional discussion.

The independent assessor will make all grading decisions.

Venue

The professional discussion should take place in a quiet room, free from distractions and influence.

The professional discussion can take place in any of the following:

- employer's premises
- a suitable venue selected by the EPAO (for example a training provider's premises)
- video conferencing can be used to conduct the professional discussion, but the EPAO must have processes in place to verify the identity of the apprentice and ensure the apprentice is not being aided.

Other relevant information

Independent assessors are responsible for generating suitable questions in line with the EPAO's training and standardisation process. A structured question bank must be developed by EPAOs. Independent assessors must use the question bank as a source for questioning and are expected to use their professional judgment to tailor those questions appropriately. The 'question bank' must be of sufficient size to prevent predictability and the EPAO must review it regularly (at least once a year) to ensure that it, and its content, are fit for purpose. The questions relating to the underpinning KSBs, must be varied yet allow assessment of the relevant KSBs.

EPAOs must ensure that apprentices have a different set of questions in the case of re-sits/re-takes. Independent assessors must be developed and trained by the EPAO in the conduct of professional discussion and reaching consistent judgement.

EPAOs will produce the following material to support this assessment method:

- A question bank as outlined above.
- Assessment recording documentation
- Guidance for apprentices, employers, training providers and independent assessors.

Reasonable adjustments

The EPAO must have in place clear and fair arrangements for making reasonable adjustments for this apprenticeship standard. This should include how an apprentice qualifies for reasonable adjustment and what reasonable adjustments will be made. The adjustments must maintain the validity, reliability and integrity of the assessment methods outlined in this assessment plan.

Weighting of assessment methods

All assessment methods are weighted equally in their contribution to the overall EPA grade.

Grading

(See appendix 1 for grading descriptors)

Assessment method 1: Workbased Project comprising of project report, presentation and questioning

KSBs	Fail	Pass	Distinction
K1 K2 K3 S1 S2 S3 S4 S5 S10 S12 S14 S15 S16 S17 S20 S21 S22 S23 S24 S25 S26 S27 B1 B2 B6	Does not meet the pass criteria	Meets all of the pass criteria	Meets all of the pass criteria and all of the distinction criteria from the core and option

Assessment method 2: Professional Discussion supported by a portfolio of evidence

KSBs	Fail	Pass	Distinction
K4 K5 K6 K7 K8 K9 K10 K11 K12 K13 K14 S6 S7 S8 S9 S11 S13 S18 S19 B3 B4 B5	Does not meet the pass criteria	Meets all of the pass criteria	Meets all of the pass criteria and all of the distinction criteria from the core and option

Overall EPA grading

All EPA methods must be passed for the EPA to be passed overall.

All assessment methods must be passed to achieve an overall pass in the apprenticeship. In order to achieve a distinction overall, distinction must be achieved in both assessment methods.

Grades from individual assessment methods should be combined in the following way to determine the grade of the EPA as a whole:

Assessment method 1 – Work Based Project	Assessment method 2 Professional Discussion	Overall grading
Fail	Any grade	Fail
Any grade	Fail	Fail
Pass	Pass	Pass
Pass	Distinction	Pass
Distinction	Pass	Pass
Distinction	Distinction	Distinction

Re-sits and re-takes

Apprentices who fail one or more assessment method will be offered the opportunity to take a re-sit or a re-take. A re-sit does not require further learning, whereas a re-take does.

Apprentices should have a supportive action plan to prepare for the re-sit or a re-take. The apprentice's employer will need to agree that either a re-sit or re-take is an appropriate course of action.

An apprentice who fails an assessment method, and therefore the EPA in the first instance, will be required to re-sit or re-take any failed assessment methods only.

If the Work Based Project assessment method is failed, the apprentice is not required to undertake a new project. Instead they should submit an amended project report or presentation.

The timescale for a re-sit/re-take is agreed between the employer and EPAO. A re-sit is typically taken within 1 month of the EPA outcome notification. The timescale for a re-take is dependent on how much re-training is required and is typically taken within 3 months of the EPA outcome notification. All assessment methods must be taken within a 9-month period, otherwise the entire EPA will need to be re-sat/re-taken.

Re-sits and re-takes are not offered to apprentices wishing to move from pass to distinction.

Where any assessment method has to be re-sat or re-taken, the apprentice will be awarded a maximum EPA grade of pass, unless the EPAO determines there are exceptional circumstances requiring a re-sit or re-take.

Roles and responsibilities

Role	Responsibility
Apprentice	As a minimum, apprentices should: <ul style="list-style-type: none"> • complete the on-programme element of the apprenticeship • prepare for and complete the EPA • undertake 20% off-the-job training as arranged by the employer and training provider
Employer	As a minimum, employers should: <ul style="list-style-type: none"> • identify when the apprentice is ready to pass the gateway and undertake their EPA, but should not be involved in the delivery of the EPA • notify the EPAO that the apprentice has passed the gateway • support the apprentice to achieve the KSBs outlined in the standard to their best ability • select the EPAO • confirm all EPA gateway requirements have been met • confirm arrangements with EPAO for the EPA (who, when, where) in a timely manner • ensure apprentice is well prepared for the EPA
EPAO	As a minimum, EPAOs should: <ul style="list-style-type: none"> • appoint administrators/invigilators and markers to administer/invigilate and mark the EPA • provide training and CPD to the independent assessors they employ to undertake the EPA • have no direct connection with the apprentice, their employer or training provider i.e. there must be no conflict of interest • have processes in place to conduct internal quality assurance and do this on a regular basis • organise standardisation events and activities in accordance with this plan's IQA section • organise and conduct moderation of independent assessors' marking in accordance with this plan • have, and operate, an appeals process • understand the occupational role • provide adequate information, advice and guidance documentation to enable apprentices, employers and providers to prepare for the EPA • deliver the end-point assessment outlined in this EPA plan in a timely manner • prepare and provide all required material and resources for delivery of the EPA in line with best practices

	<ul style="list-style-type: none"> • use appropriate assessment recording documentation to ensure a clear and auditable mechanism for providing assessment decision feedback to the apprentice
Independent assessor	<p>As a minimum, an independent assessor should:</p> <ul style="list-style-type: none"> • understand the standard and assessment plan • deliver the end-point assessment in line with the EPA plan • comply with the IQA requirements of the EPAO • satisfy the criteria outlined in this EPA plan • be independent of the apprentice, their employer and training provider(s) i.e. there must be no conflict of interest • hold or be working towards an independent assessor qualification e.g. A1 and have had training from their EPAO in terms of good assessment practice, operating the assessment tools and grading • have the capability to assess the apprentice at this level • attend the required number of EPAOs standardisation and training events per year (as defined in the IQA section)
Training provider	<p>As a minimum, the training provider should:</p> <ul style="list-style-type: none"> • work with the employer to ensure that the apprentice is given the opportunities to develop the KSBs outlined in the standard and monitor their progress during the on-programme period • advise the employer, upon request, on the apprentice's readiness for EPA prior to the gateway • plays no part in the EPA itself

Internal Quality Assurance (IQA)

Internal quality assurance refers to the requirements that EPA organisations must have in place to ensure consistent (reliable) and accurate (valid) assessment decisions. EPA organisations for this EPA must:

- appoint independent assessors who have knowledge of the following occupational areas: worked in a technical role at an occupationally competent level (evidenced through professional body membership)
- appoint independent assessors who have recent relevant experience of the occupation/sector at least one level above the apprentice gained in the last three years or significant experience of the occupation/sector
- appoint independent assessors who are preferably members of relevant professional bodies, although this can be relaxed if insufficient assessors are available
- appoint independent assessors who are competent to deliver the end-point assessment
- provide training for independent assessors in terms of good assessment practice, operating the assessment tools and grading
- have robust quality assurance systems and procedures that support fair, reliable and consistent assessment across the organisation and over time
- operate induction training and standardisation events for independent assessors when they begin working for the EPAO on this standard and before they deliver an updated assessment method for the first time
- ensure independent assessors attend standardisation events on an ongoing basis and at least once per year

Affordability

Affordability of the EPA will be aided by using at least some of the following practice:

- using an employer's premises
- use of video conferencing

Professional body recognition

This apprenticeship is designed to prepare successful apprentices to meet the requirements for registration as a Chartered Engineer with:

- Royal Aeronautical Society
- Institution of Power Engineers

For more details on the requirements and application process, please contact the professional body directly.

Mapping of knowledge, skills and behaviours (KSBs)

Assessment method 1: Workbased Project comprising of project report, presentation and questioning

Core KSBs

Knowledge
K1 Gas Turbine Theory and Performance – Introduction to gas dynamics; gas turbine cycles (ideal and actual cycles), engine configurations, design point performance and off-design behaviour by hand calculations, interpreting performance maps, approaches to transient calculations.
K2 Gas Turbine Performance Simulation - computer-based modelling, design point and off-design performance steady-state simulation, transient performance simulation (constant mass flow and inter-component method).
K3 Gas Turbine Diagnostics – condition monitoring techniques, fault diagnosis using linear and non-linear Gas Path Analysis, performance analysis based diagnostic techniques using computer-based data-driven algorithms or models.

Skills
S1 Evaluate the performance of an engine system, using well-informed assumptions to determine its condition.
S2 Assess the outcomes from quantitative evaluations of gas turbine designs, to determine appropriate engine systems for particular applications.
S3 Employ computer-based gas turbine models to estimate engine performance at design and off-design conditions.
S4 Investigate the impact of different degradation and faults on gas turbine performance using computer-based models.
S5 Employ computer-based diagnostic analysis tools to detect gas turbine faults.
S10 Assess life, fatigue and failure of cracked components.
S12 Assess the creep life of a gas turbine component subject to a complex operating profile.

Behaviours
B1 System Thinking - recognise the contribution of individuals at different levels and experiences (specialist and generalist), and appreciating interrelations and integration.
B2 Team working - comfortable working collaboratively in teams.
B6 Responsiveness to change: flexible to changing working environment and demands; resilient under pressure

Option 1 KSBs

Skills
S14 Assess jet engine control systems design, the different mechanisms and components to allow for safe and efficient operation.
S15 Apply the awareness of the regulatory requirements relevant to engine controls and fuel systems in the analysis of control and operational needs
S16 Assess the overall aircraft performance.
S17 Use component performance accounting relationships to assess the installation performance in respect of the integration of the engine and airframe.

Option 2 KSBs

Skills
S20 Evaluate gas turbine performance using machine sensor data from actual operations.
S21 Identify and assess engine performance deterioration, as well as propose retrofit technologies to mitigate the impact.
S22 Quantify the benefits of retrofit technologies related to performance enhancement and engine flexibility options.
S23 Appraise the design and off-design performance of Combined Cycle Gas Turbine power plant.
S24 Apply the appropriate methods and data available to assess the economic viability of operations and power generation technologies.
S25 Evaluate the impact of the key functional areas (procurement, strategy, marketing and supply chain) on the commercial performance, relevant to the manufacture of a product or provision of technical service.
S26 Strategic in the exploitation of team efforts/strengths effort with reference to operations and commercialising technological innovation.
S27 Demonstrate negotiating skills, deal with uncertainty to allow technological innovation and change to flourish.

Assessment method 2: Professional Discussion supported by a portfolio of evidence

Core KSBs

Knowledge
K4 Turbomachinery – Introduction to aerodynamics, thermofluids, and compressible flows, compressor design, turbine design and aerodynamic performance.
K5 Combustors – Gas turbine combustor design consideration and sizing methodologies, combustor efficiency, pollutants/emissions, heat transfer and cooling, and fuels.
K6 Blade Cooling - Heat transfer principles, cooling technologies (convection, impingement, film, transpiration and liquid cooling), their efficiency, advantages and limitations; materials and manufacturing processes.
K7 Fatigue and Fracture - theories of fatigue failure, stress based methods, complex cyclic behaviour, strain methods, methodologies for life and fatigue assessment, and criteria for material selection, corrosion and thermal degradation.
K8 Mechanical Design of Turbomachinery – Loads/forces/stresses in a gas turbine, failure criteria, blade vibration, blade off containment and turbomachine rotordynamics.

Skills
S6 Critically analyse the design and performance of turbomachinery components for modifications or new developments.
S7 Assess the influence of design choices on combustor efficiency, emissions, durability and stability to meet expected standards and compliance.
S8 Estimate the impact of operating conditions of a gas turbine combustor for maintenance replacements (life of combustor liner).
S9 Account for heat transfer effects and the cooling technology to produce a realistic assessment of turbine blade conditions.
S11 Evaluate the loads, stresses from rotation and vibration, as well as failure criteria of turbomachinery components.
S13 Employ desk-top methods to evaluate the stress distributions and vibration frequencies, to suggest ways of ameliorating any problems.

Behaviours
B3 Curiosity and Innovation – Open to new ideas and the development of such ideas of individuals or others, and adopt practices that are informed by wider considerations (environment, ethical and legal compliance).

B4 Professional Commitment - Continue to embrace the development of domain knowledge and awareness of technological advances.

B5 Leadership - taking responsibility for their actions, show perseverance and be prepared to lead, mentor and supervise others.

Option1 KSBs

Knowledge

K9 Jet Engine Control – Requirements and implementation of control constraints (variable stators, bleed valves and variable area nozzles), safe and responsive engine handling, fuel systems and fuel pumps, hydro-mechanical fuel metering - Full Authority Digital Engine Control (FADEC), electronic engine controller, staged combustion, and airworthiness considerations.

K10 Propulsion Systems Performance and Integration - Aircraft performance, jet engine performance and noise, intakes and exhaust systems, system performance and integration.

K11 Computational Fluid Dynamics for Gas Turbines - Flow modelling strategies, physical Modelling, finite difference equations, and practical demonstration.

Skills

S18 Design effective turbomachinery grid generation strategies to ensure numerical models are successfully employed.

S19 Use Computational Fluid Dynamics tools to generate effective flow analyses, evaluations and reporting of flow simulations.

Option 2 KSBs

Knowledge

K12 Gas Turbine Operations – Power and energy, configurations and applications, measured and calculated parameters, performance using operational data, part-load operations, control constraints, availability and reliability, maintenance, degradation: recoverable and non-recoverable, performance enhancement/retention: air filtration systems, compressor washing, inlet cooling technologies. Flexibility: response rate and minimum environmental load.

K13 Combined Cycle Gas Turbine - Design point performance - Gas and Steam Turbine, Heat Recovery Steam Generator (HRSG) technology, off-design performance, transient performance, frequency control, performance economics, advanced cycles, and greenhouse issues.

K14 Engineering Management - Engineers and technologists in organisations, people management, the business environment, strategy and marketing, supply chain, tendering, contract and procurement, new product development, team working and negotiation skills.

Appendix 1

Assessment method 1: Workbased Project comprising of project report, presentation and questioning

Core grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the distinction criteria.
Whole Systems core K1, K2, K3, S1, S2, S3,	Explains how informed decisions are made using computer-based and non-computer based techniques to gather and analyse factual information about the performance of a gas turbine engine under various conditions. (K1, K2, K3, S1, S2, S3)	Justifies their choices of recommended next steps outlining the advantages and disadvantages of alternative options. (S1, S2, S3)
Whole Systems with Degradation S4	Uses computer-based gas turbine models to estimate the impact of degradation and faults on gas turbine performance.	
Product Life Analysis core S5, S10, S12	Applies computer-based data-driven diagnostic analysis tools to detect gas turbine faults. (S5) Assesses life, creep life, fatigue, failure of cracked components. (S10, S12)	Evaluates and explains the operational implications of the analysis and any faults detected. Indicates the influence of diagnostic tool/method on the predictions. (S5) Indicates the influence of method of analysis on the predictions. (S10, S12)
People core B1, B2, B6	Explains how their interaction with colleagues resulted in successful project outcomes, taking account the need for flexibility and to remain calm and resilient under pressure. (B2, B6) Explains how the contribution of others is key to success. (B1)	Uses a range of strategies to support and motivate others to achieve project outcomes and justifies their choices. (B2)

Option 1 Aircraft Propulsion grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the distinction criteria
Whole Systems Option 1 S14, S15, S16, S17	Assesses the overall performance of the aircraft sub-assemblies and control & fuel systems to ensure the aircraft adheres to the safety, efficiency and regulatory requirements of the project specification. Uses this information to inform the installation criteria of the engine within the airframe. (S14, S15, S16, S17)	Exceeds the project specification by developing a design that is either more efficient, safer or reliable without compromising any minimum requirements of the project brief. (S14, S15, S16, S17)

Option 2 Rotating Machinery Applications grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the distinction criteria
Whole Systems Option 2 S20, S21, S22, S23	Uses quantitative and qualitative data to appraise the design/off design performance of a combined cycle gas turbine power plant and uses this information to inform recommendations for the power plant. (S20, S23) Justifies their choices of retrofit technologies to improve performance/ engine flexibility options. (S21, S22)	Assesses the validity of their solution and considers the risks and implications of the methods used for the evaluation of data. (S20, S23)
Operations Option 2 S24, S25	Assesses the economic viability of operations and power generation technologies in delivering their project outcomes. Uses this information to produce an implement a strategic plan. (S24)	Exceeds the commercial goals of the project, e.g. by exceeding target cost savings, exceeding target efficiencies. (S24, S25)

	Evaluates the impact of the commercial functions of the business on the project. (S25)	
People Option 2 S26, S27	<p>Involves and uses relevant functions within the business to deliver project outcomes. (S26)</p> <p>Negotiates and manages areas of uncertainty during implementation to minimise risks to delivery. Allows technological innovation. (S27)</p>	

Assessment method 2: Professional Discussion

Core grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the pass criteria
Components core K4, K5, K6, S6, S7, S9	<p>Explains how they have assessed and analysed the impact of a range of design options and operating conditions on component performance, efficiency, emissions, durability, stability and life to ensure compliance with the specification. (K4, K5, S6, S7)</p> <p>Describes how they have applied theories of heat transfer and cooling and taken account of materials and manufacturing processes to determine the performance of component parts including turbine blades. (S9)</p> <p>Describes how they have assessed turbine blade conditions, taking account of the materials and manufacturing process,</p>	Explains the risks and implications of alternative approaches to design options and operating conditions and ways to address them. (S6, S7)

	heat transfer effects and cooling technology. (K6)	
Product Life Analysis core K7, K8, S8, S11, S13	<p>Explains how they have assessed the impact of fatigue, fracture, failure and operating conditions on component life. (K7, S8)</p> <p>Explains how they have evaluated load, forces and stresses from rotation and vibration of turbomachinery components and employed desk-top methods to analyse and determine next steps. (K8, S11, S13)</p>	
People Core B3, B4, B5	<p>Explains how they have taken a considered approach to collaborative working to encourage others to contribute their best, including listening to new ideas. (B3)</p> <p>Explains how they have managed the demands of leadership under pressure, over time, in a changing work environment. (B5)</p> <p>Explains the strategies they have used to develop others. (B5)</p> <p>Discusses how their working practices have been influenced by external factors. (B3)</p> <p>Discusses how technological advancements influenced their knowledge and skills and how they have maintained currency in those areas. (B4)</p>	<p>Justifies their choice of collaborative working techniques, explaining the risks and benefits and offers an alternative. (B3)</p> <p>Justifies when and how they have challenged the norm and investigated, proposed and articulated solutions to environment, ethical and legal matters with reference to best practice outside the immediate business. (B3)</p>

Option 1 Aircraft Propulsion grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the distinction criteria
Operations Option 1 K9	Discusses the necessary control requirements and implementation/consideration for safe and efficient jet engine operation. To include engine handling, fuel systems and fuel pumps, hydro-mechanical fuel metering, FADEC, electronic engine controller, staged combustion and airworthiness considerations. (K9)	
Whole Systems Option 1 K10	Explains how to assess the overall performance of the aircraft propulsion system (noise, intakes and exhaust systems) to ensure system performance and integration and installation criteria of the engine within the airframe. (K10)	
Components Option 1 K11, S18, S19	Explains how they have designed effective turbomachinery grid generation strategies and deployed numerical models correctly. (S18) Explains how they have generated flow analysis, evaluations and reported flow simulations using computational fluid dynamic tools and explains the steps they took to achieve this. (K11, S19)	Discusses the benefits and limitations of the analysis methods and tools and justifies their choices for selection. (K11, S19)

Option 2 Rotating Machinery Applications grading descriptors

Fail- The apprentice will be deemed to have failed if they do not meet the criteria outlined in the pass descriptor

KSBs	Pass Meets all of the pass criteria	Distinction Meets all of the pass criteria and all of the distinction criteria
Whole Systems Option 2	Discusses the design performance of the combined cycle plant operation, as well as the respective role of the heat recovery	Critically analyses/evaluates the design parameters necessary for the

K13, K14	<p>steam generator, steam turbine and additional component, on the economics and greenhouse issues. (K13)</p> <p>Explains the influence people, technology, market changes and working practices have on the business and wider sector. (K14)</p>	improvement of combined cycle performance and limitations. (K13)
Operations Option 2 K12	Discusses the principles of gas turbine operations, with reference to power and energy, configurations and applications, measured and calculated parameters, performance, part load operations, control constraints, availability and reliability, maintenance and degradation, recoverable and non-recoverable, performance enhancement/retention, air filtration, compressor washing, inlets cooling technologies. Operational flexibility demonstrated in terms of response rate and minimum load requirement. (K12)	