Welcome to the T Level Engineering & Manufacturing

The webinar will begin shortly

November 2022

Engineering and Manufacturing T Level

A high-level overview of the Occupational Specialisms for Engineering, Manufacturing, Processing and Control Pathway

Using the webinar platform

Our action plan supports the planning and delivery stages to prepare for the TQ launch

Send any questions in the question area throughout the webinar

All attendees will be set to mute

Webinar resources will be shared on our website shortly after

Agenda

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- Engineering & Manufacturing T Level
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  - Engineering, Manufacturing, Processing and Control Occupational Specialisms
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- **Employer Set Project MPC**
- **Engineering, Manufacturing, Processing and Control – Fitting & Assembly Technologies**
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- **Engineering, Manufacturing, Processing and Control – Machining & Tool Making Technologies**
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  - Engineering Text book from Hodder Education
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Engineering and Manufacturing T Level programme composition

T Level courses include the following compulsory elements:

A Technical Qualification, which includes:

- **core theory, concepts and skills for an industry area**
- **specialist skills and knowledge for an occupation or career**
- **an industry placement with an employer**

The T Level is a full-time two-year programme.

UCAS tariff points will be allocated and will be equivalent in value to three A Levels.

Students will also be required to work towards the attainment of maths and English if they have not already achieved grade 4 at GCSE, as they do on other 16 to 19 programmes.

Core
680 GLH / 1000 TQT

Graded	A* - E
Paper 1	Maths & Science
Paper 2	Engineering Concepts
ESP	Employer Set Project

Covers concepts and theories including core skills.

Assessment:
External set and marked exams and an employer set project.

Occupational specialism
680 GLH / 1000 TQT

Graded Pass/merit/distinction
Based on occupational maps
Covers practical skills and knowledge in a specialist occupational area.

Assessment:
Synoptic assignment covering practical skills and applied knowledge.

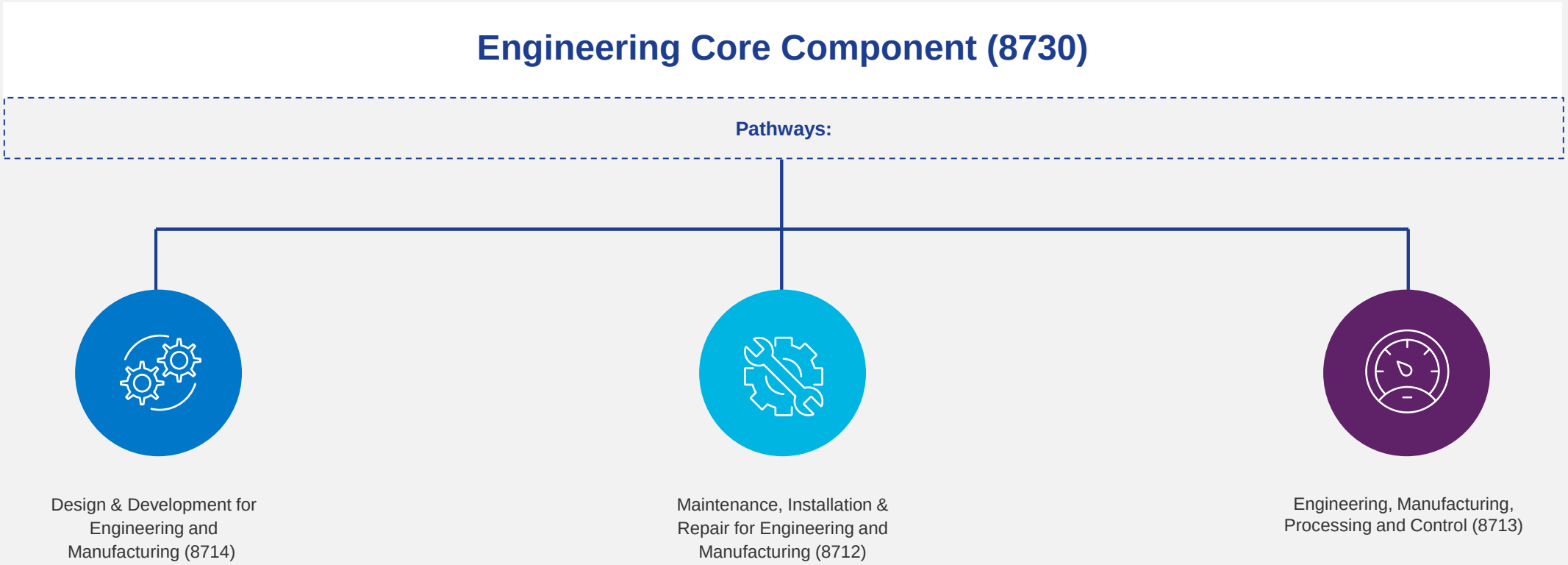
Industry Placement
315-420 hours
Min 45-60 days

Maths and English
GCSE or Functional Skills Level 2

(Continue to study as part of the condition of funding)

Tutorial- Employability enrichment, and pastoral hours

Technical Qualification overview for Engineering:



Learners must complete:

- Engineering Core
- 1 Occupational specialism within a pathway

Route: Engineering and Manufacturing

PATHWAY – Engineering, Manufacturing, Processing and Control (8713)

Occupational Specialisms

Fitting & Assembly Technologies

8713-31

Machining & Tool Making Technologies

8713-32

Composites Manufacturing Technologies

8713-33

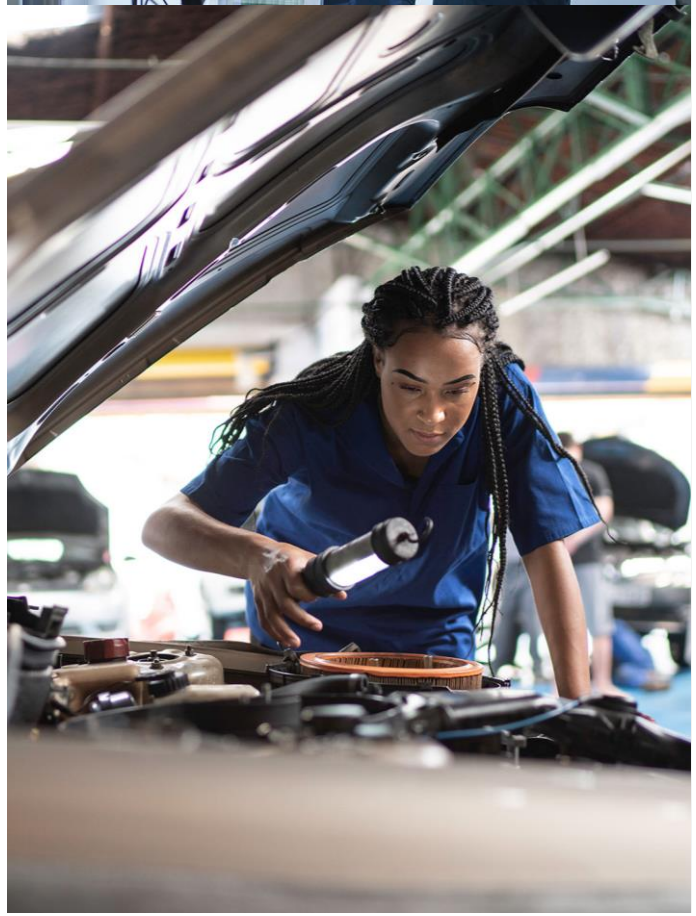
Fabrication & Welding Technologies

8713-34

T Level Technical Qualifications

Engineering, Manufacturing, Processing and Control	
8730 - 13	**Core**
8713 – 31	Fitting and Assembly Technologies
8713 – 32	Machining and Toolmaking Technologies
8713 – 33	Composites Manufacturing Technologies
8713 - 34	Fabrication and Welding Technologies

Registration information-
Core first before OS



Technical Qualification - Core

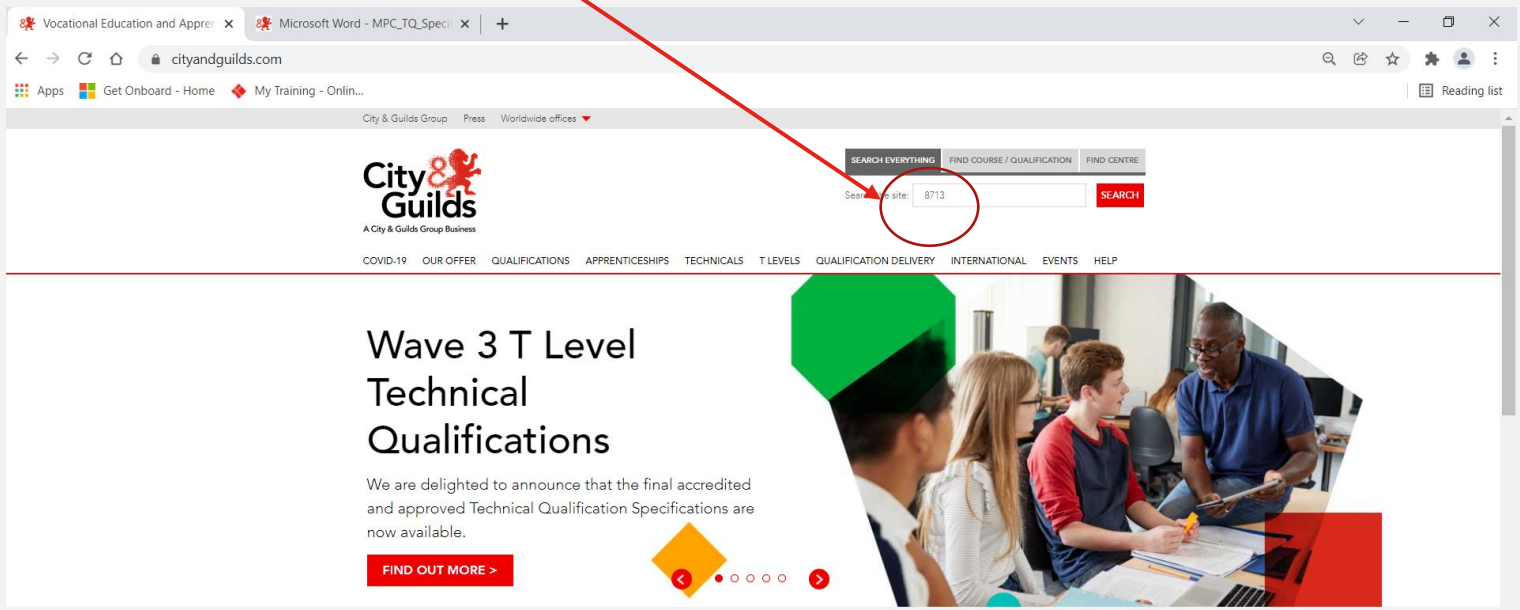
Element	Title	GLH
1	Working within the engineering and manufacturing sectors	30
2	Engineering and manufacturing past, present, and future	30
3	Engineering representations	40
4	Essential mathematics for engineering and manufacturing	90
5	Essential science for engineering and manufacturing	90
6	Materials and their properties	60
7	Mechanical principles	35
8	Electrical and electronic principles	35
9	Mechatronics	30
10	Engineering and manufacturing control systems	30
11	Quality management	30
12	Health and safety principles and coverage	60
13	Business, commercial and financial awareness	30
14	Professional responsibilities, attitudes, and behaviours	15
15	Stock and asset management	15
16	Continuous improvement	30
17	Project and programme management	30

Specifications

https://www.cityandguilds.com/tlevels/engineering

Website Navigation

From the homepage you can search for the qualification 8713



Then select the qualification

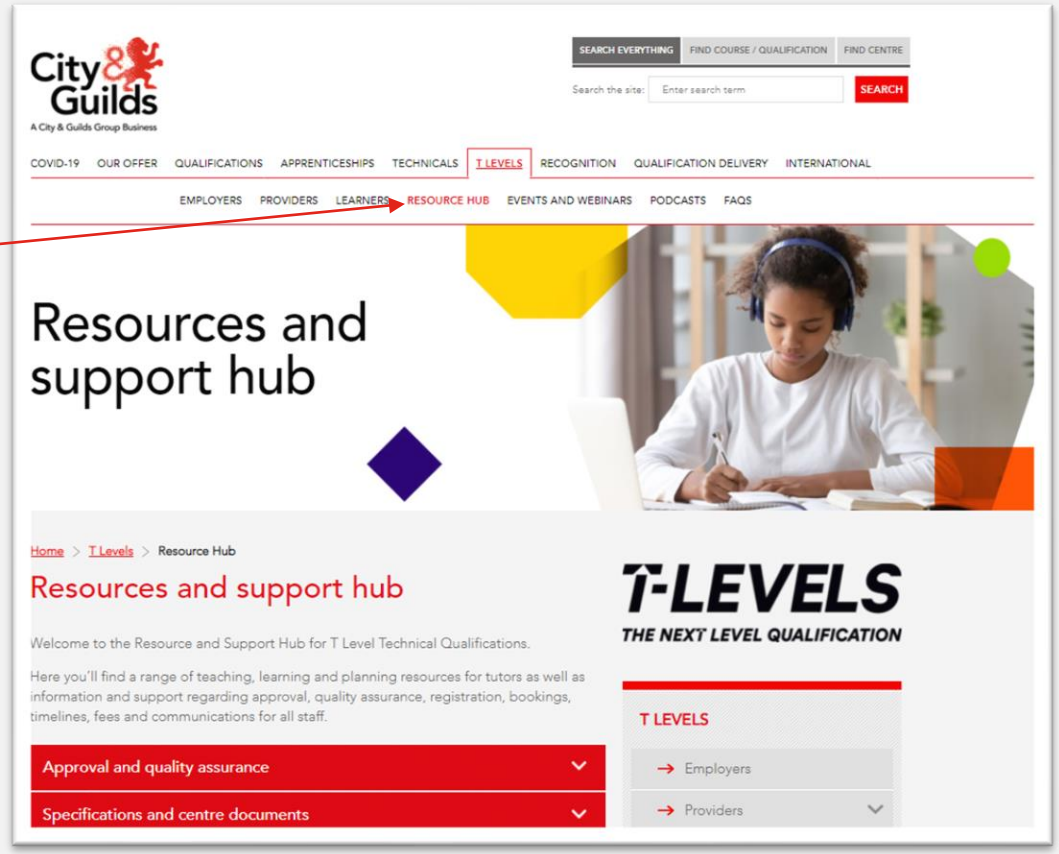
T Level Technical Qualification in Engineering, Manufacturing, Processing and Control (8713)

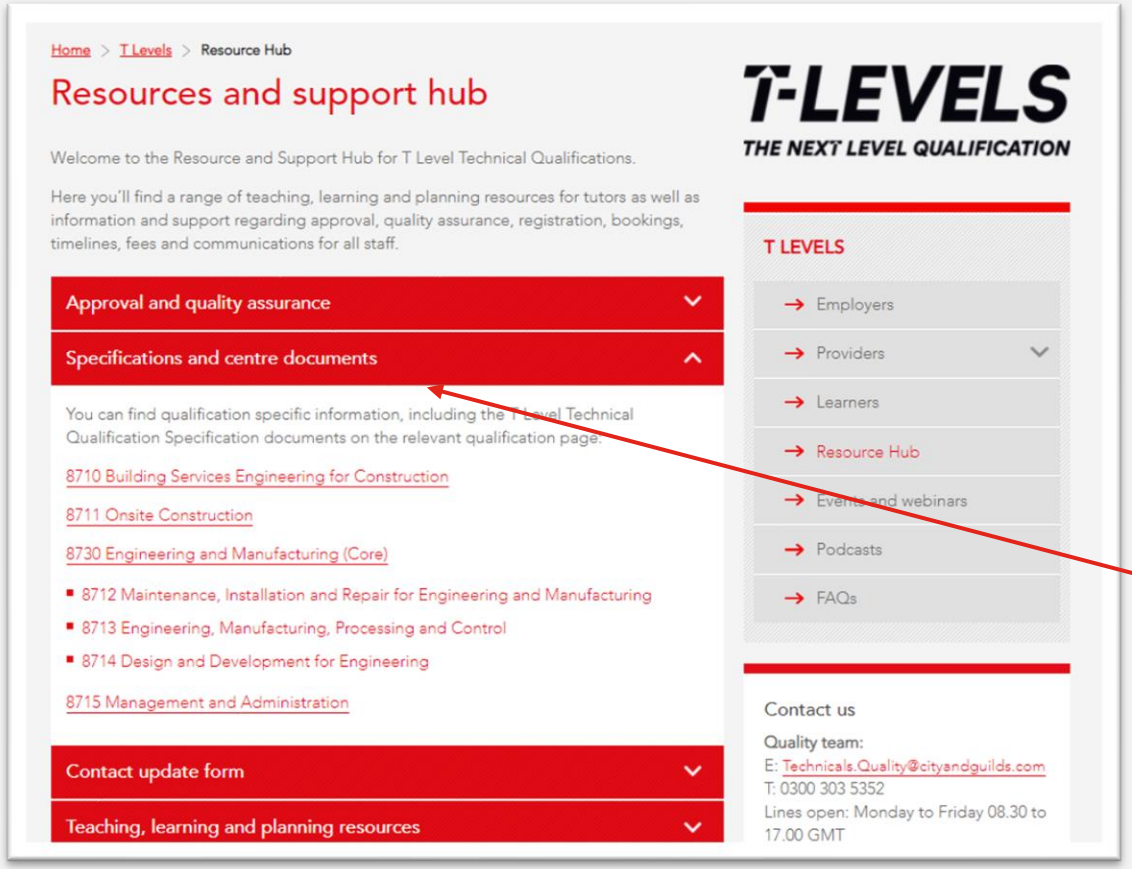
The T Level Technical Qualification in Engineering, Manufacturing, Processing and Control allows learners to gain an understanding of what is needed to work within the engineering industry. Topics covered include processes of production and manufacturing, materials, specialist machinery,

Level 3

Website Navigation

Or navigate through the C&G T Level Resource Hub webpage

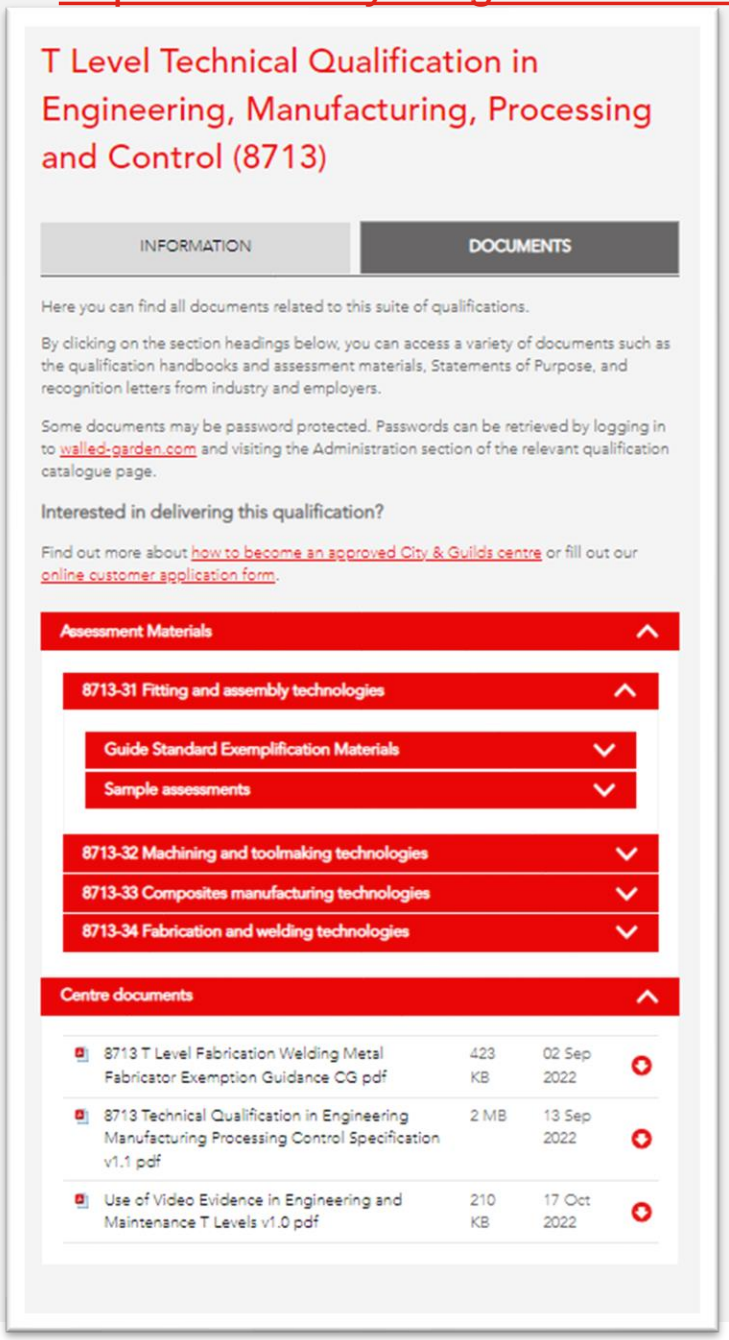




Then select specifications and centre documents

Website Navigation

https://www.cityandguilds.com/tlevels/engineering



Physical Resources Occupational Specialisms

(page 13 onwards in specification)

Physical resources

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and its assessment.

Common resources

- Virtual modelling and CAD software.
- PPE.
- Scientific calculator.
- Manufacturer's instructions.
- Manufacturer's datasheets.
- Mechanical equipment (hand tools, portable power tools).
- Electrical / electronic equipment (hand tools, soldering irons).
- Measurement devices, instrumentation and gauges.

Fitting and Assembly Technologies

- Materials – a range of ferrous, non-ferrous, polymers.
- Tools and equipment - work holding device (chucks, jigs, fixtures).
- Hand tools - saws, torque wrenches, spanners, pliers, screwdrivers, allen keys, files, tap and die set, engineers square, scriber, center punch, taps, reamers, hammers, punches.
- Power tools - cordless drill, hammer drill, mag-base drill, electric screwdriver, bench grinder, compressed air driven tools.
- Measuring equipment – rules, tapes, micrometres, Vernier/digital callipers, thread gauges, gauge blocks, comparison plates.
- Workshop machinery – pillar drill, bench grinder, bending machine, guillotine, hand drill, bearing puller, milling machines, lathes, compressor, 3D printers.

Machining and Toolmaking Technologies

- Materials – ferrous, non-ferrous, polymers, elastomers.
- Tools and equipment – tooling for workshop machinery:
  - For milling - face mills, end mills, slot drills, slotting cutters, slitting saws, profile cutters, twist drills, reamer, boring tools.
  - For turning - turning tools, facing tools, form tools, parting off tools, single point threading, boring bar, recessing tool, centre drill, twist drill, reamer, tap, die, knurling tool.
  - For drilling - centre drill, drill bit, flat-bottomed drill, counterboring tool, countersinking tool, reamer, tap.
- Work holding devices (chuck, collets, faceplate, centres and driveplates, lathe dog/carrier, steadies, angle plate, magnetic table, vee block, indexing heads, rotary table, jigs, fixtures, clamp, vice).
- Power tools - cordless drill, hammer drill, electric screwdriver, compressed air driven tools.
- Hand tools - centre and edge finders, combination, protractor and depth gauges, de-burring tools, dividers, levels, scrapers, scribes, square, straight edges, gauges, vices, punches, reamers, rivet setter, screw extractors, bolt grips, taps and dies, clamps, threading tools, files, hammers.
- Measuring equipment – rule, callipers (vernier, digital), micrometres (outside, depth), gauges (feeler, angle, slip, go/no-go), dial test indicator (DTI).
- Workshop machinery:
  - manual: router, cutters, milling machine, lathes, drilling machines, grinding machines, pillar drill.
  - CNC: lathe, milling machine, router, cutter.
  - Abrasive/grinding/polishing equipment

Physical Resources Occupational Specialisms

(page 13 onwards in specification)

Composites Manufacturing Technologies

- Materials:
  - Matrix materials - Thermoset, thermoplastic, ceramic matrix, metal matrix, bio resins.
  - Composites - Fibre material types (glass, carbon, aramid, quartz, bio fibres, thermoplastic), fibre material forms (woven (plain, twill, satin etc), unidirectional, chopped strand mat (CSM), multi-axial, tapes, 3D stitching, preforms, braiding), natural and synthetic fibres, material combinations.
  - Resins (catalysts, accelerators, hardeners), glass fibre, carbon fibre, particle, fibre and sheet-based composites (natural and synthetic).
  - Consumables – release agents, curing agents.
- Hand and power tools and equipment - Standard hand tools, powered hand tools electrical power (full mains, 110v, battery), pneumatic power tools, high-speed cut-off tools, die grinders, power drills, sanders, polishers (hand and power).
- Tools and equipment - protractor & depth gauges, micrometer, de-burring tools, safe edger, viscosity measuring cups, square, straight edges, gauges, punches, heat gun, forming tools, resin mixers, clamps, files, scales and balances.
- Measuring and marking out equipment - engineer's rule, dividers, scribe, templates, set squares, protractors, compasses, combination square, scribing block/surface gauge, callipers, Vernier height gauge, slip gauges, Dial Test Indicator (DTI), surface table and plates, angle plates, vee blocks, paint pencil (white).
- Equipment specific for each of the lay-up methods:
  - Hand lay-up, spray lay-up, pre-preg lay-up, resin infusion/transfer, automated lay-up.
- Workshop equipment - rollers, brushes, spray guns, mould, vacuum bags, heated press/autoclave/oven, heat guns, injection equipment, freezer, sanding and finishing equipment, temperature and humidity meter.
- Ventilation and fume control.
- First aid kit and eye-wash station.

Fabrication and Welding Technologies

- Specialist PPE - auto-darkening welding helmet, air-fed welding helmet, welding jacket or apron, welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator.
- Materials – ferrous metals, non-ferrous metals, fixings, welding consumables.
- Tools and equipment - centre & edge finders, combination, protractor & depth gauges, de-burring tools, dividers, levels, scribes, square, straight edges, gauges, vices, punches, rivet setter, bolt grips, taps & dies, vee blocks, clamps, files, hammers, tin snips.
- Standard hand tools, powered hand tools electrical power (full mains, 110v, battery), pneumatic power tools, powered cutters/nibblers, mag base drills.
- Measuring equipment - rules, tapes, micrometers, welding gauges, thread gauges, gauge blocks, and comparison plates.
- Workshop machinery – pillar drill, bench grinder, bending machine, guillotine, hand drill, compressor, plasma cutting, cutting machines, presses.

- Welding equipment - Flux, clamps, magnets, sheet metal gauge, conduit, electrode, wire and electrode feed system (pinch rolls, push-pull, spool on gun), gun, angle grinder, wire brush, cables, fume extractors, local exhaust ventilation systems (LEV), metal inert gas (MIG) rig, gas shielded metal arc (MAG) welding rig, manual metal arc (MMA), resistance/spot welder, tungsten inert gas (TIG) welding, portable welding plant (inverter welders), generator welding plant, oxy fuel, gas bottles.
- Forging equipment - (hammers, furnace or equivalent, tongs, clamping vice)
- Non-destructive testing equipment - dye-penetrant inspection, magnetic particle inspection, visual inspection.
- Copies of relevant welding standards.

Technical Qualification scheme of assessment components – Manufacturing, Processing & Control Pathway

Core component – Learners must complete all assessment components

Assessment component	Method	Duration	Marks	Weighting	Marking	Grading
Exam paper 1	Externally set exam	2.5 hours	100	35%	Externally marked	This component will be awarded on the grade scale A* -E
Exam paper 2	Externally set exam	2.5 hours	100	35%	Externally marked	
Employer-set project	Externally set project	15 hours	90	30%	Externally marked	

Occupational Specialism Component – Learners must complete all assessment components

Assessment component	Method	Duration	Marks	Weighting	Marking	Grading
Fitting and assembly technologies	Externally set assignment	25 hours 15 minutes	90	100%	Externally moderated	All occupational specialism components will be awarded on the grade scale P,M,D
Machining and toolmaking technologies	Externally set assignment	25 hours 15 minutes	90	100%	Externally moderated	
Composites manufacturing technologies	Externally set assignment	24 hours 15 minutes	90	100%	Externally moderated	
Fabrication and welding technologies	Externally set assignment	26 hours 15 minutes	90	100%	Externally moderated	

Technical Qualification – Employer Set Project

Employer Set project

Task		Conditions	Evidence produced	Evidence submitted?	Timings	Marks available
1	Research	Supervised/ controlled	Research notes, list of references /sources	Yes	3 hours	15
2	Report	Supervised/ controlled	Written report	Yes	4 hours	18
3	Design	Supervised/ controlled	Assembly drawings, design calculations	Yes	6 hours	24
4	Present	Supervised/ controlled	Presentation materials (slides, handouts etc.), video recording of presentation	Yes	2.5 hours	24
				Total	15.5 hours	81
				Maths, English and digital skills*		9
				Total marks		90

Employer-set project

Component	Assessment method	Assessment weighting
AO1 Plan approach to meet brief	Evidence of a planned approach to work, considered sequence of activity, evidence of prioritisation, review and iterative working. Clearly structured response to brief, cohesive response with ordered sections, logical approach to referencing, research and use of sources, response completed meeting required parameters, sources used effectively and integrated into response, effective use of time allocation available for presentations.	13.3%
AO2 Apply knowledge and skills to contexts	Linking knowledge principles and ideas and applying them in context of the brief when considering compiling response use of materials, concepts etc. Applying core skills e.g. communication, problem solving appropriately throughout tasks within project.	50%
AO3 Select techniques and resources to meet brief	Analysis of key issues, drawing together considerations and considering impacts of elements on each other (not just in isolation), consideration and analysis of the reasons for doing things in a particular way.	13.3%
AO4 Use maths, English and digital skills	Use of correct terminology, abbreviations, units of measurement in context, consideration of audience of brief response (technical versus non-technical wording), use of calculations/diagrams etc appropriately, consideration of the use of ICT and digital methods both in brief response and in presentation.	10%
AO5 Realise project outcome and review how well the outcome meets the brief	Considered analysis and evaluation of project outcome, response conclusion or evaluation, identification of solutions in response to brief problem with evidence of evaluation of other options and reasons for rejection of other options where not appropriate.	13.3%

Exemplar Employer Set Project

The employer

DH Engineering Ltd is a medium sized engineering company. It has been in business for 17 years primarily undertaking manufacture of machined components to customer designs.

Machining tasks range from the manufacture of one-off components and assemblies often made by hand on manual machines, through to larger batches of components normally manufactured on CNC machines.

Complex shapes whether in batches, or a single item are all machined on 5 axis CNC machines to reduce the time it would take to produce these manually and reduce the skilled labour required. However, assembly and finishing operations are normally undertaken manually because of the significant cost in creating machinery and AI to undertake what is a complex handling task.

The project

DH Engineering Ltd has received an order for 350 bespoke shoulder screws which comprise of a:

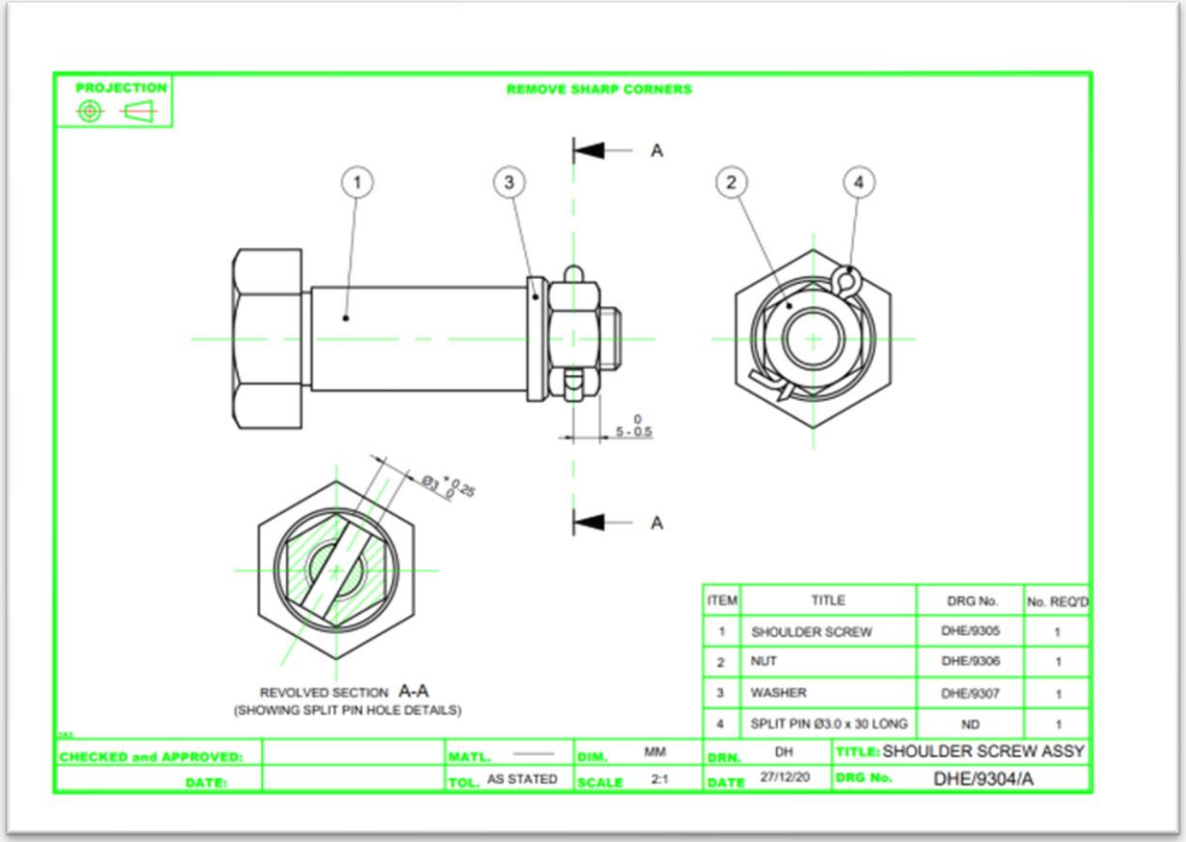
- shoulder screw body
- nut
- washer
- split pin (standard bought in part).

The split pin is to be inserted through a hole drilled through the nut and threaded portion of the shoulder screw body following assembly.

Whilst all of the individual components have been manufactured on a CNC machine, assembly needs to be undertaken by hand, and the hole for the split pin is drilled manually. This is due to the complexity of holding the screw body, fitting the washer, screwing on the nut followed by cross drilling and insertion of a split pin. Whilst it is possible to automate this process, it would be uneconomic.

The current arrangement is to hold the assembly in a standard Vee-Block and drill the hole using a centre drill, followed by standard twist drill. However, there is a problem with this method as the current method is resulting in holes being drilled out of position on the flat of the nut and not passing through the centre of the thread and not exiting the nut in the correct position.

This is leading to increased scrap rates and takes a significant amount of time to correctly drill each assembly. Figure 1 below shows the final assembly with the split pin inserted through the drilled hole and gives the size and position of the hole to be drilled.



Technical Qualification - Engineering, Manufacturing, Processing and Control

Practical Assessments

Occupational Specialism Assessment – Practical assignments

Each occupational specialism assessment will comprise of a practical assignment that.

- Contains **90 marks**
- A variety of duration across the different occupational specialisms from **24 hours 15mins to 26hrs 15mins**
- **Externally set, Internally marked**
- **Externally moderated** by City & Guilds
- is based on an overarching project brief
- Range of individual tasks that are mapped to the performance outcomes of the specialism; with weightings applied per performance outcome.
- Mark scheme that reflects the individual performance outcome assessed by the specialism and with banded marks to reflect the assigned weightings.

Technical Qualification - Engineering, Manufacturing, Processing and Control

Occupational Specialism – – Fitting & Assembly Technologies

Performance Outcomes- Fitting & Assembly Technologies

- The weightings for each performance outcome will remain the same for every version of the practical assignment. This ensures the appropriate depth and breadth of knowledge and skills for each specialism can be reliably assessed in every version and meets the needs of industry while keeping comparability between each assessment over time.

Performance outcome	Typical knowledge and skills	Weighting
PO2 Analyse projects and specifications, considering the specific requirements, context, resources, tools and equipment, and the suitability of different production technologies, processes, and methods.	Interpret requirements of a brief through the analysis and interrogation of available information sources and formats. Consider all relevant aspects of a brief challenging and confirming expectations including risks and issues. Select and use techniques, processes and technologies that will assist in the analysis of information available.	17%
PO3 Plan and prepare relevant materials, resources, tools, and equipment needed to produce the relevant products and outcomes.	Plans to meet the requirements of a brief effectively with consideration of required resources and technology. Identify and mitigate potential issues prior to the production activity. Check materials conform to specification. Prepare the work area including required tools and equipment for producing products. Measure and mark out components to specification and plan for wastage and disposal.	20%
PO4 Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant fitting and assembly technologies, methods, and processes.	Disassemble and assemble components or assemblies to fix and install components. Carry out cutting, sawing, drilling and fitting accurately to produce shapes and profiles to meet specifications. Manipulate components to achieve best fit. Produce one-off components to meet specifications and prepare surfaces and apply suitable surface treatments to products.	27%
PO5 Support the delivery (and the management) by helping to evaluate and review the outcomes to improve the final product, production methods, and workplace practices and processes.	Monitor production processes, identifying potential risks, issues and problems. Deal with issues and problems quickly and efficiently, using appropriate techniques and processes to address or resolve them, escalate issues in line with correct lines of reporting. Monitor work to ensure efficiency, and carry out checks as part of the production process, safety at all times.	20%
PO6 Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.	Use different techniques to communicate technical information effectively with consideration of audience and format. Produce technical documentation using available tools and technology, accurately recording information, data and risks as part of handover of the process to client/end user.	16%

MIR Fitting and Assembly Technologies

(page 33 onwards in specification)

Component	Assessment method	Overview and conditions
Occupational Specialism assignment	Externally set, externally moderated	This assignment is **externally set, internally marked and externally moderated**, and is designed to require the learner to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories and knowledge from across the occupational area. Assignments will be released to centre staff towards the end of the learners' programme, usually the week before Easter each year. Centres will be required to maintain the security of all live assessment materials until assessment windows are open. Assignments will therefore be password-protected and released to centres through a secure method. Guidance on equipment, resources and duration will be released as appropriate to ensure centres can plan for delivery of practical assignments in advance. Learners who fail the occupational specialism following the first submission can retake in any assessment window. Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking process and associated marking grid in the assessment pack for the qualification, and guidance on the use of marking grids.

Component	Assessment method	Overview and conditions
Fitting and assembly technologies	Externally set, externally moderated	**Content overview** Learners will be able to: • Analyse projects and specifications, considering the specific requirements, context, resources, tools and equipment, and the suitability of different production technologies, processes, and methods. • Plan and prepare relevant materials, resources, tools, and equipment needed to produce the relevant products and outcomes. • Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant fitting and assembly technologies, methods, and processes. • Support the delivery (and the management) by helping to evaluate and review the outcomes to improve the final product, production methods, and work place practices and processes. • Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes. **Assessment overview:** Learners will be assessed against the following assessment themes: Health and safety Planning and preparation Production Quality review and evaluation

Specification – Fitting and Assembly Technologies
(page 84 onwards)

Underpinning knowledge outcomes

On completion of this specialism, learners will understand:

1. Fitting and assembly technologies knowledge criteria.

Performance outcomes

On completion of this specialism, learners will be able to:

2. Analyse projects and specifications, considering the specific requirements, context, resources, tools and equipment, and the suitability of different production technologies, processes, and methods.
3. Plan and prepare relevant materials, resources, tools, and equipment needed to produce the relevant products and outcomes.
4. Produce relevant products and outcomes, considering the specified requirements, context, and materials, using the relevant fitting and assembly technologies, methods, and processes.
5. Support the delivery (and the management) by helping to evaluate and review the outcomes to improve the final product, production methods, and workplace practices and processes.
6. Communicate production information, proposals, and solutions, producing, recording, and explaining relevant technical information, representations, processes, and outcomes.

Completion of this specialism will give learners the opportunity to develop their maths, English and digital skills. Details are presented at the end of the specification.

331 Fitting and assembly technologies

Level:	3
GLH:	680
Assessment method:	Practical assignment

What is this specialism about?

The purpose of this specialism is to engage with the technical expertise, technology, methods, and skills involved in producing items or assemblies (generally on an industrial scale), using specialist tools, equipment and machinery.

Learners will examine a range of production processes, systems, and facilities, investigating factors such as scale, efficiency and demand, the application of quality management, and the analysis and optimisation of conditions, processes and practices when producing high-quality products for a variety of purposes.

Learners will develop their knowledge and understanding of, and skills in:

- Scientific and mathematical principles along with production and materials awareness.
- Suitable tools and equipment, machines and technology widely used in production along with fault finding and diagnosis.
- General workplace practices and production standards.
- Regulatory and legal requirements, specifically health and safety and employment.
- Project and programme management principals incorporated into general business and commercial aspects of production.
- Production quality aspects and communications in the workplace.
- Drawings and tools used in production.
- The planning, preparation, and production of products.
- Communications and supporting production activities.

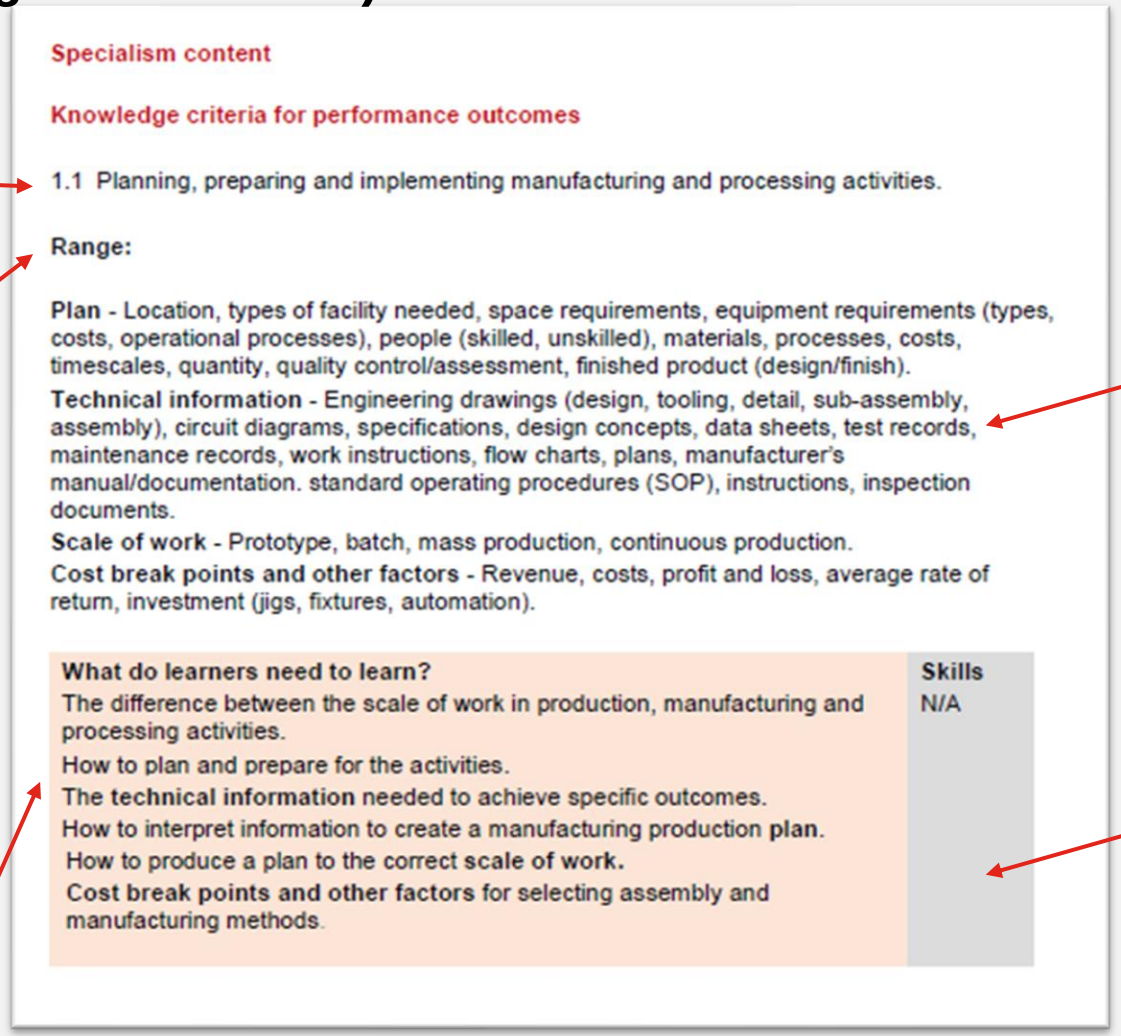
Learners may be introduced to this specialism by asking themselves questions such as:

- Do I enjoy coming up with ideas and thinking about how I could turn them into a physical product?
- Am I a team player? Do I like working with others in a team environment towards a common goal?
- Am I a planner? Do I like planning things out and trying to decide how a sequence of events will work together to deliver a product?
- Do I get enjoyment from assembling and taking things apart to see how they work and then putting them back together?

Specification – Fitting and Assembly Technologies - Knowledge (page 86 onwards)

Learning Outcome

This section of the specification outlines the subject or topic that needs to be delivered and assessed. Criteria are often supported by the “range”



Specialism content

Knowledge criteria for performance outcomes

1.1 Planning, preparing and implementing manufacturing and processing activities.

Range:

Plan - Location, types of facility needed, space requirements, equipment requirements (types, costs, operational processes), people (skilled, unskilled), materials, processes, costs, timescales, quantity, quality control/assessment, finished product (design/finish).

Technical information - Engineering drawings (design, tooling, detail, sub-assembly, assembly), circuit diagrams, specifications, design concepts, data sheets, test records, maintenance records, work instructions, flow charts, plans, manufacturer’s manual/documentation. standard operating procedures (SOP), instructions, inspection documents.

Scale of work - Prototype, batch, mass production, continuous production.

Cost break points and other factors - Revenue, costs, profit and loss, average rate of return, investment (jigs, fixtures, automation).

What do learners need to learn?	Skills
The difference between the scale of work in production, manufacturing and processing activities.	N/A
How to plan and prepare for the activities.	
The **technical information** needed to achieve specific outcomes.	
How to interpret information to create a manufacturing production **plan**.	
How to produce a plan to the correct **scale of work.**	
Cost break points and other factors for selecting assembly and manufacturing methods.	

Provides the detail of the information required to be delivered as part of that topic.

What do learners need to learn?
The primary purpose of these sections is to support the delivery of the content in the criteria.
These sections provide context
In relation to the depth and breadth to which a subject or topic needs to be taught.

Relate to Core Skills and general competencies in English, Mathematics and Digital Skills.

Specification – Fitting and Assembly Technologies – Practical Skills (page 96 onwards)

Learning Outcome

This section of the specification outlines the subject or topic that needs to be delivered and assessed. Criteria are often supported by the “range”

What do learners need to demonstrate?
The primary purpose of these sections is to support the practical skills of the content in the criteria.
These sections provide context In relation to the depth and breadth to which a subject or topic needs to be taught and demonstrated through practical skills.

4.3 Carry out cutting, drilling, sawing and fitting accurately to produce shapes and profiles to meet specifications.

Range:

Method - Cutting, sawing (hand saw, bandsaw), drilling (hand drill, pilar drill), fitting techniques (folding, riveting, self-clinching, fasteners, press tools), drilling (tapping, reaming, countersinking).

Materials - Ferrous metals (stainless steel, cast iron, high speed steel, silver steel, low, medium and high carbon steel), non-ferrous metals (aluminium, copper, lead and zinc).

Assemblies - Bolted, rivetted, screwed, brazed, jointed, dowelled.

Technical documentation - SOPs, inspection sheets, engineering drawings.

What do learners need to demonstrate?	Skills
Set up tools and equipment to carry out cutting, drilling, sawing and fitting activities.	MC1
Select the most appropriate **method** to produce or alter the component.	MC2
Use hand and machine cutting tools to manipulate **materials** into shapes and profiles to meet **technical documentation**.	MC3
Check machined components meet the required quality standard.	MC4
Fasten components together to produce a range of **assemblies**.	MC5

Provides the detail of the information required to be delivered and assessed as part of that topic.

Relate to Core Skills and general competencies in English, Mathematics and Digital Skills.

OS Exemplar Assessment - Fitting and Assembly Technologies

2. Assignment brief

You are working as a fitter/maintenance engineer in a large-scale fabrication facility. You have been asked to join a team of engineers that are setting up production processes to create small batch (100 parts per batch) production of new components.

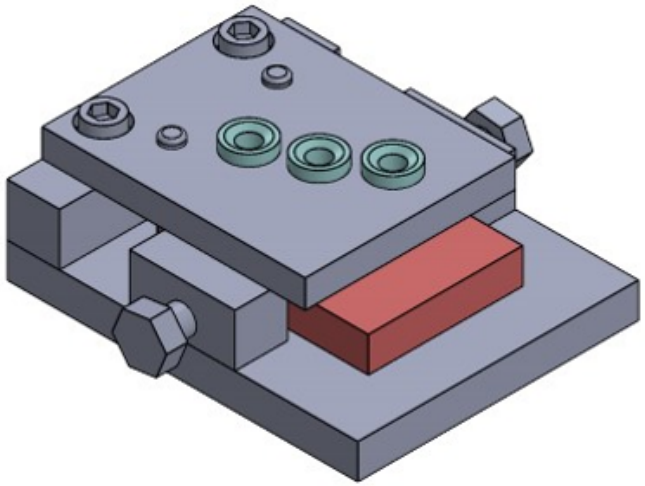
Each component has a number of spaced drilled holes so set-up speed, accuracy and efficiency of drilling, and machine up-time are all important. Technical drawings for the drill jig have been provided by the design department.

You are required to:

- create a drill jig to drill a series of holes quickly and accurately for the manufacturing process
- quality test the drilling output and adjust the jig as needed
- produce a sample drilled part for quality checking
- evaluate the processes and procedures used to produce the finished drill rig assembly
- present your findings to your supervisor in a handover meeting.

This assignment has a time allocation of **25 hours and 15 minutes**.

Drill jig assembly



Time

The time allocated for the completion of the tasks and production of evidence for this assessment is **25 hours and 15 minutes**. Timings for completion of specific tasks are outlined below.

- Task 1 – 3 hours
- Task 2 – 18 hours
- Task 3 – 4 hours and 15 minutes.

When working under supervised conditions for longer sessions, breaks can be facilitated outside of the controlled conditions, ensuring the room is locked and all candidates have vacated once the break begins. All materials **must** be kept securely during the break.

OS Exemplar Assessment - Fitting and Assembly Technologies

Task 1 – Planning

Candidates **must**:

a) analyse the brief and technical information to produce a resources list needed for the production of the drill jig
b) produce a risk assessment covering all the activities needed to produce the drill jig
c) produce a method statement with justifications
d) create a work plan
e) produce a
    - commissioning checklist (for use in task 2)
    - quality check sheet (for use in task 3a)
f) carry out calibration checks on measurement equipment.

Resources:

- technical drawings
- writing materials
- measuring and marking out equipment (with calibration certificate) (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape, scribe)
- generic risk assessment template
- COSHH data sheets
- non-programmable calculator.

Task 2 – Production

Candidates **must**:

a) prepare the work area
b) produce the drill jig assembly using both hand tools and workshop machinery
c) commission the assembly and complete the commissioning checklist
d) reinstate the work area following the production of the drill jig assembly.

Resources:

- access to a range of hand tools
- access to a pillar drill
- marking out tools
- measurement and inspection tools (with calibration certificate) (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape)
- suitable surface treatment: degreaser, lubricant, rust protection spray
- full range of PPE (eye protection (glasses/goggles/visor), safety footwear, overalls, gloves, masks/face protection)
- COSHH data sheets
- access to the required production drawings
- commissioning checklist template
- copies of completed documentation from Task 1.

Materials:

- low carbon mild steel plate
- mild steel locating rods
- pre-manufactured bolts, dowels and press fit bushes.

OS Exemplar Assessment - Fitting and Assembly Technologies

Task 3A – Quality review

Candidates **must**:

a) carry out a full quality inspection of the completed drill jig assembly, recording findings using the quality check sheet
b) produce a sample drilled part.

Resources:

- measurement and inspection tools (with calibration certificate) (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape)
- writing materials
- copies of completed documentation from Task 1
- quality check sheet from Task 1
- drill jig assembly from Task 2
- materials to create sample part
- drilling equipment and tooling.

Task 3B – Evaluation and recording

Candidates **must**:

a) produce a quality inspection report evaluating the production of their finished drill jig assembly. The report should typically be 800 words.
This **must** include:
    - finished sizes of components and confirmation the drill jig assembly conforms to the dimensional requirements of the specification
    - an explanation of the quality checks undertaken and the reasons for their use
    - result of the sample drilled part and functioning of the drill jig assembly
    - a concessions list for every facet of the assembly that does not conform to the specification, reasons for occurrence and how to prevent reoccurrence
    - an evaluation of the fitness for purpose of the finished drill jig assembly and method of production used with reasoning and justifications
    - any improvements or adaptions required to the drill jig assembly, including any reasoning and justifications if adaptions or improvements are not required.

Resources:

- writing materials
- access to a computer to write report
- copies of completed documentation from Task 1
- completed drill jig assembly
- sample drilled part.

Task 3C – Handover

Candidates **must**:

a) hold a meeting with the supervisor to complete handover procedures, including:
    - confirmation of work completed
    - overview of findings in quality inspection report
    - suggested improvements to design or production process
    - handover of finished drill jig assembly, sample part and quality inspection report.

Resources:

- quality inspection report
- completed drill assembly from Task 2
- sample drilled part from Part 3A.

Technical Qualification - Engineering, Manufacturing, Processing and Control

Occupational Specialism – Machining and Toolmaking Technologies

Performance Outcomes- Machining and Toolmaking Technologies

- The weightings for each performance outcome will remain the same for every version of the practical assignment. This ensures the appropriate depth and breadth of knowledge and skills for each specialism can be reliably assessed in every version and meets the needs of industry while keeping comparability between each assessment over time.

Performance outcome	Typical knowledge and skills	Weighting
PO2 Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications.	Interpret requirements of a brief through the analysis and interrogation of available information sources and formats. Consider all relevant aspects of a brief, challenging and confirming expectations including risks and issues. Select and use techniques, processes and technologies that will assist in the analysis of information available.	17%
PO3 Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant products and produce appropriate outcomes.	Plans to meet the requirements of a brief effectively with consideration of required resources and technology. Identify and mitigate potential issues prior to the manufacturing activity. Check materials conform to specification. Prepare the work area including required tools and equipment for manufacturing products. Measure and mark out components to specification minimising material wastage.	21%
PO4 Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant machining and toolmaking technologies, methods and processes.	Accurately shape and manipulate components and products by material removal using appropriate machines, tools and equipment. Effectively operate machinery using appropriate safety measures and guarding. Prepare surfaces and apply suitable treatments to products.	27%
PO5 Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.	Monitor production processes, identifying potential risks, issues and problems. Deal with issues and problems quickly and efficiently, using appropriate techniques and processes to address or resolve them, escalate issues in line with correct lines of reporting. Monitor work to ensure efficiency, and carry out checks as part of the production process, safely at all times.	19%
PO6 Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.	Use different techniques to communicate technical information effectively with consideration of audience and format. Produce technical documentation using available tools and technology, accurately recording information, data and risks as part of handover of the process to client/end user.	16%

MPC Machining and Toolmaking Technologies (page 33 onwards in specification)

Component	Assessment method	Overview and conditions
Occupational Specialism assignment	Externally set, externally moderated	This assignment is **externally set, internally marked and externally moderated**, and is designed to require the learner to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories and knowledge from across the occupational area. Assignments will be released to centre staff towards the end of the learners' programme, usually the week before Easter each year. Centres will be required to maintain the security of all live assessment materials until assessment windows are open. Assignments will therefore be password-protected and released to centres through a secure method. Guidance on equipment, resources and duration will be released as appropriate to ensure centres can plan for delivery of practical assignments in advance. Learners who fail the occupational specialism following the first submission can retake in any assessment window. Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking process and associated marking grid in the assessment pack for the qualification, and guidance on the use of marking grids.

Component	Assessment method	Overview and conditions
Machining and toolmaking technologies	Externally set, externally moderated	**Content overview** Learners will be able to: • Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications. • Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant products and produce appropriate outcomes. • Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant machining and toolmaking technologies, methods and processes. • Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices. • Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes. **Assessment overview:** Learners will be assessed against the following assessment themes: Health and safety Planning and preparation Production Quality review and evaluation

Specification – Machining and Toolmaking Technologies (page 109 onwards)

Knowledge (page 111 onwards)

Practical Skills (page 121 onwards)

Underpinning knowledge outcomes

On completion of this specialism, learners will understand:

1. Machining and toolmaking technologies knowledge criteria.

Performance outcomes

On completion of this specialism, learners will be able to:

2. Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications.

3. Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant products and produce appropriate outcomes.

4. Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant machining and toolmaking technologies, methods and processes.

5. Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.

6. Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.

Completion of this specialism will give learners the opportunity to develop their maths, English and digital skills. Details are presented at the end of the specification.

332 Machining and toolmaking technologies

Level:	3
GLH:	680
Assessment method	Practical assignment

What is this specialism about?

The purpose of this specialism is for learners to know and undertake a range of industrial processes and manufacturing techniques to manufacture and maintain the engineering tooling used to produce components, products and assemblies. This requires the application of a broad range of activities including the interpretation of engineering drawings and technical instructions and the use of hand, machine and automated computer-controlled machine tools and measuring equipment.

Learners will develop their knowledge and understanding of, and skills in:

- common materials structure, composition and properties.
- special requirements for tools and fixtures for the manufacture of components.
- requirements for tools and fixtures to aid the manufacture of new or changed components.
- how to set up, select and safely operate, the application of a range of hand tools, operating principles of a range of complex and often state of the art workshop machinery.
- analysis of data, documentation, tasks, projects and specifications.
- producing products to specification using suitable methods and techniques.
- undertaking preventative planned maintenance and checking for faults using fault diagnosis.
- utilising project management and process improvement.

Learners may be introduced to this specialism by asking themselves questions such as:

- What are the different techniques that are used to produce complex components?
- How are car parts like alloy wheels, produced and how many people does it take?
- Where do these processes and production methods take place?
- What is the impact on a process if people are replaced by automated processes?

OS Exemplar Assessment – Machining and Toolmaking Technologies

2. Assignment brief

You are employed within the research and development department of a local engineering company which produces a range of products to the engineering sector.

You have been asked to produce a bearing assembly to be used to in a roller assembly of a bespoke conveyor system.

The bearing assembly is to be manufactured from low carbon mild steel and nylon, produced using the lathe and milling machines you have within your facility.

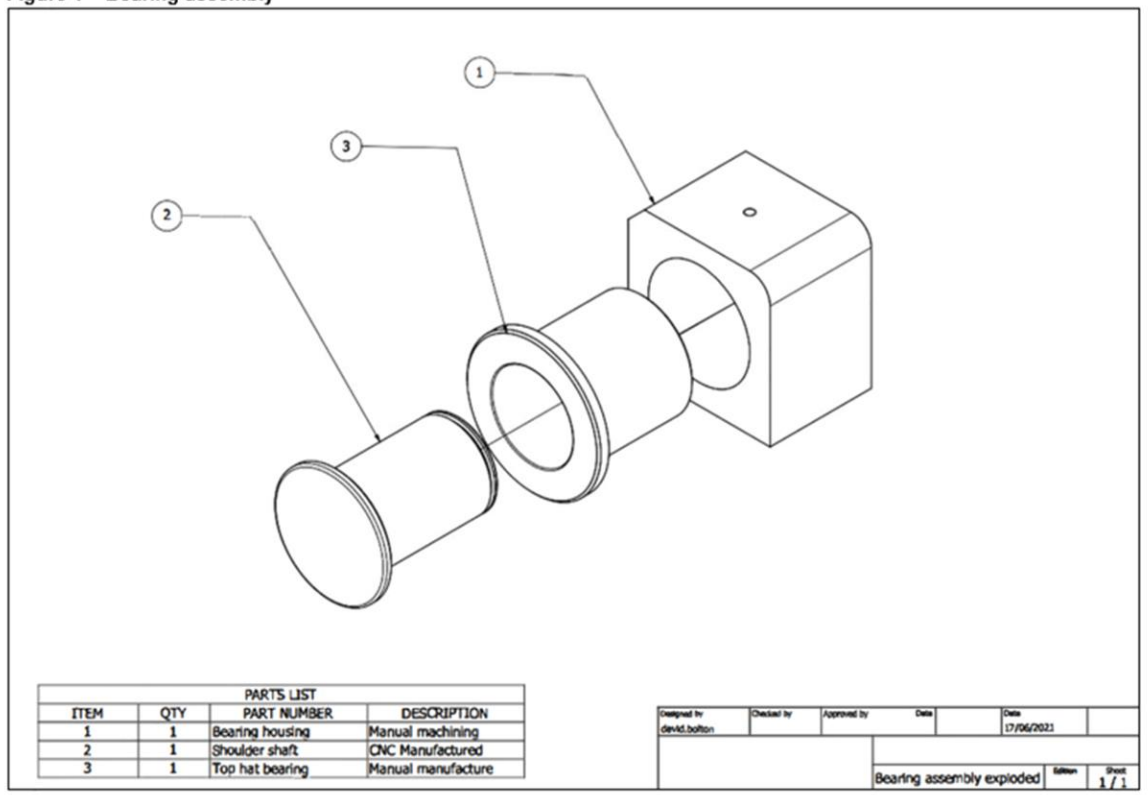
The design office has provided technical drawings.

You are required to:

- create a new bearing assembly
- use manual and pre-programmed CNC machines to manufacture the components
- carry out in-production checks, make adjustments to the components, as required, to ensure the fit conforms to the specification
- quality check the completed bearing assembly
- finish all components with an anti-corrosion product prior to handover
- evaluate the processes and procedures used to produce the finished bearing assembly
- present your completed work and your findings to your supervisor at a handover meeting.

This assignment has a time allocation of **25 hours and 15 minutes.**

Figure 1 – Bearing assembly



Time

The time allocated for the completion of the tasks and production of evidence for this assessment is **25 hours and 15 minutes**. Timings for completion of specific tasks are outlined below.

- Task 1 – 3 hours
- Task 2 – 18 hours
- Task 3 – 4 hours and 15 minutes.

When working under supervised conditions for longer sessions, breaks can be facilitated outside of the controlled conditions, ensuring the room is locked and all candidates have vacated once the break begins. All materials **must** be kept securely during the break.

OS Exemplar Assessment – Machining and Toolmaking Technologies

Task 1 – Planning

Candidates **must**:

a) analyse the brief and technical information to produce a resources list needed for the production of the bearing assembly
b) produce a risk assessment for the activities needed to produce the bearing assembly to specification
c) produce a method statement with justifications
d) create a work plan
e) produce a:
   - commissioning checklist (for use in Task 2)
   - quality check sheet (for use in Task 3A)
f) carry out calibration checks on measurement equipment.

Resources:

- technical drawings
- writing materials
- measuring equipment (with calibration certificate) (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape)
- generic risk assessment generic template
- non-programmable calculator.

Task 2 – Production

Candidates **must**:

a) prepare the work area
b) produce the bearing assembly components using both manual and pre-programmed computer numerical control (CNC) machinery to specification
c) apply a suitable surface treatment to the finished components
d) commission the assembly and complete the commissioning checklist
e) reinstate the work area following the production of the bearing assembly.

Resources:

- access to a conventional/manual milling machine
- access to the associated tooling required to produce the components
- access to a manual lathe and CNC centre lathe
- access to the associated tooling/holding devices required to aid with the production of the components
- measuring equipment (with calibration certificate (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape)
- anti-corrosion surface treatment (e.g. degreaser, lubricant, rust protection spray, light tool oil)
- PPE (eye protection, safety footwear, overalls, gloves, masks/face protection)
- technical drawings
- commissioning checklist template
- copies of completed documentation from Task 1.

Materials:

- low carbon mild steel billet with appropriate diameter to the shoulder shaft
- low carbon mild steel billet at correct dimensions to allow machining of bearing housing
- nylon rod billet with appropriate diameter to allow machining of top hat bearing.

OS Exemplar Assessment – Machining and Toolmaking Technologies

Task 3A – Quality review

Candidates **must**:

a) carry out a full quality inspection of the completed bearing assembly
b) record findings using the quality check sheet.

Resources:

- selection of measuring equipment (with calibration certificate) (e.g. callipers, go-no-go gauges, DTI clock gauge, rules, tape)
- writing materials
- copies of completed documentation from Task 1
- quality check sheet from Task 1
- completed bearing assembly from Task 2.

Task 3B – Evaluation and recording

Candidates **must**:

a) produce a quality inspection report evaluating the production of their finished bearing assembly. The report should typically be 800 words.
This **must** include:
    - finished sizes of components and confirmation the bearing assembly conforms to the dimensional requirements of the specification
    - an explanation of the quality checks undertaken and the reasons for their use
    - an evaluation of the fitness for purpose of the finished bearing assembly and method of production used with reasoning and justifications
    - a concessions list for every facet of the bearing assembly that does not conform to the specification, reasons for occurrence and how to prevent reoccurrence
    - any improvements or adaptions required to the bearing assembly, including any reasoning and justifications if adaptions or improvements are not required.

Resources:

- writing materials
- access to a computer to write report
- copies of completed documentation from Task 1
- completed bearing assembly.

Task 3C – Handover

Candidates **must**:

a) hold a meeting with the supervisor to complete handover procedures, including:
    - confirmation of work completed
    - overview of findings in quality inspection report
    - suggested improvements to design or production process
    - handover of completed bearing assembly and quality inspection report.

Resources:

- quality inspection report
- completed bearing assembly from Task 2.

Technical Qualification - Engineering, Manufacturing, Processing and Control

Occupational Specialism – Composites Manufacturing Technologies

Performance Outcomes- Composites Manufacturing Technologies

- The weightings for each performance outcome will remain the same for every version of the practical assignment. This ensures the appropriate depth and breadth of knowledge and skills for each specialism can be reliably assessed in every version and meets the needs of industry while keeping comparability between each assessment over time.

Performance outcome	Typical knowledge and skills	Weighting
PO2 Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications.	Interpret requirements of a brief through the analysis and interrogation of available information sources and formats. Consider all relevant aspects of a brief, challenging and confirming expectations including risks and issues. Select and use techniques, processes and technologies that will assist in the analysis of information available.	10%
PO3 Plan and prepare the relevant processes, tools, equipment, and resources, needed to manufacture relevant products and produce appropriate outcomes.	Plans to meet the requirements of a brief effectively with consideration of required resources and technology. Identify and mitigate potential issues prior to the production activity. Check materials conform to specification. Prepare the work area including required tools and equipment for moulding composite products. Measure and mark out materials to specification and plan for wastage and disposal.	28%
PO4 Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant composite manufacturing technologies, methods and processes.	Prepare moulds and materials prior to laminating activities. Laminate the required product and apply debulking and consolidation processes. Cure the product according to manufacturer's specification. De-mould the components, safe-edge, trim and prepare for assembly. Assemble the product and carry out finishing processes.	43%
PO5 Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.	Monitor production processes, identifying potential risks, issues and problems. Deal with issues and problems quickly and efficiently, using appropriate techniques and processes to address or resolve them, escalate issues in line with correct lines of reporting. Monitor work to ensure efficiency, and carry out checks as part of the production process, ensuring safety at all times.	10%
PO6 Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.	Use different techniques to communicate technical information effectively with consideration of audience and format. Produce technical documentation using available tools and technology, accurately recording information, data and risks as part of handover of the process to client/end user.	9%

MPC Composites Manufacturing Technologies (page 33 onwards in specification)

Component	Assessment method	Overview and conditions
Occupational Specialism assignment	Externally set, externally moderated	This assignment is **externally set, internally marked and externally moderated**, and is designed to require the learner to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories and knowledge from across the occupational area. Assignments will be released to centre staff towards the end of the learners' programme, usually the week before Easter each year. Centres will be required to maintain the security of all live assessment materials until assessment windows are open. Assignments will therefore be password-protected and released to centres through a secure method. Guidance on equipment, resources and duration will be released as appropriate to ensure centres can plan for delivery of practical assignments in advance. Learners who fail the occupational specialism following the first submission can retake in any assessment window. Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking process and associated marking grid in the assessment pack for the qualification, and guidance on the use of marking grids.

Component	Assessment method	Overview and conditions
Composite manufacturing technologies	Externally set, externally moderated	**Content overview** Learners will be able to: • Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications. • Plan and prepare the relevant processes, tools, equipment, and resources, needed to manufacture relevant products and produce appropriate outcomes. • Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant composite manufacturing technologies, methods and processes. • Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices. • Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes. **Assessment overview:** Learners will be assessed against the following assessment themes: Health and safety Planning and preparation Production Quality review and evaluation

Specification – Composites Manufacturing Technologies (page 137 onwards)

Knowledge (page 139 onwards)

Practical Skills (page 152 onwards)

Underpinning knowledge outcomes

On completion of this specialism, learners will understand:

1. Composites manufacturing technologies knowledge criteria

Performance outcomes

On completion of this specialism, learners will be able to:

2. Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings and specifications.
3. Plan and prepare the relevant processes, tools, equipment, and resources, needed to manufacture relevant products and produce appropriate outcomes
4. Produce relevant products and outcomes, considering the specified requirements, context and materials, using the relevant composite manufacturing technologies, methods and processes.
5. Support the delivery (and management) of relevant projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.
6. Communicate production information, proposals, and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.

Completion of this specialism will give learners the opportunity to develop their maths, English and digital skills. Details are presented at the end of the specification.

333 Composites manufacturing technologies

Level:	3
GLH:	680
Assessment method	Practical assignment

What is this specialism about?

The purpose of this specialism is for learners to know and understand composites manufacturing technologies. Learners will engage with the technical expertise, technology, methods, and skills involved in developing and making products at various scales, using specialist tools, materials, equipment and machinery.

Learners will examine a range of industrial processes, computer-aided manufacture, manual and machining techniques, research, and planning required to develop products using a combination of materials and components to form a lighter, more efficient and stronger rigid structure, and to understand how these complex processes, practices and outcomes are evaluated and optimised.

Learners will develop their knowledge and understanding of, and skills in:

- Scientific and mathematical principles along with technical and materials awareness.
- Suitable tools and equipment, machines and technology widely used in composites manufacturing along with damage assessment and process induced faults and failures.
- General workplace practices and composites manufacturing standards.
- Regulatory and legal requirements, specifically health and safety.
- Project and programme management incorporated into general business and commercial aspects of manufacturing.
- Composites manufacturing quality aspects and communications in the workplace.
- Drawings and tools used in composites manufacturing.
- Planning, preparation, and production of composites manufactured products.
- Communications and supporting composites manufacturing activities.

Learners may be introduced to this specialism by asking themselves questions such as:

- What are the processes involved to manufacture composite components for a high-performance sports car?
- How are composite materials produced and tested for strength?
- How does the use of composite materials affect the design of a product, compared to those traditionally produced in metal?
- What are the cost implications of using composite materials in the manufacturing process?

OS Exemplar Assessment – Composites Manufacturing Technologies

2. Assignment brief

You are working as a composite materials technician in a large-scale composite fabrication facility. You have been asked to join a team of composite engineers that are setting up production processes to create small batch (100 parts per batch) production of composite components.

You have been tasked with producing an assembly to be used as a spacer block within the aerospace industry to ensure the correct spacing of wing skins in a jig during the manufacturing process.

Each component has a number of plies which are either laid up on a platen or onto a core material.

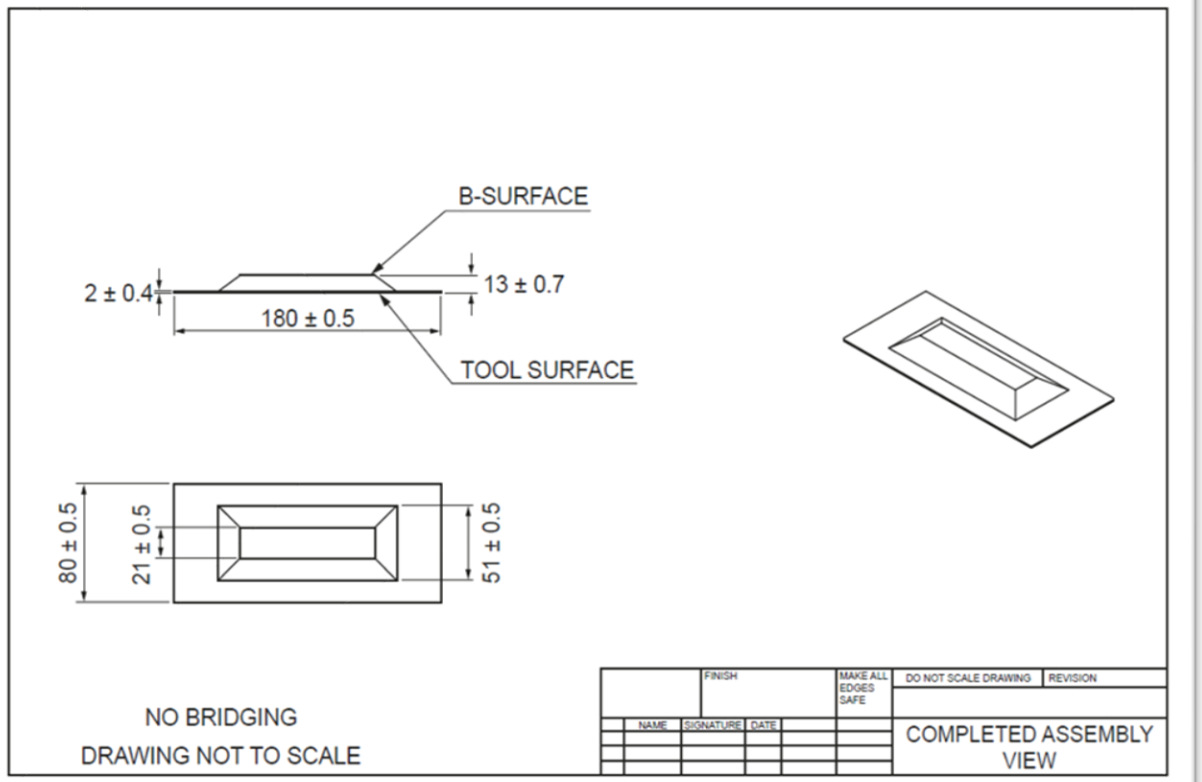
Technical drawings for the assembly have been provided by the design department which indicate the specified composite materials to be used for the construction of the spacer block assembly.

You are required to:

- create a sample spacer block assembly using specified composite materials and the vacuum bag consolidation method
- perform in-production quality checks to ensure the dimensions and make any required adjustments to conform to the specification
- quality test the finished spacer block assembly
- evaluate the processes utilised and evaluate your work
- identify and attribute faults in other manufactured assemblies to deficiencies in material selection, production or process.
- record and present your findings to your supervisor at a handover meeting.

This assignment has a time allocation of **24 hours and 15 minutes.**

Figure 1 – Completed assembly view



Time

The time allocated for the completion of the tasks and production of evidence for this assessment is **24 hours and 15 minutes**. Timings for completion of specific tasks are outlined below.

- Task 1 – 3 hours
- Task 2 – 16 hours
- Task 3 – 5 hours and 15 minutes.

When working under supervised conditions for longer sessions, breaks can be facilitated outside of the controlled conditions, ensuring the room is locked and all candidates have vacated once the break begins. All materials **must** be kept securely during the break.

OS Exemplar Assessment – Composites Manufacturing Technologies

Task 1 – Planning

Candidates **must**:

a) analyse the brief to produce a resources list needed for the production and fabrication of the composite assembly and spacer block
b) produce a risk assessment for the activities needed to produce and fabricate the assembly to specification
c) create a method statement with justifications
d) create a work plan
e) produce a quality check sheet for use in Task 3B
f) carry out calibration checks on measurement equipment.

Resources:

- technical drawings
- writing materials
- measuring equipment (with calibration certificate)
- engineering technical data references (e.g. manufacturer's data sheets)
- generic risk assessment template.

Task 2A – Preparing the mould

Candidates **must**:

a) prepare the work area
b) prepare the mould
c) reinstate the work area.

Resources:

- writing materials
- mould
- cleaning supplies and tools
- a range of release agents
- appropriate PPE (as per resources list)
- copies of completed documentation from Task 1.

Task 2B – Production of the spacer block components

Candidates **must**:

a) prepare the work area for the laying up activities
b) construct the spacer block components (lower, core and upper) demonstrating:
    - marking out and cutting materials
    - laying up
    - curing
    - demoulding
c) re-instate the work area.

Resources:

- writing materials
- twill weave carbon epoxy pre-preg composite material (210g/m² 2x2 twill weave carbon epoxy pre-preg recommended)
- closed core foam sheet
- demoulding equipment including demoulding wedges, trimming, finishing and measuring equipment
- laminating consumables to include peel-ply, breather fabric, tacky tape, bagging film, vacuum breach units
- vacuum application and consolidation equipment
- curing equipment
- marking and measuring out equipment
- tools (as per resources list)
- appropriate PPE (as per resources list)
- copies of completed documentation from Task 1.

OS Exemplar Assessment – Composites Manufacturing Technologies

Task 2C – Assembly

Candidates **must**:

a) prepare the work area for the assembly activities
b) complete the spacer block assembly; demonstrating:
   - the bonding process
   - the curing process
   - the trimming and finishing process.

Resources

- writing materials
- twill weave carbon epoxy pre-preg composite material (210g/m² 2x2 twill weave carbon epoxy pre-preg recommended)
- demoulding equipment including demoulding wedges, trimming, finishing and measuring equipment
- laminating consumables to include peel-ply, breather fabric, tacky tape, bagging film, vacuum breach units
- vacuum application and consolidation equipment
- curing equipment
- marking out equipment
- measurement equipment (with calibration certificate)
- tools (as per resources list)
- appropriate PPE (as per resources list)
- copies of completed documentation from Task 1.

Task 3A – Defect identification

Candidates **must**:

a) carry out a defect identification inspection of a pre-fabricated defect sample assembly
b) suggest processes that should be introduced or modified to prevent defects that are present in the defect sample assembly from reoccurring in future production runs.

Resources:

- pre-fabricated defect sample assembly
- writing materials
- measurement equipment (with calibration certificate)
- copies of completed documentation from Task 1.

OS Exemplar Assessment – Composites Manufacturing Technologies

Task 3B – Quality review and recording

Candidates **must:**

a) perform quality assurance checks on their finished assembly
b) produce an inspection report evaluating the production of their finished assembly. The report should typically be 800 words.
This **must** include:
- finished sizes of components and confirmation the spacer block assembly conforms to the dimensional requirements of the specification
- an explanation of the quality checks undertaken and the reasons for their use
- an evaluation of the fitness for purpose of the finished spacer block assembly and method of production used with reasoning and justifications
- a concessions list for every facet of the spacer block assembly that does not conform to the specification, reasons for occurrence and how to prevent reoccurrence
- any amendments needed to their work plan with reasoning
- any improvements or adaptions required to the spacer block, including any reasoning and justifications if adaptions or improvements are not required.

Resources:

- measuring equipment (with calibration certificate)
- quality check sheet from Task 1
- writing materials
- access to a computer to write the report
- copies of completed documentation from Task 1
- completed spacer block assembly from Task 2C.

Task 3C – Handover

Candidates **must**:

a) hold a meeting with the supervisor to complete handover procedures, including:
- confirmation of work completed
- overview of findings in Quality inspection report
- suggested improvements to design or process
- handover of finished spacer block assembly and Quality inspection report.

Resources:

- quality inspection report
- the completed spacer block assembly.

Technical Qualification - Engineering, Manufacturing, Processing and Control

Occupational Specialism – Fabrication and Welding Technologies

Performance Outcomes- Fabrication and Welding Technologies

- The weightings for each performance outcome will remain the same for every version of the practical assignment. This ensures the appropriate depth and breadth of knowledge and skills for each specialism can be reliably assessed in every version and meets the needs of industry while keeping comparability between each assessment over time.

Performance outcome	Typical knowledge and skills	Weighting
PO2 Analyse the tasks, projects and specifications, considering the specific processing requirements, context, resources, materials, tools and equipment, and the suitability of different fabrication and welding technologies, methods and processes.	Interpret requirements of a brief through the analysis and interrogation of available information sources and formats. Consider all relevant aspects of a brief challenging and confirming expectations including risks and issues. Select and use techniques, processes and technologies that will assist in the analysis of information available.	13%
PO3 Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant materials and products.	Plans to meet the requirements of a brief effectively with consideration of required resources and technology. Identify and mitigate potential issues prior to the fabrication activity. Check materials conform to specification. Prepare the work area including required tools and equipment for fabricating products. Measure and mark out components to specification and plan for wastage and disposal.	19%
PO4 Produce the relevant product considering the specified requirements and raw materials using the relevant fabrication and welding process and method.	Use measurement techniques, tools and equipment safely and efficiently. Accurately cut,shape and drill products using cutting, forging, fabrication and welding techniques. Use effective joining and bonding techniques and equipment. Assembly all components to produce the final fabricated product.	35%
PO5 Support the delivery (and the management) of relevant fabrication and welding projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.	Evaluate conditions and processes to support selection and application of specific materials. Carry out quality monitoring and assurance checks on fabricated product. Use non-destructive testing methods. Deal with issues and problems quickly and efficiently, escalate issues in line with correct lines of reporting. Monitor work to ensure efficiency, and safety at all times.	21%
PO6 Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.	Use different techniques to communicate technical information effectively with consideration of audience and format. Produce technical documentation using available tools and technology, accurately recording information, data and risks as part of handover of the process to client/end user.	12%

MPC Fabrication and Welding Technologies (page 33 onwards in specification)

Component	Assessment method	Overview and conditions
Occupational Specialism assignment	Externally set, externally moderated	This assignment is **externally set, internally marked and externally moderated**, and is designed to require the learner to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories and knowledge from across the occupational area. Assignments will be released to centre staff towards the end of the learners' programme, usually the week before Easter each year. Centres will be required to maintain the security of all live assessment materials until assessment windows are open. Assignments will therefore be password-protected and released to centres through a secure method. Guidance on equipment, resources and duration will be released as appropriate to ensure centres can plan for delivery of practical assignments in advance. Learners who fail the occupational specialism following the first submission can retake in any assessment window. Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking process and associated marking grid in the assessment pack for the qualification, and guidance on the use of marking grids.

Component	Assessment method	Overview and conditions
Fabrication and welding technologies	Externally set, externally moderated	**Content overview** Learners will be able to: • Analyse the tasks, projects and specifications, considering the specific processing requirements, context, resources, materials, tools and equipment, and the suitability of different fabrication and welding technologies, methods and processes. • Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant materials and products. • Produce the relevant product considering the specified requirements and raw materials using the relevant fabrication and welding process and method. • Support the delivery (and the management) of relevant fabrication and welding projects and activities, helping to evaluate and review processes and outcomes, and to improve practices. • Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes. **Assessment overview:** Learners will be assessed against the following assessment themes: Health and safety Planning and preparation Production and assembly Quality testing, review and evaluation

Specification – Fabrication and Welding Technologies (page 166 onwards)

Knowledge (page 168 onwards)

Practical Skills (page 176 onwards)

Underpinning knowledge outcomes

On completion of this specialism, learners will understand:

1. Fabrication and welding technologies knowledge criteria

Performance outcomes

On completion of this specialism, learners will be able to:

2. Analyse the tasks, projects and specifications, considering the specific processing requirements, context, resources, materials, tools and equipment, and the suitability of different fabrication and welding technologies, methods and processes.

3. Plan and prepare the relevant processes, tools, equipment, and resources, needed to produce relevant materials and products.

4. Produce the relevant product considering the specified requirements and raw materials using the relevant fabrication and welding process and method.

5. Support the delivery (and the management) of relevant fabrication and welding projects and activities, helping to evaluate and review processes and outcomes, and to improve practices.

6. Communicate production information, proposals and solutions, producing, recording and explaining relevant technical information, representations, processes and outcomes.

Completion of this specialism will give learners the opportunity to develop their maths, English and digital skills. Details are presented at the end of the specification.

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Level:	3
GLH:	680
Assessment method	Practical assignment

What is this specialism about?

The purpose of this specialism is for learners to know and undertake a range of industrial processes and manufacturing techniques to carry out metal fabrication work and in welding technologies which can be used across a range of sectors including civil engineering, marine, automotive, petro-chemical and aviation. The size and weight of the fabrications can range from components that can easily be picked up by hand, to massive structures that require several cranes to manipulate.

Learners will develop their knowledge and understanding of, and skills in:

- knowledge of structure, properties and characteristics of common materials.
- knowledge of general engineering mathematical and scientific principles including metallurgy.
- knowledge of machinery and technology used in fabrication and welding.
- knowledge of importance to continually review fabrication and general engineering processes and procedure.
- knowledge of principles, procedures and testing of different joining techniques.
- skills in the analysis of technical documentation, tasks, projects and specifications.
- skills in producing products to specification using suitable methods and techniques.
- skills in cutting and forming metal for the production of fabricated products.
- skills in quality, compliance or testing using the correct procedures, processes and/or equipment.

Learners may be introduced to this specialism by asking themselves questions such as:

- What are the different welding techniques that are used to produce complex components?
- Do I like working as part of a team to achieve a common goal?
- Do I like working to given instructions, working accurately and being responsible for the quality of a finished product?
- How are welds tested for quality and strength?

OS Exemplar Assessment – Fabrication and Welding Technologies

2. Assignment brief

You are working as a fabrication engineer for a local company which fabricates many products including products for the marine industry.

You have been asked to plan out the required material and cut sizes, and then fabricate and weld an anchor for a customer's small boat.

The customer has supplied the overall size of the anchor required.

You are required to fabricate all parts of the anchor including the:

- stock
- crown
- shank
- flukes and support.

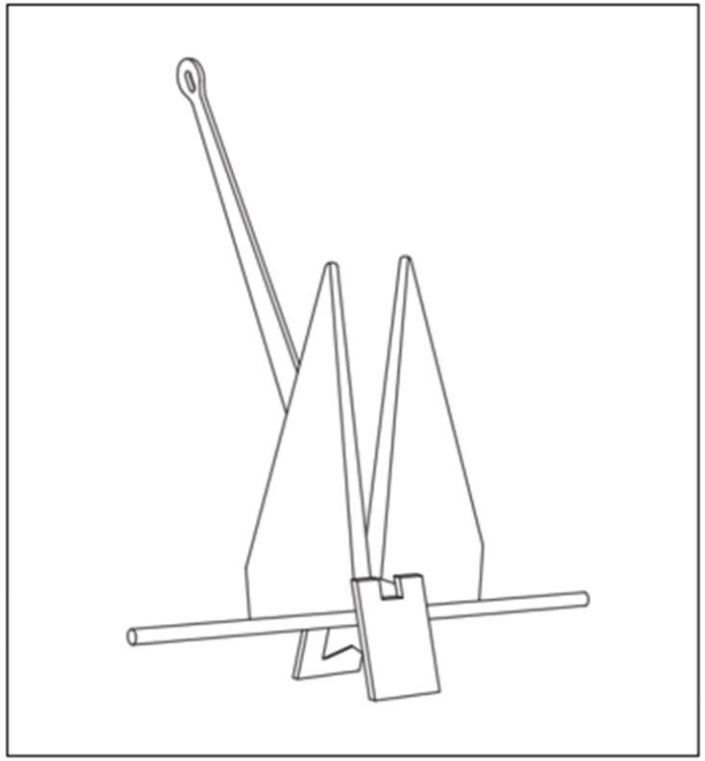
Once the anchor has been fabricated and welded you will have to test the integrity of your welds using a Non-Destructive Testing (NDT) method.

You will complete the assembly of the anchor by attaching the pre-fabricated chain and shackle.

You will evaluate the processes and procedures used to produce the finished anchor and present your findings to your supervisor in a handover meeting.

This assignment has a time allocation of **26 hours and 15 minutes.**

Design representation



Time

The following timings are provided to support centre planning.

The time allocated for the completion of the tasks and production of evidence for this assessment is **26 hours and 15 minutes**. Timings for completion of specific tasks are outlined below.

- Task 1 – 3 hours
- Task 2 – 20 hours
- Task 3 – 3 hours and 15 minutes.

When working under supervised conditions for longer sessions, breaks can be facilitated outside of the controlled conditions, ensuring the room is locked and all candidates have vacated once the break begins. All materials **must** be kept securely during the break.

OS Exemplar Assessment – Fabrication and Welding Technologies

Task 1 – Planning

Candidates **must**:

a) analyse the brief and technical information to produce a resources list needed for the production of the anchor
b) produce a risk assessment for the activities needed for the production of the anchor
c) produce a method statement with justifications for the production of the anchor
d) complete a hot works permit
e) carry out calibration checks on measurement equipment
f) produce a detailed work plan for the fabrication, welding and testing of the anchor
g) produce a cutting list for the fabricated pieces
h) produce a quality check sheet for use in Task 3A.

Resources:

- writing materials
- measuring equipment (with calibration certificate)
- engineering drawings
- risk assessment generic template
- hot works generic template
- copies of industrial welding standards.

Task 2 – Production

Candidates **must**:

a) prepare the work area
b) mark out and cut components for the anchor using cutting equipment
c) prepare cut components for welding
d) fabricate the components using two different welding techniques and two different welding positions
e) forge the stock end
f) assemble the anchor
g) reinstate the work area.

Resources

- Personal Protective Equipment (PPE) (auto-darkening welding helmet, air-fed welding helmet, welding jacket or apron, welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator)
- marking out tools
- hand tools (hammer, hand file)
- band saw
- abrasive equipment (files, angle grinder)
- cutting equipment (flame, plasma, laser, power nibblers, hand tools)
- welding equipment (two from TIG, MIG, MAG, MMA)
- forging equipment (hammers, furnace or equivalent, tongs, clamping vice)
- drilling equipment (pillar drill, power tool, bits, chucks)
- emery cloth
- copies of completed documentation from Task 1.

Materials:

- 6mm mild steel plate
- 6mm mild steel round bar
- 10mm mild steel flat bar
- mild steel chain (pre-fabricated)
- shackle (pre-fabricated)
- pin (pre-fabricated).

OS Exemplar Assessment – Fabrication and Welding Technologies

Task 3A – Quality review and testing

Candidates **must**:

a) prepare the work area to carry out non-destructive testing
b) perform quality assurance checks to the fabricated assembly
c) perform non-destructive testing methods to **three** different welds
d) record NDT test results in the quality check sheet.

Resources:

- writing materials
- PPE (welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator)
- magnetic particle testing equipment
- welding brush
- welding magnifying glass
- cleaning products
- measuring equipment (with calibration certificate)
- quality check sheet from Task 1
- copies of completed documentation from Task 1.

Task 3B – Evaluation and recording

Candidates **must:**

a) produce an inspection report evaluating the production of the finished anchor. The report should typically be 800 words.
   This **must** include:
   - finished sizes of components and confirmation the fabricated anchor conforms to the dimensional requirements of the specification
   - results from the non-destructive testing with reasonings
   - an explanation of the quality checks undertaken and the reasons for their use
   - an evaluation of the fitness for purpose of the finished assembly and method of production used with reasoning and justifications
   - a concessions list for every facet of the assembly that does not conform to the specification, reasons for occurrence and how to prevent reoccurrence
   - any amendments needed to their work plan with reasoning
   - any improvements or adaptions required to the anchor, including any reasoning and justifications if adaptions or improvements are not required.

Resources:

- writing materials or access to a computer to compose report
- copies of completed documentation from Task 1
- completed quality check sheet (from Task 3A)
- completed assembly for Task 2.

Task 3C – Handover

Candidates **must**:

a) hold a meeting with the supervisor to complete handover procedures, including:
   - confirmation of work completed
   - overview of finding in quality inspection report
   - suggested improvements to design or process
   - handover of finished anchor and quality inspection report.

Resources:

- quality inspection report
- completed anchor assembly from Task 2.

OS Exemplar Assessment – Fabrication and Welding Technologies Marking Grid

Marking grids

There is a marking grid for each assessment theme that **must** be assessed as part of this occupational specialism assessment. The individual statements within the band descriptors should be treated together to make one whole descriptor and **not** separately.

Assessment theme – Health and safety

Guidance for assessors

Evidence from Tasks 1,2, 3a and 3c **must** be used to assess performance against this assessment theme.

Task 1

- resources list with measuring equipment calibration check recorded
- risk assessment
- method statement with justifications.
- hot works permit (countersigned by the assessor).

Task 2

- assessor observations:
  - the work area (preparation of, during and on completion of tasks).
  - the preparation of tools and equipment
  - the application and use of tools and equipment
- photographic evidence:
  - the work area, prior to, during and on completion of fabrication activities
  - the application and use of tools and welding equipment.

Task 3a

- assessor observations:
  - the preparation, inspection and use of tools and equipment
  - the work area (preparation of, during and on completion of tasks).

Marks per band	1 - 4	5 - 8	9 - 12	n/a	12
	Risk assessment is mostly complete and covers some of the major risk factors. Risk mitigation methods are limited. Likelihood, severity or probability has been taken into account but not for all risks and hazards.	Risk assessment is complete and covers all of the major risk factors and a good range of other associated risks. Risk mitigation methods have been identified for some of the potential risks, but not all. Likelihood, severity or probability has been taken into account but for most risks and hazards.	Risk assessment identifies all of the major risk factors and all other associated risk factors. Risk mitigation methods are detailed and have been clearly identified for all potential risks. Potential for harm and probability factors have been identified throughout.		

Task 3c

- assessor observations:
  - handover meeting.

Note: where there is insufficient evidence to award a mark, a zero mark may be given	Band 1 descriptor	Band 2 descriptor	Band 3 descriptor	Total marks per sub assessment theme	Total marks for assessment theme

	Indicative content:
	Completion of a comprehensive assessment of risk and risk management including risks associated with tools and welding equipment, work area and the safety of others.
	Risk assessment to include all fabrication and welding processes:
	• identification of low, medium and high risks that may include:
	  ○ high risk: fumes and gas inhalation, physical (burns, cuts, crushed toes/fingers, eye damage), non-ionising radiation, electricity (shock, electrocution), fire and explosions
	  ○ medium risk: noise, trailing cables/pipes
	  ○ low risk: slip, trip and falls, disposal of waste, handling materials and equipment (manual handling, minor physical injuries, handling and storing gas cylinders/bottles), work environment
	• analysis of the risk occurring, including who could be affected and the likelihood of them being affected
	• identification of control measures using hierarchy of control, including PPE (auto-darkening welding helmet, air-fed welding helmet, welding jacket or apron, welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator, managing long hair/loose clothing), isolation, ventilation, fire prevention).
	Completion of a hot works permit and permission to start work obtained (checked and countersigned by the assessor).
	Production and testing of the anchor:
	• correct checks and preparation of resources including tools and welding equipment (MMA, MIG, TIG, Oxy-acetylene), PPE (auto-darkening welding helmet, air-fed welding helmet, welding jacket or apron, welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator)
	• safe isolation procedures for tool/machinery maintenance, replacement or adjustment, completed accurately and safely. (Failure to complete safe isolation as specified and leading to an unsafe situation, will require the assessment to be stopped immediately)				

	• work environment must be prepared for welding and fabrication (well ventilated, have first aid and eye wash station, fire extinguishers, fire blankets, segregated disposal of waste) • work area to be kept tidy throughout the tasks and reinstated after completion of practical activities • wearing the correct PPE (auto-darkening welding helmet, air-fed welding helmet, welding jacket or apron, welding shoes/boots, gloves, safety glasses, ear plugs or ear defenders, mask or respirator, managing long hair/loose clothing) at all times, as identified in their risk assessment and/or materials list • following safe systems of work throughout all practical activities, when working and handling materials • all tools and welding equipment checked prior returning to storage. Completion of an evaluation and implementation report including: • Health and safety regulations (HASAWA, COSHH, PUWER, Manual Handling, Waste) • workplace procedures relating to safe use of tools and equipment, materials, consumables, maintenance and disposal of waste • checking and complying with manufacturer's manuals and safety information • measures required for ventilation and fume management • measures required for dealing with emergencies • implications of incorrect set-up and maintenance of welding equipment (injury, fire, explosion, damage to equipment, damage to work, physical harm) • implications of incorrect construction, assembly and overall performance of the anchor.

How we support you

Updates/Topics/Networks

Blended approach to communication

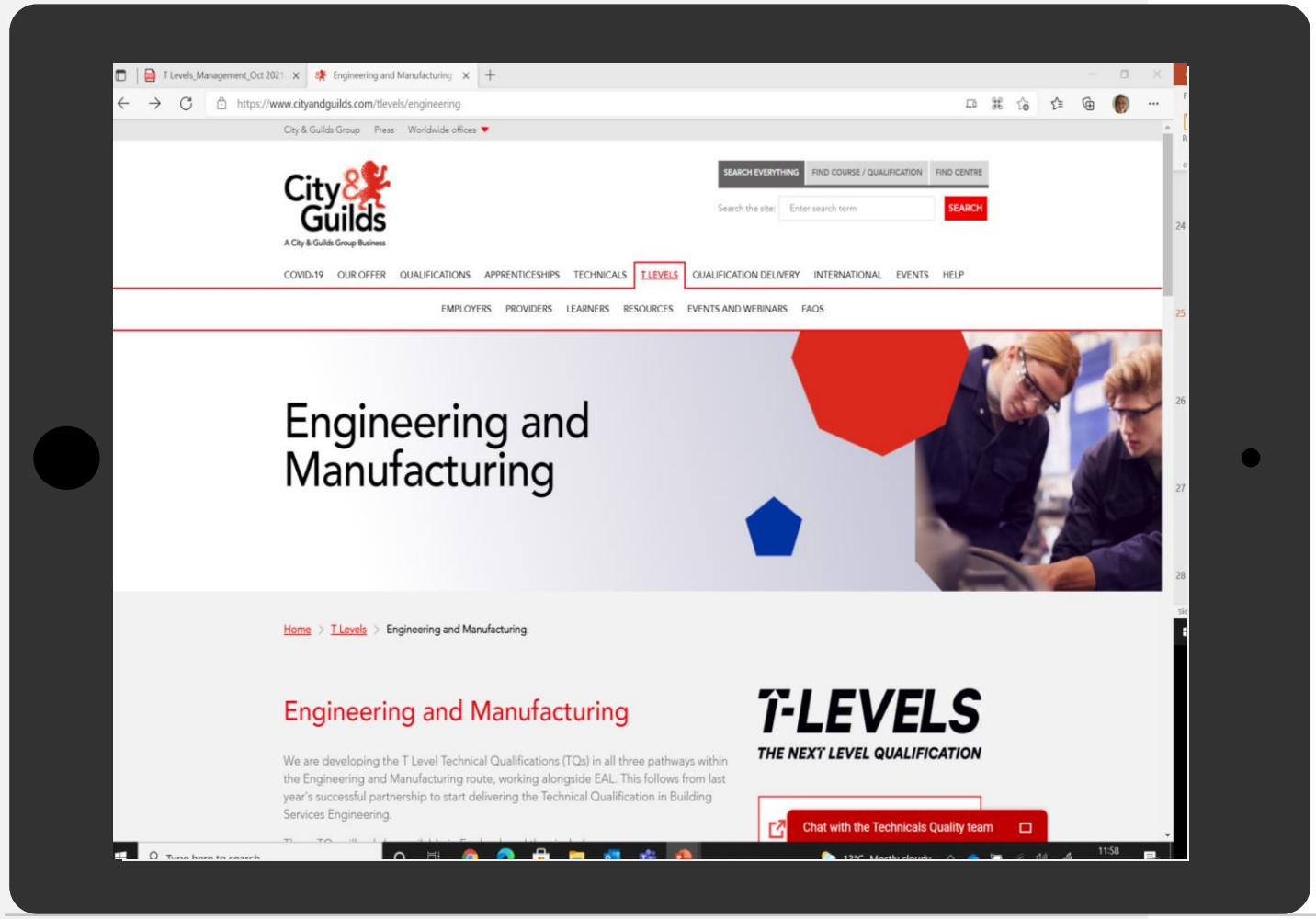
Provider networks and events

e-bulletin content and email updates

Website

Support and Guidance

Ready to support eligible providers and stakeholder engagement



- Timeline
- Provider focus groups
- Employer Industry Boards
- e-bulletins
- Specification
- Resource Hub https://www.cityandguilds.com/tlevels/resources
- Learner flyer t-levels-learner-flyer-engineering-and-manufacturing
- Dedicated Technical Advisors

https://www.cityandguilds.com/tlevels/providers

Events & Webinars

- Resource development for the core
- Teaching & Learning support for exam component
- Face-to-face events
- Events, networks and webinars are located on our T Level Home page here under the accordion Engineering & Manufacturing. Here you will also find copies of the slide decks presented in the events, networks and webinars.
- Recorded webinars on our dedicated Engineering Go To Webinar Channel here.
- For the most up to date information regarding future events please register for our T Level e-bulleting at the bottom of this webpage, here.
- (**18.01.23,** 14.45-15.45 GMT) Network event (recorded) Curriculum Plan & delivery models

Websites to Support Providers

T Level Industry Placement Delivery Guidance
T Level industry placements delivery guidance - GOV.UK (www.gov.uk)

Introduction to T levels
T levels - GOV.UK (www.gov.uk)

How T Levels are funded
How T Levels are funded - GOV.UK (www.gov.uk)

T Levels capital fund
T Levels capital fund - GOV.UK (www.gov.uk)

T Levels resources for teachers and careers advisers
T Levels resources for teachers and careers advisers - GOV.UK (www.gov.uk)

T Levels: next steps for providers
T Levels: next steps for providers - GOV.UK (www.gov.uk)

Supporting with delivering T Levels
Support with delivering T Levels

T Level Transition Programme Framework for 2022 – 2023
T Level Transition Programme Framework for Delivery 2022 to 2023 - GOV.UK (www.gov.uk)

ETF Foundation – T Levels
T Level Professional Development - Education & Training Foundation (et-foundation.co.uk)

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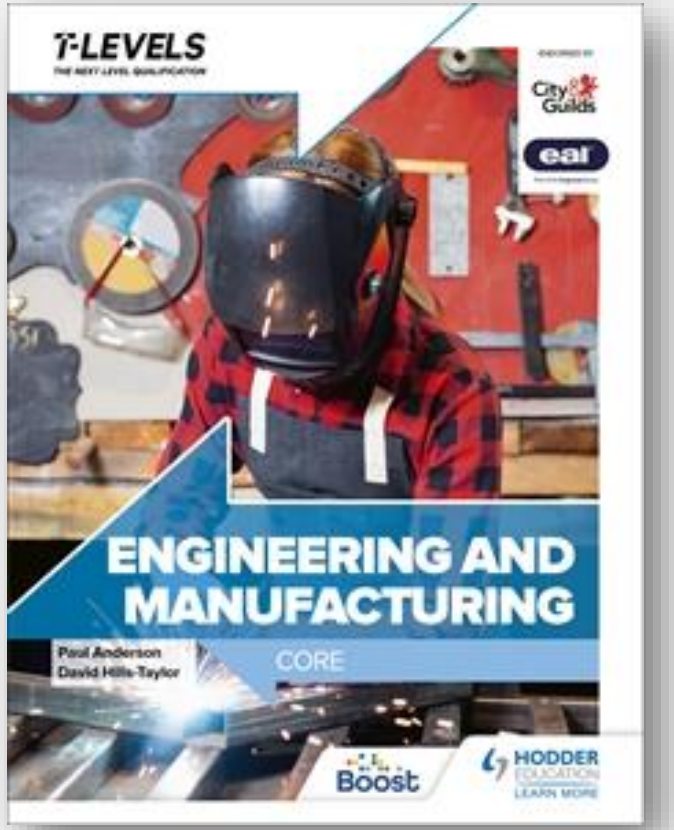

Contact Gemma Simpson to receive an advance sample chapter:
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- **Technical Qualification Associates (TQAs)**

Review Eligible Provider approval applications, including supplementary evidence and carry out approval and support activities.

- **Chief/Principal Examiners**

Produce and submit assessment materials and participate in all stages of the production process until sign off.

- **Marking Examiners**

Mark candidates' scripts/evidence in accordance with the agreed marking scheme/criteria within the agreed timescale

For further information, please contact Samantha.Ashman@cityandguilds.com or visit our website on the attached link:
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