T-LEVELS | IfATE Institute for Apprenticeships and Technical Education

T Level Technical Qualification in Design and Development for Engineering and Manufacturing (8714-32)

Electrical and Electronic (322)

Practical Assignment

Sample Assessor Pack

First teaching from September 2022

Version 2.0

City & Guilds | eal

Contents

Version and date	Change detail	Section
2.0 February 2024	Additional guidance on video requirements for Task 2	Task 2 – Video requirements
	Task 2 evidence detail updated	Assessment theme: Manufacturing
	Task specific guidance – overview	Minor amendment to wording.
	Resources	Task 4 – Resources
	What must be produced for marking guidance	Task 1 – What must be produced for marking guidance

1. Assessment

The assessment for this component consists of a practical assignment that includes an assignment brief and then a number of tasks for the candidate to complete. Tasks are assessed by assessment themes that cover a range of knowledge and skills from the performance outcomes. They are designed to allow judgement of the candidate to be made across different categories of performance.

The assessment for this component has been allocated a set number of marks against each assessment theme, based on weightings recommended by stakeholders of the qualification. This mark allocation remains the same for all versions of the assessments, ensuring consistency across assessment versions and over time.

Performance outcomes

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.	Analyse and interpret engineering and manufacturing requirements, systems, processes, technical drawings, diagrams and specifications.	16%
PO3 Evaluate systems, designs, components and processes, managing and integrating design information, proposals and specifications, to develop and improve electrical and electronic engineering and manufacturing proposals and solutions.	Evaluate systems, designs, components, sub-assemblies and processes, managing and integrating design information, proposals and specifications, to develop and improve electrical and electronic engineering and manufacturing proposals and solutions.	22%
PO4 Propose and design electrical and electronic engineering and manufacturing systems, products, components, processes and solutions, considering requirements, constraints and context.	Design and model electrical and electronic concepts, systems and circuitry. Use CAD software to produce diagrams, models and simulations. Use tools safely and effectively for specific purposes. Safely carry out engineering processes and activities.	23%
PO5 Collaborate to help manage, develop, test and quality assure electrical and electronic engineering and manufacturing design information, systems, processes and outcomes.	Work in accordance with professional standards, work-place policies, health and safety requirements and regulations. Complete detailed risk analysis. Respond to feedback from others to inform design decisions. Develop and test models and prototypes. Investigate and analyse test results and accurately report and respond to them.	26%
PO6 Communicate proposals, design information and solutions, producing, recording and explaining engineering and manufacturing representations, systems, processes, outcomes, specifications and technical drawings.	Use methods to communicate proposals, design ideas and solutions. Produce technical documentation using industry conventions.	13%

Grade descriptors

To achieve a pass (threshold competence), a candidate will typically be able to:

Demonstrate a basic use of software/technologies to model, evaluate and produce electrical and electronic engineering diagrams and simulations that meets the requirements of the brief.

Demonstrate basic technical skills when developing models and prototypes, resulting in a model that may require some modifications.

Apply basic knowledge and understanding of testing processes, resulting in a model that has been tested against most of the design criteria.

Interpret information, plan, assess risk and follow safe working methods appropriately when applying practical skills to an acceptable standard in response to the requirements of the brief.

Apply basic knowledge and understanding of the design principles required for electrical and electronic engineering resulting in proposals and solutions that meet the minimum requirements of the brief.

Work safely showing an understanding and suitable level of awareness in the preparation and application of processes, selection and use of tools and manufacturing materials and components, resulting in tasks that are carried out with some minor errors.

Use industry and technical terminology accurately most of the time in both written and verbal contexts.

To achieve a distinction, a candidate will typically be able to:

Demonstrate a comprehensive use of software/technologies to model, evaluate and produce electrical and electronic engineering diagrams and simulations that meets the requirements of the brief.

Demonstrate excellent technical skills when developing models and prototypes, resulting in a model that is fully functional.

Apply comprehensive knowledge and understanding of testing processes, resulting in a model that has been tested against all of the design criteria.

Critically interpret information to plan, assess risk, follow safe working practices and apply the technical skills to practical tasks and procedures to an exemplary standard in response to the requirements of the brief, producing an excellent quality of work.

Apply comprehensive knowledge and understanding of the design principles required for electrical and electronic engineering resulting in proposals and solutions that meet all requirements of the brief.

Work safely and make well founded and informed decisions on the selection and appropriate use of tools, materials and equipment within the environments that they are working in, resulting in tasks that are carried out to a high degree of accuracy.

Use accurate industry and technical terminology consistently in both written and verbal contexts.

2. Assignment brief

You are an electrical engineer employed by a company that sells a variety of products online. The company operates from large warehouses, each storing a range of products. When an order is received, human workers put the items in boxes and place the boxes on a conveyor belt to the despatch area. Depending upon the size of each box, it is then allocated to one of two couriers who will deliver it.

Due to a growth in sales, the company wants to automate the sorting activity in the despatch area. You have been asked to design, build and test a prototype for a circuit that will sort and allocate the boxes.

Figure 1 shows a plan view of the despatch area.

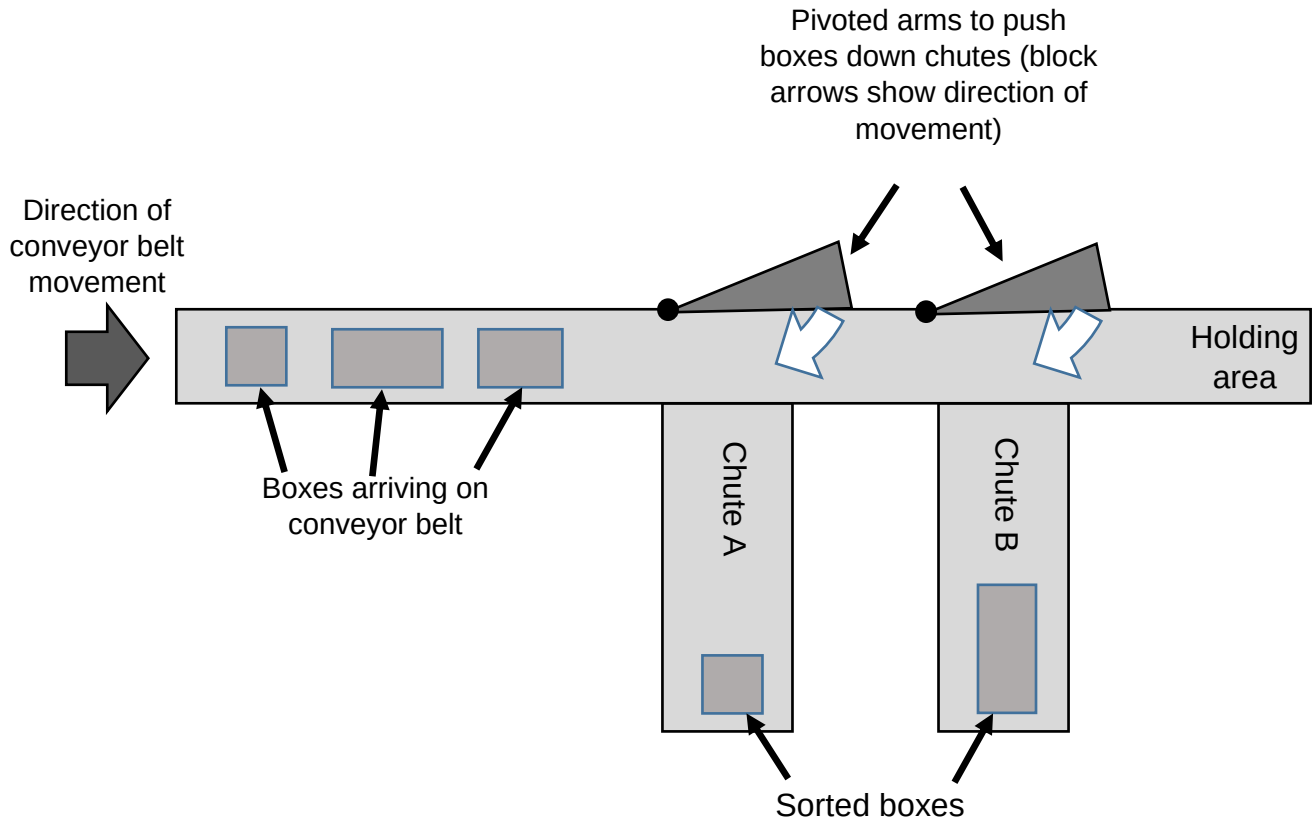

Figure 1

The boxes will arrive on a conveyor belt that travels at a constant speed.

All boxes are cuboid in shape, with a standard width of 250 mm.

If the box is less than 200 mm high and 300 mm long, it must be directed down chute A. If it is larger than these sizes, it must be directed down chute B. The required accuracy of the device must be within a tolerance of 10% of the parameters stated here.

The boxes are directed down the chutes by pivoted arms. These are powered by servo motors.

If, for some reason, a box passes the chutes and arrives in the holding area a warning light and buzzer must activate, to alert human operators that attention is needed.

Design Criteria

The design criteria for this application are:

- the circuitry must detect when the height of a box is less than 200 mm
- the circuitry must detect when the length of a box is more than 300 mm
- the required accuracy of detection is within tolerance of 10% tolerance of the parameters stated
- the maximum weight of the box is 2 kg
- if the box is less than 200 mm high and 300 mm long, it must be directed down chute A. If it is larger than these sizes, it must be directed down chute B
- the inputs to the circuitry must include:
    - a method to turn the system on and off
    - appropriate sensors to detect the required dimensions
    - a sensor to detect when a product reaches the holding area
- the outputs from the circuitry must include:
    - a visual indicator (light) to indicate when a product should be directed down chute A
    - a visual indicator (light) to indicate when a product should be directed down chute B
    - appropriate output signals to operate the servo motors for the pivot arms, to both direct the boxes down the chute and to return to the start position as appropriate for the next box
    - a visual indicator (light) and audible output to indicate when a product is in the holding area
- the input and output devices should be connected to the circuitry.

This assignment has a time allocation of **34 hours**.

3. Tasks

General task guidance

Please read **ALL** information carefully before the assessment.

Ensure you have read the following guidance before you undertake the assessment of candidates:

- T level technical qualifications – marking
- T level technical qualifications – moderation (updated annually)
- T level technical qualifications – teaching, learning and assessment
- Technical qualification guides on marking and moderation
- Practical Observation template
- Mark grids following the tasks below
- Feedback guidance for assessors.

Centres have to meet the design criteria and the specification in **Figure 1** given in **the assignment brief** as a minimum but may scale dimensions or add additional criteria based on availability of resources within a centre. If they are unable to implement or facilitate this specification, they must contact City & Guilds to agree appropriate actions to be taken in such extreme circumstances.

All work carried out should be to industry standards, undertaken in a safe manner and compliant with relevant regulations. If a candidate fails to carry out the activities in a safe manner, the assignment should be suspended until this aspect is corrected. Further guidance for assessors can be found in the centre guidance section under health and safety.

Photographs must be used to support the qualitative statements captured on the Practical Observation form. Details of specific photograph requirements are outlined in the task information below. Photographs must have the date and candidate's name attached so that they can be differentiated. The candidate does not need to be in the photograph, the purpose of the photograph is to demonstrate the quality and standards of work of specific activities and of the work throughout various stages of the assignment.

Time

The time allocated for the completion of the tasks and production of evidence for this assessment is 34 hours. Timings for completion of specific tasks are outlined below.

- Task 1 – 14 hours
- Task 2 – 13 hours
- Task 3 – 1 hour
- Task 4 – 6 hours.

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.

Scheduling assessment sessions

It is the centre's responsibility to arrange how time is managed to fit with timetables and meet the times allocated for each task during the assessment window. Assessment windows are specified in the key date schedule.

The tasks must be issued in order, one at a time to candidates by centres in the scheduled assessment times. Candidates are able to refer to the brief and scenario during all of the scheduled assessment time. Candidates are not permitted to return to tasks after the assessment time for the task has ended and the next task has begun. Candidates must not move on to the next task within the assessment session until instructed to do so by the assessor. It is the assessor's responsibility to ensure that all evidence for a task has been submitted before administering the next task. Candidates are not required to have formal reading time for the scenario and brief, this is included within the duration for Task 1.

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.

Centres should aim to schedule tasks in the fewest amount of assessment sessions but ensure that the durations dictated for each task are covered. However, to aid deliverability and manageability of assessment, sessions can be split where there is a requirement – for example where timetabling of an appropriate location for six hours is not possible, e.g. where centre's access to computer resources is limited, or where candidates are not available for six consecutive hours (e.g. due to work placement commitments). Where this is necessary, sessions must, where possible be timetabled over consecutive days and in as few sessions as possible. All assessment evidence must be stored securely and access to assessment materials and their work only given to candidates during the formal assessment times. All candidates are required to complete a declaration of authenticity along with their evidence submission, and the arrangements must support the assessor in being confident in confirming authenticity.

Where assessments need to be completed in a number of assessment sessions or over consecutive days, all practical work areas and any evidence produced must be kept secure and must only be accessed by the assessor. Information and notices should be used to inform other users of the facility that no access will be granted when assessment sessions are in progress. Practical work areas, tools, equipment and systems for the assessment must not be reset until a candidate has completed the full assessment.

Peer review

Within the occupational specialism assessment candidates will be asked to carry out a peer review. Instructions for this are shared as part of the task within the assessor guidance. Candidates are not marked on the peer review they carry out but still need to submit this to the assessor. What needs to be submitted within this task will be covered by the 'what needs to be submitted' section.

Internet access

Where internet access is allowed as part of a task (e.g., for research purposes) candidates must be advised that this is the case and reminded of the importance of submitting their own work and the seriousness of plagiarism, malpractice and collusion. Candidates should be advised that their browser history can be monitored and checked. Depending on the type of task candidates may be requested to submit their internet search history to be considered as part of the submission of evidence, in order to confirm the authenticity of submitted evidence.

Where candidates are allowed the use of computer equipment, but not the use of the internet for a task, equipment should be provided with internet capability disabled (e.g., Wi-Fi disabled, machine disconnected from network etc).

Resources

Candidates must have access to a suitable range of resources to carry out the tasks and, where appropriate, to have the opportunity to choose materials demonstrating the ability to select from a range of appropriate materials.

Where candidates need access to evidence that has been submitted as part of a previous task, this will be provided as a copy of the original evidence and will be given at the start of the relevant task.

The candidate should have access to the following to select and carry out each task:

- a range of tools and equipment
- appropriate PPE
- manufacturer's instructions must be available
- Internet access for research: (for e.g. costs, component data and production information)
- access to appropriate CAD (Computer aided design) software suitable for circuit design and simulation
- manufacturer's datasheets (for electronic components)
- scientific calculator for design calculations
- a selection of various sizes of boxes to enable testing of the system
- equipment to physically prototype circuit designs, such as breadboards or modular systems
- basic electronic components including; capacitors, resistors, sensor components, integrated and discrete components, cables, connectors and cable terminations
- DC power supply unit
- diagnostic equipment, including multimeters, logic probes etc
- PCB (Printed circuitry board) or stripboard for prototype circuit
- tools for the electronic assembly, for example: soldering iron, side cutters, snipe nose pliers, wire strippers, stripboard cutter (if used), PCB/stripboard holder, solder extraction units (portable or fixed)
- if required, programmable system software and hardware upload facilities.

Where defined in the controlled conditions candidates will need to provide any notes produced of research undertaken including citation of sources.

Task specific guidance

Each task should be administered separately, and each task should be completed and submitted by all candidates before moving onto the next.

It is not essential for a conveyor system to be available, although this can provide a visual stimulus. If a conveyor system is not available candidates will need to simulate the system inputs and monitor that the outputs meet the requirements.

If necessary, to facilitate the use of an existing conveyor system, it is acceptable to scale the activity (i.e. box sizes) so that it is suitable for the available resources. Similarly, if an existing facility has an alternative method of directing the boxes down the chutes, for example simple rams rather than pivoted arms, this is acceptable.

The speed of the conveyor system can be specified by the centre. It is important that this is a consistent speed, as the length of the boxes could be determined by the amount of time needed to pass an appropriate sensor system.

The control system could use programmable or non-programmable components.

Resources are specified through the centre resource list sent in advance of the assessment. This list must not be made available to students. Candidates will have access to the workshop/tool cupboard to select resources rather than a list and the required resources are dictated by the guidance and brief.

Task 1

The physical modelling could use stripboard or an approach that does not require permanent fixings, such as breadboards or modular systems. The measurement of the system outputs could use basic electrical measurement equipment such as multimeters or logic probes, to verify if the design functions are being achieved.

Evidence of the virtual modelling of the circuitry could be captured using annotated screen captures or print outs.

Task 2

Any appropriate method to manufacture the PCB is acceptable.

As noted in the task guidance, if available candidates should be given access to a conveyor system to which they can attach their proposed system. If this is not available candidates will need to simulate the operation to evaluate the function.

Work area must be representative of normal centre practice prior to any practical activities taking place for candidates to complete their work area preparation.

Candidates must have access to appropriate materials, tools, equipment and machinery in order for them to manufacture their prototype.

Task 3

Task 3 must take place in a single assessment session on the same day.

The assessor must ensure the following requirements are met:

- organise candidates into groups (recommend three candidates per group) for the discussions. Where this is not possible i.e. candidate absence group sizes may be flexed but should be closely monitored by the assessor to ensure a comparable experience is achieved for all candidates
- ensure access to candidate resources as directed in the task information

- the task should be candidate led but the assessor may facilitate through prompting to support the level of engagement and feedback gained for candidates
- monitor timings as directed by the task
- the discussion takes place in an appropriate environment where candidates are unlikely to be disturbed
- check all completed peer review forms for appropriateness before sharing with the candidate whose evidence is being reviewed
- further guidance is provided within Task 3 ‘guidance to assessor’ section.

Following tasks, copies of the final submitted evidence from preceding tasks should be saved securely for return to candidates for use in future tasks within this assessment. This could be facilitated through the use of memory sticks or a specific location on a secure drive for work to be saved on.

Task 1 – Design

Candidates must:

a) produce a design specification that builds on the design criteria for the circuitry, including any references to research used

b) generate a suitable design for the circuitry, including:

- selection of appropriate sensors with justifications
- calculations of the values required for successful operation, including the power required by the circuitry and the motors, timings and values for at least two different types of component
- configuration of the circuitry including a circuit diagram and wiring diagram
- printed circuitry board (PCB) layout for the circuitry

c) simulate the performance of the proposed design using CAD software

d) assemble a physical model of the circuitry and test its functionality

e) produce a bill of materials (BoM) listing all of the parts required in the final design proposal.

Conditions of assessment:

- the time allocated for this task is **14 hours**
- candidates must carry out the task on their own, under **controlled conditions**.

Controlled conditions:

- candidates must only work on their tasks in the allocated times
- assessment evidence must be handed in at the end of each session for secure storage which cannot be accessed by candidates
- candidates must not share or discuss their work with other candidates
- candidates are not permitted to bring any materials into the assessment session.

What must be produced for marking:

- design specification
- design calculations, including all workings
- justifications of design options for the sensors
- circuit diagram and wiring diagram
- PCB layout
- outcomes of the virtual modelling of the proposed circuit design, either as screen captures or printouts
- record of outcome of testing the functionality of the physical model of the circuit and any changes if necessary
- bill of materials.

Additional evidence

- any notes produced of research undertaken including citation of sources and internet search history must be submitted to ensure the authenticity of evidence produced.

Resources:

- access to internet
- access to PCB software
- access to appropriate CAD software suitable for circuit design and simulation
- manufacturer's datasheets (for electronic components)
- scientific calculator for design calculations
- basic electronic components including: capacitors, resistors, sensor components, integrated and discrete components, cables, connectors and cable terminations
- access to appropriate circuit modelling methods
- DC power supply unit.

Task 2 – Manufacture and test

Candidates must:

a) produce risk assessments for the production of the PCB and the construction of the soldered prototype

b) produce the PCB for the design

c) build a soldered prototype working circuitry from your design

d) test the operation of the circuitry.

Conditions of assessment:

- the time allocated for this task is **13 hours**
- candidates must carry out the task on their own, under **controlled conditions**
- correct PPE must be worn at all times and as designated in their risk assessment (If unsafe working occurs the assessment is to be stopped immediately).

Controlled conditions:

- candidates must only work on their tasks in the allocated times
- assessment evidence must be handed in at the end of each session for secure storage which cannot be accessed by candidates
- assessor observations must be carried out within the assessor to candidate ratio stipulated by City & Guilds
- candidates must not share or discuss their work with other candidates
- where assessments need to be completed in a number of assessment sessions or over consecutive days, all practical work areas and any evidence produced must be kept secure and must only be accessed by the assessor
- candidates are not permitted to bring any materials into the assessment session.

What must be produced for marking:

- risk assessments
- test records for the results of testing the circuitry
- PCB
- prototype.

Additional evidence for this task:

- assessor observation of:
    - the production of the PCB
    - building of the soldered prototype
    - testing of the circuitry.

To support the comments made within the Practical Observation the assessor must capture the following photographs and videos that must be submitted as supporting evidence for each candidate.

Photographic evidence which shows:

- unassembled PCB clearly showing the track layout
- back of the assembled PCB showing all soldered joints
- front of the assembled PCB showing positioning and fitting of components.

Video evidence which shows:

- functionality of the prototype (maximum of five minutes)

Resources:

- copies of completed documentation from task 1
- PCB production facilities
- basic electronic components including; capacitors, resistors, sensor components, integrated and discrete components, cables, connectors and cable terminations
- DC power supply unit
- diagnostic equipment, including multimeters, logic probes etc
- tools for the electronic assembly, for example: soldering iron, side cutters, snip nose pliers, wire strippers, stripboard cutter (if used), PCB/stripboard holder, solder extraction units (portable or fixed)
- if required, programmable system software and hardware upload facilities.

Task 3 – Peer review

As part of the development and design process it is critical that engineers can work constructively with others and consider feedback to inform designs to ensure they meet their purpose and requirements.

The assessor will set up the groups and make sure that candidates have access to copies of their design. The candidate being assessed will present their design.

a) Prepare to present their design verbally using annotated sketches and diagrams.

b) Present and explain the design.

c) Peer reviewers will now have time to reflect on the design.

d) Discuss feedback from the group on the design presented in part b).

e) Peer reviewers will now complete the peer review feedback form.

Conditions of assessment:

- the time allocated for this task is **60 minutes**. This broken down for the above tasks below:
  a) 10 minutes to prepare to present designs
  b) 10 minutes to present and explain designs
  c) 10 minutes for the peer review group to discuss and reflect on the design before providing feedback
  d) 15 minutes for the peer review group to discuss the design with the candidate and ask them questions
  e) 15 minutes for the peer review group to provide collective feedback on the peer review form to submit to the assessor for approval
- the task must be supervised at all times
- the candidate leading the discussion must take notes and record any feedback to questions asked using the feedback record form. The peer group will provide their feedback using the peer review form, which must be checked for the appropriateness by the assessor before being shared with the candidate.

Controlled conditions

- candidates must only work on the tasks in the allocated times
- assessment evidence must be handed in at the end of each session for secure storage which cannot be accessed by candidates
- candidates must not share or discuss their work or the work of others outside the assessment time
- candidates are not permitted to bring any materials into the assessment session.

For parts a), b) and d) **candidates** must:

- proactively participate in the discussion
- manage their time
- seek any clarity in the feedback given and be prepared to ask questions
- record any feedback notes on the feedback record form provided.

For parts c), d) and e) **peer reviewers** must:

- proactively engage in the discussion
- respond constructively and fairly
- ensure the peer review feedback form is completed fully and handed to the assessor.

For parts a) to e) **assessors** must:

- familiarise themselves with the task specific guidance section to support the administration of the peer review task
- provide clear instructions on the purpose and conditions of the task
- intervene at their discretion if they believe there is a risk of the candidate not receiving sufficient feedback. In this context, this means there is sufficient feedback being given and recorded on the peer review form, it aligns with the design and is realistic and meaningful for the candidate to use to inform design choices
- ensure all candidates receive a completed peer review feedback form and the quality of feedback is sufficient before handing it to the candidate
- ensure that copies of the feedback record form completed by the candidate, and the peer review form are submitted as evidence for marking.

What must be submitted:

- feedback record form
- peer review feedback form.

Task 4 – Evaluation and implementation

Candidates must:

a) produce a virtual model of the design using appropriate software incorporating any changes they have decided to make in response to feedback or as a result of manufacturing and testing

b) produce a revision control document or report that is typically 500 words justifying why changes were made or not made as a result of the peer review feedback

c) produce a report evaluating the proposed design. The report should typically be 800 words. This must include:

- an explanation of the test methods used, reasons for their use and their limitations
- a summary of the capabilities of the circuitry
- an evaluation of the fitness for purpose of the design proposal and its conformance to the design criteria and specification
- the information necessary for a third party to implement the prototype
- an outline of any additional factors that may need to be considered during the implementation, including:
  - cable types to be used to connect the sensors to the circuitry, if appropriate
  - health and safety considerations
  - applicable requirements from wiring regulations
- any improvements or adaptions required to the prototype, including any reasoning and justifications if adaptions or improvements are not required.

Conditions of assessment:

- the time allocated for this task is **6 hours**
- candidates must carry out the task on their own, under **controlled conditions**.

Controlled conditions:

- candidates must only work on their tasks in the allocated times
- assessment evidence must be handed in at the end of each session for secure storage which cannot be accessed by candidates
- candidates must not share or discuss their work with other candidates
- candidates are not permitted to bring any materials into the assessment session.

What must be produced for marking:

- outcomes of virtual modelling
- revision control document
- evaluation and implementation report.

Resources:

- copies of completed documentation from tasks 1 and 2
- feedback record form and peer review form from task 3
- access to the internet for research (e.g. costs, component data, production information)
- manufacturer's datasheets (for electronic components)
- wiring regulations.

4. Centre guidance

Guidance provided in this document supports the administration of this project.

The following documents, available on the City & Guilds website, provide essential generic guidance for centres delivering Technical qualifications and **must** be referred to alongside this guidance:

- ***T level technical qualifications – marking***
- ***T level technical qualifications – moderation*** (updated annually)
- ***T level technical qualifications – teaching, learning and assessment.***

This assessment is designed to require the candidate to make use of their Core knowledge, understanding and the practical skills they have built up over the course of their learning to tackle tasks, problems or challenges.

This approach to assessment emphasises to candidates the importance and applicability of the full range of their learning to practice in their industry area and supports them in learning to take responsibility for transferring their knowledge, understanding and skills to the practical situation, fostering independence, autonomy and confidence.

Candidates are provided with an assignment brief. They then have to draw on their knowledge and skills and independently select the correct processes, tools, equipment, materials and approaches to take, to complete the brief.

During the learning programme, it is expected that tutors will have taken the opportunity to set shorter, formative tasks that allow candidates to be supported to independently use the learning they have so far covered, drawing this together in a similar way, so they are familiar with the format, conditions and expectations of the assessment.

Candidates should be made aware during learning what the assessment themes are and how they are implemented in marking the assignment, so they will understand the level of performance that will achieve them high marks.

Candidates should not be entered for the assessment until the end of the course of learning for the qualification, so they are in a position to complete the assignment successfully.

Health and Safety

Candidates must not be entered for assessment without being clear of the importance of working safely and having attended sufficient practical training to be able to work safely. The assessor must immediately stop an assessment if a candidate works unsafely. At the discretion of the assessor, depending on the severity of the incident, the candidate may be given a warning. If they continue to work unsafely, risking the safety of themselves or others however, their assessment must be ended, and they must retake the assessment in a future series after significant further training has taken place. Any warnings issued to a candidate must be considered as part of the marking process and recorded on the candidate record form (CRF). Any actions that have led to that warning must be detailed on the CRF so they can be considered along with the other evidence when applying the descriptors in the mark scheme.

Compliance with timings

Due to the nature of this assessment, the maximum time allowances provided must be adhered to. They refer directly to assessment time, not any additional setting up times the centre needs to create an appropriate assessment environment.

It is the centre's responsibility to plan sufficient assessment sessions as stated in each of the tasks, under the appropriate conditions, within the assignment window, to allow candidates reasonable time to complete the assessment tasks.

Where candidates are required to plan their work, they should have their plans confirmed for appropriateness in relation to the time allocated for each task, to ensure their planning has not left them with too short a time to complete the tasks safely. Any planning that is not appropriate must be recorded on the candidate record form (CRF) as part of the marking process.

Candidates should be allowed sufficient time to fully demonstrate the range of their skills, however this also needs to be reasonable and practicable. Candidates should be allowed to overrun their own planned timings in order for evidence of a range of their skills to be captured. If, however, the time required exceeds the maximum time allowance for the task, the centre must stop the assessment and base the marking on the evidence up to that point.

Any guidance or feedback relating to timings or planning should follow the guidance provided in section *Guidance and feedback* below.

Word counts

Typical word counts, where indicated, are to be used as approximates for guidance to support the production of sufficient evidence. The marking will relate to the quality of the evidence produced and not whether the word count has been met.

Assessor student ratios

The number of candidates an assessor will be able to observe at one time will vary depending on local conditions related to:

- monitoring and maintaining safety during assessment
    - any specific hazards related to the task that pose a risk of harm in relation to the competence of the learners
    - availability of supervisory staff to support the assessor
- the practicalities of collecting evidence
    - the complexity of evidence collection for the task
    - whether there are any peak times where there is a lot of evidence to collect that will need additional support or any that are quieter, which may be eased through staggered starts etc
    - local conditions e.g.
        - layout of the assessment environment and sufficient assessor line of sight to task activity throughout the assessment period
        - amount of additional support available (e.g. to capture image or video evidence)
        - availability of suitable workspaces/bays or of shared resources and equipment.

Centres are advised to trial the planned arrangements during formative assessment, reviewing the quality of evidence captured and manageability. It is expected that for straightforward observations, (and unless otherwise specified) no more than six candidates will be observed by a single assessor at one time, and the number will usually be fewer than this maximum. The key factors to consider are the logistics of collecting sufficient evidence and ability to remain working safely in the assessment environment. A timetable of assessments and layout of the workspaces, detailing:

- the students being assessed at each workstation,
- the assessor(s) and
- support staff present

must be available for the moderator on request.

Observation evidence

Observation notes form part of the candidate's evidence and must capture evidence of student performance during the practical tasks describing how well the activity has been carried out, rather than stating the steps or actions, the candidate has taken. The notes must be very descriptive and focus on the quality of the performance that are notable in relation to the quality indicators in the marking grid. They must provide sufficient, appropriate evidence that can be used by the assessor (and moderator) to mark the performance using the marking grid. These descriptions will be used, along with e.g. photographic and video evidence to choose the relevant marking band and mark within the band so that students can be reliably and validly differentiated based on their performance. Evidence captured in the observation form must give the necessary information to enable the final assessment of the task at a later date. This is to allow a holistic judgement to be carried out after all evidence for the task is available, at which point full consideration of how the student has applied both their skills and their knowledge during the practical can be given.

Identifying what it is about the performances that is different between candidates can clarify the qualities that are important to record. Each candidate is likely to carry out the same steps, so a checklist of this information would not help differentiate between them. However, qualitative comments on how well they do it, and quantitative records of accuracy and tolerances would.

The assessor should refer to the marking grid to ensure appropriate aspects of performance are recorded. These notes will be used for marking and moderation purposes and so must be detailed, accurate and differentiating.

Assessors should refer to The ***Technical qualifications guides on marking and moderation*** and The Guide Standard Exemplification Materials to support with the collection of evidence through observation.

Assessors should ensure that any required additional supporting evidence including e.g. photographs or video can be easily matched to the correct candidate, are clear, well-lit and showing the areas of particular interest in sufficient detail and clarity for assessment (i.e. taken at appropriate points in production, showing accuracy of measurements where appropriate).

Assessor marking and justification is completed on a separate form (CRF) to differentiate this evidence from the judgement, since in some cases the observation form will provide evidence relating to the judgement for more than one assessment theme.

As far as possible, candidates must not be distracted, or their performance affected by the process of observation and evidence collection.

The ***Technical qualifications guides on marking and moderation*** are essential guidance documents and are available on the City & Guilds website. These provide further information on preparing for assessment, evidence gathering, standardisation, marking and moderation, and must be referred to when planning and carrying out assessment.

Video and photograph evidence in T Level Technical qualifications

The assessment materials for each assignment identify the minimum candidate and assessor evidence requirements to support marking and moderation. Where ephemeral evidence (e.g. areas of candidate performance that may be hard to capture with photographs and assessor notes alone) plays a significant part of the practical assessment. If this is the case City & Guilds will prescribe the type/capture where the use of video is necessary for practical assessment components (e.g. specifying exactly which elements of the practical must be videoed, or photographed), and any technical specifications for these forms of evidence e.g. length of videos, maximum file sizes etc will also be supplied. Photographic and video evidence will be submitted along with the written candidate evidence and assessor evidence (PO forms) as described in the additional evidence section of the task.

If this is the case then the video evidence must meet these minimum requirements, in order to be considered by moderators:

- as per the guidance in section 2.3.2 of The *Marking and Moderation Guide for Centres*, assessors must ensure that this evidence can be easily matched to the correct candidate and task, is clearly shot, well-lit and shows the areas of particular interest in sufficient detail and clarity for assessment (i.e. filmed at appropriate points in production, showing accuracy of measurements where appropriate)
- the qualitative written evidence provided by assessors must
    - clearly identify the parts of the video that are being referred to, when used as supporting evidence. Using a timecode for this is recommended
    - include their judgement on the performance being demonstrated
- Section 6.5 of the *Centre Manual* also contains general information about the requirements for video evidence submission.

Please note that centres must ensure that video evidence is clear and meets the minimum requirements. The ability of the moderators to take this evidence into account may be impaired and delay the moderation process if the requirements are not met.

Minimum evidence requirements for marking and moderation

The sections in the assignment:

- ***What must be produced for marking***, and
- ***Additional evidence for this task.***

These list the minimum requirements of evidence to be submitted for marking and the moderation sample.

Evidence produced during assessment above and beyond this may be submitted, as long as it provides useful information for marking and moderation and has been produced under appropriate conditions.

While technological methods which support the capturing or creating of evidence can be helpful, e.g. pin board style websites for creating mood boards, the final evidence must be converted to a suitable format for marking and moderation which cannot be lost, deleted or amended after the end of the assessment period (e.g. screen prints, pdf files). Considerations around tracking authenticity and potential loss of material hosted on such platforms during assessment is the centre's responsibility.

Note: Combining candidates' individual pieces of evidence into single files or zip files may make evidence management during internal marking more efficient and will greatly simplify the uploading of the moderation sample.

Where the minimum requirements have not been submitted for the moderation sample by the final moderation deadline, or the quality of evidence is insufficient to make a judgement, the moderation, and therefore any subsequent adjustment, will be based on the evidence that *has* been submitted. **Where this is insufficient to provide a mark on moderation, a mark of zero must be given.**

Preparation of candidates

Candidates should be aware of which aspects of their performance will give them good marks in assessment. This is best carried out through routinely pointing out good or poor performance during the learning period, and through formative assessment. Although candidates will not have access to the marking grids during the assessment. Candidates should be made aware of what they need to do to achieve a pass or distinction by referring and formatively being assessed against grade descriptors as part of their formal learning programme.

During the learning programme, direct tutor instruction in how to approach tasks through modelling, support, guidance and feedback are critical. However, gradual removal of this support is necessary

in preparation for summative assessment. This supported approach is not valid for summative assessment.

The purpose of summative assessment is to confirm the standard the candidate has reached as a result of participating in the learning process. Candidates should be encouraged to do the best they can and be made aware of the difference between these summative assessments and any formative assessments they have been subject to. Candidates will not have access to the marking grids. Refer to the ***T Level Technical qualifications – teaching, learning and assessment*** centre guidance document, available on the City & Guilds website for further information on preparing candidates for Technical qualification assessment.

Guidance on assessment conditions

The assessment conditions that are in place for this assignment are to:

- ensure the rigour of the assessment process
- provide fairness for candidates
- give confidence in the outcome.

They can be thought of as the rules that ensure that all candidates who take an assessment are being treated fairly, equally and in a manner that ensures their result reflects their true ability.

The conditions outlined below relate to this assignment. These do not affect any formative assessment work that takes place, although it is advised that candidates are prepared for the conditions they will need to work under during summative assessment.

The evidence for the tasks that make up this assignment must be completed under the specified conditions. This is to ensure authenticity and prevent malpractice as well as to assess and record candidate performance for assessment in the practical tasks. It is the centre's responsibility to ensure that local administration and oversight gives the assessor sufficient confidence to be able to confirm the authenticity of the candidate's work.

Security and authentication of candidate work

Candidate evidence must be kept secure to prevent unsupervised access by the candidate or others. Where evidence is produced over a number of sessions, the assessor must ensure learners and others cannot access the evidence without supervision. This might include storing written work or artefacts in locked cupboards and collecting memory sticks of evidence produced electronically at the end of each session.

Candidates are required to sign declarations of authenticity, as is the assessor. The relevant form is included in this assignment pack and must be signed after the production of all evidence.

Where the candidate or assessor is unable to or does not confirm authenticity through signing the declaration form, the work will not be accepted at moderation and a mark of zero will be given. If any question of authenticity arises e.g. at moderation, the centre may be contacted for justification of authentication.

Accessibility and fairness

Where a candidate has special requirements, assessors should refer to the *Access arrangements and reasonable adjustments* section of the City & Guilds website.

Assessors can support access where necessary by providing clarification to any candidate on the requirements or timings of any aspect of this assignment. Assessors should not provide more guidance than the candidate needs as this may impact on the candidate's grade, see the guidance and feedback section below.

All candidates must be provided with an environment, time frame and resources that allows them reasonable access to the full range of marks available.

Where candidates have worked in groups to complete one or more tasks for this assessment, the assessor must ensure that no candidate is disadvantaged as a result of the performance of any other team member. If a team member is distracting or preventing another team member from fully demonstrating their skills or knowledge, the assessor must intervene.

Guidance and feedback

To support centre file management, assessors may specify a suitable file format and referencing format for evidence (unless otherwise specified e.g. if file naming is an assessment point for the assignment). Guidance must only support access to the assignment brief and must not provide feedback for improvement. The level and frequency of clarification and guidance must be:

- recorded fully on the candidate record form (CRF)
- taken into account along with the candidate's final evidence during marking
- made available for moderation.

Assessors must not provide feedback on the quality of the performance or how the quality of evidence can be improved. This would be classed as malpractice. However, this does not apply if the assessor asks questions as part of the assessment process. Such requirements will be specifically stated within task centre guidance.

Assessors should however provide general reminders to candidates throughout the assessment period to check their work thoroughly before submitting it, and to be sure that they are happy with their final evidence as it may not be worked on further after submission.

Candidates can rework any evidence that has been produced for each task during the time allowed.

Assessors should check and be aware of the candidates' plans and designs to ensure management of time and resources is appropriate, and so any allowed intervention can take place at an appropriate time.

The information on the guidance given and captured on the CRF is part of the evidence that must be taken into account along with the other evidence for the task when marking. It is up to the assessor to decide if the guidance the candidate has required suggests they are lacking in any performance outcome and consider the severity of the issue when applying the marking criteria. The assessor must record where and how guidance has had an impact on the marks given, so this is available should queries arise at moderation or appeal.

What is, and is not, an appropriate level of guidance

- The assessor should intervene with caution if a candidate has taken a course of action that will result in them not being able to submit the full range of evidence for assessment. However, this should only take place once the assessor has prompted the candidate to check that they have covered all the requirements. Where the assessor has to be explicit as to what the issue is, this is likely to demonstrate a lack of understanding on the part of the candidate rather than a simple error, and full details should be recorded on the CRF.
- The assessor should not provide guidance if the candidate is thought to be able to correct the issue without it, and a prompt would suffice. In other words, only the minimum support the candidate actually needs should be given, since the more assessor guidance provided, the less of the candidate's own performance is being demonstrated and therefore the larger the impact on the marks awarded.
- The assessor must not provide guidance that the candidate's work is not at the required standard or how to improve their work. In this way, candidates are given the chance to identify and correct any errors on their own, providing valid evidence of knowledge and skills that will be credited during marking.
- The assessor must not produce any templates, pro-formas, work logs etc. If templates are provided by the awarding organisation as part of the assignment, these should not be

adapted but can be provided to candidates either electronically or as paper based. Compliance of this requirement will be checked at moderation.

All specific prompts and details of the nature of any further guidance must be recorded on the relevant form and reviewed during marking and moderation.

5. Marking

Guidance on marking

Please refer to the ***T Level Technical qualifications – marking*** *and* ***moderation*** centre guidance documents for further information on gathering evidence suitable for marking and moderation, and on using the marking grid and forms.

The Candidate Record Form (CRF) is used to record:

- details of any guidance or the level of prompting the candidate has received during the assessment period
- rough notes bringing together relevant evidence from across tasks during marking
- summary justifications when holistically coming to an overall judgement of the mark for each performance objective and overall
- if an assessment has to be stopped on the grounds of Health and Safety or if a candidate has been working in an unsafe manner.

The Practical Observation form (PO) is used to record:

- descriptive information and evidence of candidate performance during an observation.

Carrying out marking using assessment themes

The process of marking each assessment theme is iterative and should follow the process below which will become more spontaneous over time as the descriptors become familiar. It is recommended to refer back to these frequently however, so the standard does not unintentionally drift over the marking period.

The indicative content gives an indication of the expected content parameters the responses are likely to cover, and which aspects of the evidence are relevant. It is not exhaustive, and an acceptable answer may concentrate more on depth rather than fully cover the range indicated or deviate into relevant topics not listed.

The specific task evidence listed within the assessor guide and marking grid must be used to make a judgement on performance in relation the specific assessment theme.

The assessment tasks guide the production of valid evidence under appropriate conditions for assessment. Candidate evidence from a range of tasks may contribute to the marking of a single assessment theme, or from a single task to more than one assessment theme. In this case different aspects of the evidence are being considered for each theme and need to be judged against the marking descriptors specified in the assessment themes independently of each other.

In some cases, the quality indicators looked for in the judgement may naturally be more strongly evidenced in one piece of evidence than another. For instance, more formulaic or prescriptive forms of evidence may not be able to generate evidence of higher levels of performance, so this evidence would need to be looked for in the other forms of evidence. This means that where a range of evidence is to be assessed, it should be treated as a single package of evidence for the purposes of marking even if generated through different tasks.

Timing of marking

As some assessment themes require the triangulation of a number of pieces of evidence, marking cannot take place until after all of these are available. This does not however mean that all marking needs to take place after all candidates have completed the whole assessment.

Also, it is possible to begin recording the notes that will justify the marking for some assessment themes as evidence is produced, with the final mark only being decided once the complete array of evidence is available. This is particularly the case if later evidence is more confirmatory, and the

earlier evidence is sufficiently informative for the qualities being assessed to make this a useful exercise.

Through planning, it should be possible to identify any evidence that can start being reviewed earlier, and the assessment themes which could be scheduled for earlier completion of marking e.g. while observation evidence is fresh in the mind should this be helpful. Care must of course be taken to ensure any evidence required by candidates to progress with another task are available for that task to take place. In addition, a sense check must take place across marking for each assessment theme, and across assessors, at the end to ensure marking has not drifted during the period. This may take the form of comparing candidate work to check that the ranking of quality of evidence matches the ranking of marks – where there are discrepancies marking should be checked for accuracy. These checks should be the responsibility of the Internal Quality Assurer and undertaken as part of the centre's Internal Quality Assurance strategy.

Process for each assessment theme:

- Select the range of evidence relevant for making the judgement – this is indicated in the mark scheme for each assessment theme. However, should relevant evidence for any candidate be found elsewhere amongst the rest of their evidence, this may also be taken into consideration when making the marking judgement as long as it is:
    - valid in relation to the assessment theme
    - is produced under appropriate conditions
    - and the marker is confident that it is authentic.
- Scan/read the candidate evidence, any notes on the CRF e.g. regarding level of support/guidance recorded, evidence captured by the assessor and the indicative content and band descriptors in the mark scheme.
- Note: for any warnings given during the assessment the actions that have led to that warning must be detailed on the CRF so they can be considered along with the other evidence when applying the descriptors in the mark scheme.
- Note: the evidence contained on the CRF must be considered and a judgement made on the level of performance the candidate has independently demonstrated – this will vary depending on the level of support detailed on the CRF – i.e. consider all relevant evidence and then judge the appropriate mark following the process below.
- Make an initial assessment of the required evidence as a whole, considering each band in turn and considering the level of performance described in the context of the knowledge and skills in the indicative content to make a balanced judgement of the best band to use as a starting point.
- Read the evidence and review it against the band descriptor in more detail,

  deciding if the response is securely sitting within the band; i.e. all quality characteristics described by the band descriptor are seen, and strongly meets the level of performance described by the descriptor holistically (i.e. across the range of relevant evidence):
    - check the descriptor for the level above
    - if the evidence clearly shows some of the characteristics of the higher band, select a suitable mark at the bottom of that band
    - if *not* showing characteristics of the higher band revert to the original band, select a mark at the higher end of that mark range.

  If the response is not securely in the band, but *is partially* showing the characteristics of the band,
    - check the descriptor of the level below
    - decide on a suitable mark either at the bottom of the original band as some characteristics shown, or top of the lower band if it better describes the quality of the characteristics being shown.

  If the response is largely meeting the band, with only a few concerns, and is not showing characteristics aligning with the higher or lower bands, the appropriate mark is likely to be in the middle range.

If there is no alignment with the descriptor, reassess the starting band, and begin again.

- Based on the level of alignment with the descriptor, confirm the final mark within the band, bearing in mind that the available marks form an *evenly distributed scale*:
    - if the quality of response *fully* aligns with the performance described by the descriptor – assign a high mark within the band

      if the quality of the response *partially* aligns with the performance described by the descriptor – assign a low to medium mark within the band
    - consider the quality compared to a range of similar responses (e.g. relevant annotated training material exemplars, responses reviewed during standardisation, and through experience) choose a mark on the point on the scale that would give an appropriate ranking for the assessed piece of evidence in relation to this information and in comparison with that of the rest of the cohort for that assessment theme.

Marking grid

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

The following evidence from Task 1, 2 and Task 4 should be used to assess performance against this assessment theme.

Task 1

- design specification.

Task 2

- risk assessment
- assessor observations:
    - production of the PCB
    - building of the soldered prototype
    - testing of the circuitry.

Task 4

- evaluation and implementation report.

Additional supporting evidence

Photographic and/or video evidence requirements are stated in the specific task guidance for each task within this assessor pack.

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

	Indicative content:
	Completion of a comprehensive risk assessment, including:
	• identification of risks and hazards that if not controlled could cause injury to themselves or others, that may include:
	  ○ low risk – slips, trips and falls
	  ○ medium risk – working in high temperatures (burns and scaling), flying debris, personal injury from use of tools
	  ○ high risk – chemicals, electric shock
	• analysis of risk with appropriate mitigation and control measures prepared against hazards for planned tasks, including PPE, correct handling of power sources, extraction, isolation, measures to ensure safety when soldering
	• assessment of risk as part of planning and preparing for manufacturing and testing activities, including health and safety preparatory checks on tools and equipment and the work area.
	
	Manufacture and testing of prototype:
	• correct preparation of tools, prototype manufacture and assembly equipment and PPE for the proposed design
	• work area to be kept tidy throughout the tasks
	• wearing the correct PPE at all times, as identified in their risk assessment
	• following safe work practices throughout the manufacture, development and testing of the prototype e.g. safe use of tools and equipment e.g. soldering equipment, PCB production equipment, wire cutters.
	
	Completion of a design specification for the system to include consideration to:
	• safe use of power supplies
	• safe production and manufacture of the PCB
	• safe construction and assembly of the PCB
	• testing requirements to ensure safe operation
	• health and safety legislations and regulations and local workplace procedures (use of tools and equipment, measurement, IET wiring regulations).
	
	Completion of an evaluation and implementation report to consideration of:
	• health and safety legislations and regulations e.g. wiring regulations				

	• wider implications of both the construction and operation of the system e.g. environmental considerations, capabilities of human operators, ergonomics • measures required to work on components, systems, wiring and cables • location in which activity is carried out.				
Marks per band	**1-4**	**5-8**	**9-12**	**N/A**	**12**
	Risk assessment covers the majority of risk factors and some control measures have been identified. Likelihood or severity has been considered for some risks and hazards. Risk mitigation methods are limited.	Risk assessment covers a good range of risk factors, including risk control measures identified for most of the potential risks and hazards. Likelihood and severity have been considered for most risks and hazards. Risk mitigation methods have been identified for some of the potential risks, but not all.	Risk assessment is detailed and clearly identifies all of the associated risk factors, risk control measures and have been clearly identified for all potential risks and hazards. Likelihood and severity have been considered for all risks and hazards. Risk mitigation methods are detailed and have been clearly identified for all potential risks.		
	Health and safety is followed during preparation and throughout the tasks so that all work is completed safely. Some risks and hazards that occur during the tasks are mitigated against as they arise.	Health and safety is followed during preparation and throughout tasks and all work completed safely. Most risks and hazards that occur during the tasks are correctly mitigated against as they arise.	Health and safety is followed during preparation and throughout tasks and all work completed safely. Risks and hazards that occur during the tasks are correctly mitigated against as they are arise.		
	Minimal health and safety considerations have been included as part of the design and evaluation/implementation.	A good range of health and safety considerations have been included as part of the design and evaluation/implementation.	A comprehensive range of health and safety considerations have been considered as part of the design and evaluation/implementation.		

Assessment theme – Design and Planning

Guidance for assessors

The following evidence from Task 1 should be used to assess performance against this assessment theme.

Task 1

- design specification
- design calculations
- evaluation of design options for the sensors
- bill of materials
- circuit diagram and wiring diagram
- PCB layout
- outcomes of the virtual modelling of the proposed circuit design, either as screen captures or printouts.

Task 4

- outcomes of virtual modelling.

Note: where there is insufficient evidence to award a mark, a zero mark must be given	**Band 1 descriptor**	**Band 2 descriptor**	**Band 3 descriptor**	**Total marks per sub assessment themes**	**Total marks for assessment theme**
	Indicative content: **Documents** • analysis and interpretation of design criteria • the appropriate selection of technology, input, process and output components, tools and equipment - technologies and components: potential dividers, 4000 series logic, 74 series logic, PAL, FPGA, PID controller, PLC, microcontroller or alternatives - input devices: SPST switch on/off, infrared sensors, ultrasonic sensors, LDR, microswitches, pressure sensors or alternatives				

	- output devices: lamps, light emitting diodes, buzzers, bells, loudspeakers, motors and servo motors • the appropriate selection of materials and components and sub-systems required to meet the design criteria and specification with justifications for the selections • accuracy and precision of sensors • sustainability considerations and requirements e.g. use of renewable energy, safe disposal of components, designing for recycling and re-use, circular economy • the type, size and quantity of materials and components required to complete the tasks to ensure the highest quality, which shows no evidence of damage to components, sensors and wiring etc • considerations relating to the design of the PCB (track and pad layouts, track thickness, grounding considerations, decoupling) • design calculations e.g. calculate required resistor and capacitor values, potential divider voltages, output voltages, power supplies • scientific principles e.g. Ohms Law, Watts Law, voltage, current, resistance, capacitance, power. **Drawings and diagrams** • engineering diagrams and representations (wiring diagrams, block diagrams, circuit diagrams, schematics, PCB layouts) • block diagrams include signal flow and feedback loop for sensor control • wiring diagrams include type of wire, connection types, physical layout of sub--systems and grounding • schematics including correct abbreviations and symbols for on/off switch, sensors detecting the dimensions of each box, holding area sensor (e.g infrared sensor), LED or lamp for the visual indicator and buzzer or speaker for the audible sound output • PCB layouts include all pads, tracks and components arranged in an efficient manner with little wasted board space • industry standard conventions, symbols, abbreviations, references and annotations. **Virtual modelling** • use of virtual modelling tools or CAD to simulate function of circuit including on/off switch, sensors, visual indicator and sound output device • use of virtual modelling tools or CAD to simulate function of PCB including all input, process and output devices.				
Marks per band	**1-4**	**5-8**	**9-12**	**12**	**33**
Documents	Specification is brief with minor inaccuracies in technical knowledge. Most points have been analysed, considered and elaborated on.	Specification is detailed and minor inaccuracies in technical knowledge. All points have been analysed, considered and most have been elaborated on.	Specification is detailed and thorough with accurate technical knowledge throughout. All points have been analysed, considered and elaborated on.		

	Some key materials and quantities to meet the brief have been identified. No reasoning provided to justify choices made for selection of materials. Some design calculations and methodology applied are accurate.	Most key materials, quantities required to meet the brief have been identified. Some reasoning provided to justify choices made for selection of materials. Most design calculations and methodology applied are accurate.	All materials and quantities required to meet the brief have been identified. Detailed reasoning provided to justify choices made for selection of materials. All design calculations and methodology applied are accurate with reference to industry standards annotated.		
Marks per band	**1-4**	**5-8**	**9-12**	**12**	
Drawings and diagrams	Drawings/diagrams are produced using some correct conventions. Drawings/diagrams are clear and contain some of the appropriate information needed in order for a third party to reproduce them. Sketches include brief annotations and some relevant information.	Drawings/diagrams are produced using most correct conventions. Drawings/diagrams are clear and contain most of the appropriate information needed in order for a third party to reproduce them. Sketches are clearly annotated and contain most relevant information.	Drawings/diagrams produced with fully compliant and correct conventions. Drawings/diagrams are clear and well presented and contain all of the appropriate information needed in order for a third party to reproduce them. Sketches are annotated in detail and contain all relevant information.		
Marks per band	**1-3**	**4-6**	**7-9**	**9**	
Virtual modelling	Use of virtual modelling tools is basic. Virtual model(s) is functional meets some of the requirements of the design criteria.	Use of virtual modelling tools is good. Virtual model(s) is functional and meets most of the requirements of the design criteria.	Use of virtual modelling tools is comprehensive. Virtual model(s) is functional and meets all requirements of the design criteria, including any changes/ modifications of required.		

Assessment theme – Manufacturing

Guidance for assessors

The following evidence from Tasks 1 and 2 should be used to assess performance against this assessment theme.

Task 1

- records of the results of testing the model of the circuit.

Task 2

- test records for the results of testing the circuitry
- Assessor observations:
    - production of the PCB
    - building of the soldered prototype
    - testing of the circuitry.

Additional supporting evidence

Photographic and/or video evidence requirements are stated in the specific task guidance for each task within this assessor pack.

Note: where there is insufficient evidence to award a mark, a zero mark must be given	Band 1 descriptor	Band 2 descriptor	Band 3 descriptor	Total marks per sub assessment theme	Total marks for assessment theme
	Indicative content: **Developing the prototype/model** • the appropriate selection and use of components, tools, equipment and processes for PCB production and assembly • hand skills e.g. wiring, soldering of components to PCB, fitting input, process and output devices • soldering and assembling a prototype • use of equipment to manufacture and produce a PCB e.g. etching, milling. Measuring and cutting of components, materials, wiring and cables using appropriate tools and equipment • soldered joints are correctly formed and dry joints avoided, use of strain holes for soldered wiring connections, sockets used to avoid heat damage to ICs when soldering, screw connections are tightened, correctly matched crimps and wires, no exposed wiring or connections, appropriate colour coding of wiring used, appropriate circuit protection methods used, microcontroller programming is fully tested where relevant. **Tests from the range below** • use of electrical measurement and test equipment (e.g. multimeter, oscilloscope, logic probe) to measure input and output signal parameters for both the full circuit and individual switches, sensors, processes sub-systems and output devices (e.g, voltage, current, resistance and characteristic of signal waveforms) • use of manual and automated testing processes, such as functional testing and visual inspection, to test against each point of the design criteria listed in the brief. E.g. using a range of different box sizes and weights to check that the system responds as required to each one by directing them down the appropriate chute.				
Marks per band	**1-3**	**4-6**	**7-9**	**9**	**27**
Prototype/ model	The prototype/model is mainly appropriate but may require significant modifications. The prototype/model meets some of the requirements of the design criteria.	The prototype/model is mainly appropriate and functional but may require some minor modifications. The prototype/model meets most of the requirements of the design criteria.	The prototype/model is functional without modification. The prototype/model meets all of the requirements of the design criteria.		

Marks per band	**1-2**	**3-4**	**5-6**	**6**	
Developing	The soldering is adequate for functionality. Selection of tools, equipment and processes is not always appropriate to the task. Use of tools, equipment and processes is basic, resulting in a finish that is of poor quality.	The soldering is of a good standard for functionality. Selection of tools, equipment and processes is mostly appropriate to the task. Use of tools, equipment and processes is good resulting in a finish that is of adequate quality.	The soldering is neat and tidy and carried out to a high standard. Selection of tools, equipment and processes is always appropriate to the task. Use of tools, equipment and processes is excellent, resulting in a finish that is of high-quality.		
Marks per band	**1-4**	**5-8**	**9-12**	**12**	
Testing	Some understanding shown through selection of tests, some appropriate tests carried out in order to check the prototype/model meets the design criteria. The model has been tested against some of the design criteria and meets some of the requirements. Selection and use of testing and measurement equipment is mostly appropriate and carried out with some errors in accuracy.	Good understanding shown through selection of tests, most appropriate tests carried out in order to check the prototype/model meets the design criteria. The model has been tested against most of the design criteria and meets most of the requirements. Selection and use of testing and measurement equipment is mostly appropriate and carried out accurately.	Comprehensive understanding shown through selection of tests, all appropriate tests carried out in order to check the prototype/model meets the design criteria. The model has been tested against all of the design criteria and meets all of the requirements. Selection and use of testing and measurement equipment is always appropriate to the task and carried out with a high degree of accuracy.		

Assessment theme – Reports

Guidance for assessors

The following evidence from Tasks 1, 2, 3 and 4 should be used to assess performance against this assessment theme.

Task 1

- records of the results of testing the model of the circuit.

Task 2

- test records for the results of testing the circuitry.

Task 3 – for consideration only

- candidate notes on the candidate feedback record form
- peer review feedback form.

Task 4

- evaluation and implementation report
- revision control document
- outcomes of virtual modelling.

Note: where there is insufficient evidence to award a mark, a zero mark must be given	Band 1 descriptor	Band 2 descriptor	Band 3 descriptor	Total marks per sub assessment theme	Total marks for assessment theme
	Indicative content: **Implementation** Completion of an evaluation and implementation report to include: • use of wiring, circuitry and components • wiring regulations BS7671 (IET) or relevant wireless connection regulations • any adaptions/modifications and improvements with justifications • justifications where no adaptions/modifications are required • revision control document with justifications • conformance to design requirements and functionality • commissioning procedures, siting of switches, sensors, output devices and circuitry • compliance to legal standards. **Records/reports** • completion of test records and reports/results, including function, performance testing, relevance and any limitations or challenges to methods used • descriptions of methods and processes • consideration of accuracy and sources of any errors • use of technical language and terminology.				
Marks per band	**1-4**	**5-8**	**9-12**	**12**	**18**
Implementation	Contains some basic information, some minor details missing that could impact on a third party familiar with the design being able to reproduce it.	Contains good information that would allow a third party that is familiar with the design to reproduce it.	Contains detailed information that would allow a third party to reproduce it.		

	Evaluation of the design is basic and identifies a brief list of improvements with no justification. Where no improvements or adaptions are needed, this is supported with brief reasoning and justifications to why. Changes or no changes to the design as a result of manufacturing, testing or feedback are not always suitable and lack reasoning.	Evaluation of the design is good and identifies a range of improvements with some justification. Where no improvements or adaptions are needed, this is supported with good reasoning and justifications to why. Changes or no changes to the design as a result of manufacturing, testing or feedback are suitable with some reasoning.	Evaluation of the design is thorough and identifies a comprehensive range of improvements with clear and detailed justification. Where no improvements or adaptions are needed, this is supported with detailed and thorough reasoning and justifications to why. Changes or no changes to the design as a result of manufacturing, testing or feedback are suitable with detailed reasoning.		
Marks per band	**1-3**	**4-6**	**7-9**	**6**	
Records/reports	Reports are partially completed/brief in content with some incorrect technical and industry terminology. Test records include some of the appropriate information. Some inaccuracies in recording of test outputs and measurements.	Reports checklists are completed in a clear format with only minor details missing. Content and technical and industry terminology is mostly accurate. Test records include most of the appropriate information. Some minor inaccuracies in recording of test outputs and measurements.	Reports are detailed and accurate with correct technical and industry terminology throughout. Test records are detailed and include all appropriate information. All test outputs and measurements are accurate.		

6. Links to Maths, English and Digital Skills

The table below indicates where each of the General Maths, English and Digital Competencies have been integrated into the assignment tasks.

Task	Skills
1	EC1, EC2, EC3, MC2, MC8, MC10, DC1, DC2
2	EC1, EC3, MC1, MC10
3	EC1, EC2, EC3, EC4, EC6, MC2
4	EC1, EC2, EC3, EC4, MC10, DC1, DC2

7. Peer review form

Candidate name	Candidate number
Centre name	**Centre number**

Question	Feedback
Explain how well the diagrams and drawings meet the design criteria.	
Explain how well the diagrams and drawings meet the specification criteria.	
Explain how well the diagrams and drawings conform to the relevant conventions.	
Explain how the system could be optimised/improved.	

8. Feedback record form

Candidate name	Candidate number
Centre name	**Centre number**

Candidate's notes

9. Declaration of authenticity

Assessment ID	Qualification number
Candidate name	**Candidate number**
Centre name	**Centre number**

Additional Support

Has the candidate received any additional support in the production of this work?

No □ **Yes** □ (Please tick appropriate)

If yes, give details below (and on a separate sheet if necessary).

Candidate:

I confirm that all work submitted is my own, and that I have acknowledged all sources I have used.

Candidate signature	Date

Assessor:

I confirm that all work was conducted under conditions designed to assure the authenticity of the candidate's work, and am satisfied that, to the best of my knowledge, the work produced is solely that of the candidate.

Assessor signature	Date

Note: Where the candidate and/or assessor is unable to or does not confirm authenticity through signing this declaration form, the work will be returned to the centre and this will delay the moderation process. If any question of authenticity arises, the assessor may be contacted for justification of authentication.

10. Candidate Record Form (CRF) - Exemplar

T level technical qualifications

(T level technical qualification – Electrical and electronic engineering occupational specialism)

Candidate name	Candidate number
Centre name	**Centre number**

Marker Notes *– Please always refer to the relevant marking grid for guidance on allocating marks and make notes which describe the quality of the evidence and justification of marks.*

Please record any guidance, intervention (including Health and Safety) or feedback that is given to a candidate.

Expand boxes as required.

Health and safety												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark	Notes and justification											
Design and planning												
Documents												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark	Notes and justification											
Drawings and diagrams												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark	Notes and justification											
Virtual modelling									
---	---	---	---	---	---	---	---	---	---
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark	Notes and justification								

Manufacturing									
Prototype / model									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark	Notes and justification								
Developing									
	1	**2**	**3**	**4**	**5**	**6**			
Mark	Notes and justification								
Testing									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark	Notes and justification											
Reports												
Implementation												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark	Notes and justification											
Records												
	1	**2**	**3**	**4**	**5**	**6**						
Mark	Notes and justification											

Internal assessor signature	Date

Total