

L5 - ACDA5025A Engineering & Project management Assignment

Project proposal

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Table of Contents

1. Overview	3
1.1 Product description.....	3
1.2 Use case	3
2. Specifications	3
2.1 Physical Characteristics	3
2.2 Electronic Characteristics.....	4
2.3 Regulatory Compliance	4
3. Deliverables.....	5
3.1 Product construction and fitting	5
3.2 Adhesive development	5
3.3 Electronics design	6
3.4 Quality and standards assurance	6
4. Resourcing.....	6
4.1 Time resourcing	6
4.11 Skills Requirement	8
4.12 Time cost	8
4.2 Materials budget.....	8
4.21 Standards cost.....	8
4.22 Software licenses	9
4.23 Personal Protective Equipment (PPE)	9
5. Risks, Mitigations and the Environment	10
5.1 Chemical work.....	10
5.2 Safe working.....	10
5.3 Standards guidance.....	10
6. Ethics	11
6.1 Light pollution	11
6.2 Waste	11
6.3 Ethical sourcing	11
Conclusion.....	11
References	12

1. Overview

1.1 Product description

LED tape is a reel of adhesive safety tape with the ability to actively illuminate and make clear of a particular area. The product will be reflective, but produce light using embedded LEDs for enhanced visibility over standard safety tape (reflective or otherwise).

1.2 Use case

This product is designed for use in environments where large vehicles and/or where path restrictions are in place, such as a building site or warehouse. It should be deployed to make drivers and pedestrians aware of low ceilings, designated walking paths in high vehicle mobility zones, and vehicle docking bays.

2. Specifications

2.1 Physical Characteristics

The product must:

- Stick with at least *low** strength to common external surfaces such as brick, concrete and painted surfaces.
- Continue to stick to surfaces when exposed to *moderate breezes/rain** conditions.
- Have easy tear tabs as 30cm increments to provide a safe and determined disconnection points for the circuit.
- Fit fairly smoothly onto a reel.
- Flex, despite internal componentry.
- Reflect its own, as well as oncoming lights from the likes of vehicles and personnel equipment.
- Be ruggedized to IP54 as a minimum.

The product should:

- Stick with at least *moderate** strength.
- Continue to stick to surfaces when exposed to *moderate rain/gales**.
- Have tear tabs at 15cm intervals.
- Fit smoothly onto a reel.
- Flex well despite internal componentry.
- Be ruggedized to IP55.

The product will at a stretch:

- Stick with at least *high** strength.
- Continue to stick to surfaces when exposed to *storm** conditions.
- Fit seamlessly onto a reel.
- Be ruggedized to IP67

Table 1 - Strength and severity of weather [1] [2]

Strength level	Wind (Mph)	Rain (mm/h)	Adhesive Strength (N)
Low (Light-Fresh Breeze)	<19	<2.5mm	10
Moderate (Strong Breeze – Gale)	19 - 37	2.6 - 7.5	25
High (Storms)	37 - 52	7.6 - 55	35
Extreme (Violent Storms+)	>52	>55	50+

2.2 Electronic Characteristics

The product must:

- Be capable of being supplied by both battery and mains power.
- Last at least 8 hours on battery, equating to 1 working day.
- Be powered by a commercially standard battery.
- Produce yellow/orange light.

The product should:

- Last at least 12 hours on battery.
- Be powered by a rechargeable commercially standard battery.
- Produce light luminosity equivalent to road safety standard lighting.
- Flash at a consistent interval so as to better draw attention to itself.

The product will at a stretch:

- Last 24+ hours on battery.
- Produce light luminosity equivalent to car headlights, so long as it doesn't dazzle.
- Flash at a controllable interval, with a choice of patterns.

2.3 Regulatory Compliance

Mandated:

- European conformity (CE)/UKCA markings
 - Consideration made for all relevant EU/UK regulation.
- Electrical Equipment (Safety) regulations 2016.
- Electromagnetic Compatibility regulations 2016.
- Restriction of Hazardous Substances (RoHS) 2012.
- BS EN 60598- 1 Luminaires - General requirements and tests.
- BS EN 62471:2008 Photobiological safety of lamps and lamp systems.
- BS EN 60529 – Ingress protection (IP).
- UK REACH – Registration, evaluation, authorisation and restriction of chemicals

Documentation formatting:

- IEC/IEEE 82079-1:2019 - Design requirements for instructions of use
- BS 8888 – Engineering drawings & specifications

Industrially reputable, optional:

- BSI Certification

- ISO9001 Quality Standards
- ISO14001 Environment
- ISO31000 Risk management

3. Deliverables

In order to meet the previously constructed requirements, there are a number of separate tasks that should be tackled in order to bring the product together. These tasks will determine the number and type of staff required.

- 1) Product construction and fitting (Mechanical)
- 2) Adhesive characteristics (Chemical)
- 3) Electronics design (Electronic)
- 4) Quality and standards assurance (Team leader)

Each of these can be split into a number of work package milestones, all requiring completion in order for the deliverable to be met.

3.1 Product construction and fitting

The mechanical engineer will be helping throughout with size, weight and integrity of the product as a whole, consulting with the other engineers as to what is viable and what isn't in terms of size, and how to best accommodate in the overall structure with the electronic components.

WPs:

- 1a. Design tape roll layout
- 1b. Design LED layout/placement
- 1c. Design & place tear points
- 1d. Integrate battery
- 1e. Ensure structural integrity
- 1f. Test and certify adhesive strength as a system

3.2 Adhesive development

This deliverable will be primarily worked on by a chemical engineer, where their job will be to source or produce an adhesive that meets the specification as best as possible within the timeframe. They will work with a mechanical engineer to discuss what is feasible to the design of the tape, and what forces it should be able to sustain. They will then develop the appropriate documentation to be provided with the product, such as a safety data sheet (SDS) and ensure compliance with UK REACH, RoHS and BSI certification where possible.

WPs:

- 2a. Adhesive market research
- 2b. Adhesive chemical design
 - 2ba. Chemical design feasibility study
 - 2bb. Risk balance case
 - 2bc. Production & Testing
- 2c. Compile safe application method

2d. Complete/Collect safety data sheets and complete safe usage instructions

3.3 Electronics design

This deliverable will require a junior electronics engineer to progress, designing the LED & control circuit, specifying electronic. Implementation of a flashing control circuit will be required, but external access to said control circuit will prove more difficult as a stretch task to the product requirements. Once the circuits are designed, the electronics engineer will be able to determine how much power will be needed, and the size/composition of the battery required to meet specification.

A junior staff member should be sufficient to this task due to the simplicity of light control circuits, though it may take them slightly longer to complete their tasks. They should also be responsible for ensuring all produced design documentation is correct to the relevant standard, and that the design process is done in line with ISO9001 with the help of the team leader.

WPs:

- 3a. LED Market research
- 3b. LED circuit design to standard
- 3c. Control circuit design to standard
- 3d. Battery specification in line with specification and space constraints
- 3e. Power connection design

3.4 Quality and standards assurance

This will be the team leader's primary goal, to ensure compliance with ISO9001 and to keep the team on track with proper product design process as per the standard, communicating progress and financial forecasts with the project manager. They will ensure effective communication and cohesion between the team members and be the primary conduit for their working concerns. They will also finalise documentation to make sure it is sufficient and complete to the relevant standards, helping out where they are required and capable.

WPs:

- 4a. Manage staff utilisation
- 4b. Ensure safety documentation is in order
- 4c. Obtain relevant BSI accreditation

4. Resourcing

4.1 Time resourcing

Each of these deliverables will require a set amount of time, some more than others. Below is the Gantt chart/critical path analysis that describes the order and resource each task will take, and in what order they are required to be completed.

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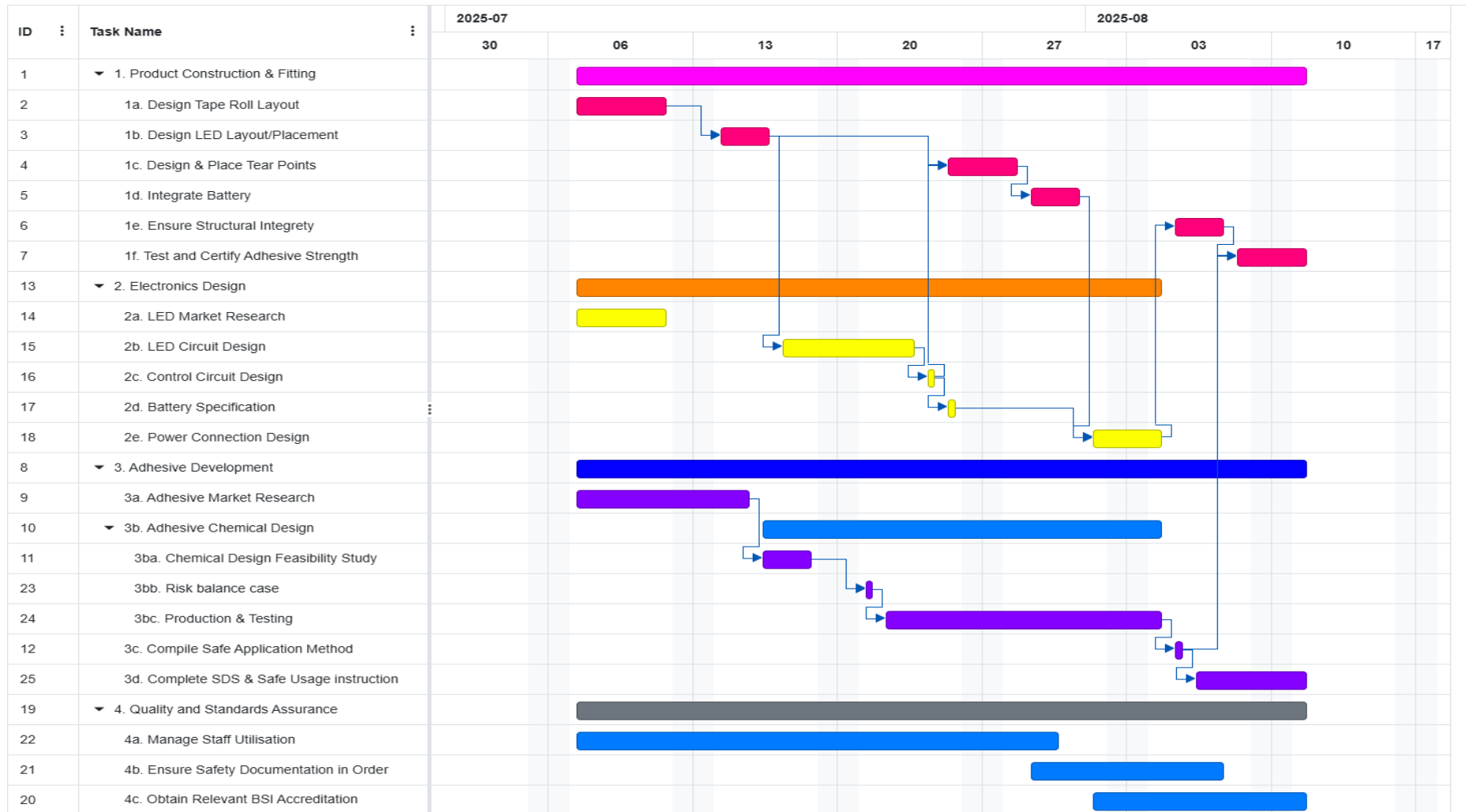


Figure 1 - Deliverables Gantt Chart

4.11 Skills Requirement

Based on the required deliverables, the skills required can be encapsulated in a small team including the following roles and their average charge out rate:

- Project manager - £55
- Team leader - £50
- Senior Chemical engineer - £40
- Mechanical engineer - £35
- Junior electronics engineer - £30

4.12 Time cost

Given these figures, and the predicted project duration and that it is expected that they will be working full time, 8 hours a day, 5 days a week on this project (with the exception of the project manager), the total staff cost can be calculated:

$$\text{Individual staff cost} = \text{working days}(\text{staff rate} \times \text{daily working hours})$$

Where the project spans 26 days, each staff member costs the following:

$$PM \text{ Cost} = 26(55 \times 2) = £2,860$$

$$TL \text{ Cost} = 26(50 \times 8) = £10,400$$

$$CE \text{ Cost} = 26(35 \times 8) = £8,320$$

$$ME \text{ Cost} = 26(35 \times 8) = £7,280$$

$$EE = 26(30 \times 8) = £6,240$$

$$\text{Total staff cost} = £35,100$$

To account for deadline slipping, a tolerance of 15% will be added to this staff figure to attempt to reduce the damage of delays.

$$\text{Staff time budget} = £35,100 \times 1.15 = £40,365$$

4.2 Materials budget

To pay for materials and consumables, due to the small scale of prototyping that is likely to take place, 5% of the original staff cost will be allocated within the budget to be spent as the engineers see fit.

$$\text{Materials budget} = 35,100 \times 0.05 = £1,775$$

4.21 Standards cost

A copy of the up to date BSI standards also have an associated cost, if the team leader is serious about their formal acquisition for the product, they will be required.

- ISO9001 - £362
- ISO14001 - £196
- ISO31000 - £308 [3]

$$\text{Materials Budget} = £1,775 + £362 + £196 + £308 = £2,641$$

4.22 Software licenses

In order to properly design and produce electronic and mechanical diagrams/prototypes to standard, appropriate software should be obtained if not already available. As a minimum, Solidworks and Proteus will be required for this.

For an annual standard license, they will cost the following:

- Solidworks - £2,080 [4]
- Proteus - £625 [5]

This brings our new materials total up to:

$$\text{Materials Budget} = £2,641 + £2,080 + £625 = £5,346$$

4.23 Personal Protective Equipment (PPE)

Due to the hazardous nature of some of the work that will take place, such as: Chemical development, handling, electronic prototyping and display screen equipment (DSE) work, it is imperative that we allow budget for PPE.

The primary items that will be required are:

- Nitrile gloves for handling of adhesive, chemicals and solder
- Safety glasses
- Respirators
- Protective footwear for workshop areas
- Lab coat etc.

Though it is better to provide too much than not enough, as such, an estimate of £800 will be allocated for use towards PPE.

New materials total:

$$\text{Materials Budget} = £5,346 + £800 = £6,146$$

And our total resourcing budget up to:

$$\text{Resourcing budget} = £40,365 + £6,146 = £46,511$$

5. Risks, Mitigations and the Environment

5.1 Chemical work

There will always be risks involved with developing and prototyping a product of any kind, however the most prevalent source of risk will be with the development of adhesive. This process will likely involve chemicals that are irritants and damaging to both humans and the environment, which is why it is imperative that sufficient time with both the chemical engineer and team leader is taken to undergo the risk balance case. If the activity is to be deemed too risky, then the product will have to suffice with a commercially available adhesive, likely at the cost of quality.

The seniority of the chemical engineer should provide sufficient experience and understanding to mitigate risks to health and environment. The extra cost for their time is a very worthwhile trade when considering the cost and damage if the risk balance case is not properly completed.

To support these hazardous activities, ample budget has been allocated to the procurement of PPE with opportunity for uplift should the given amount prove insufficient as a safety business case should only be rejected in exceedingly rare cases.

5.2 Safe working

As is standard for all engineering tasks, electronics, mechanical and chemical tasks should have risk assessments in place for the working environment already. In the case that this isn't true, staff working at this level (including junior) are already trained to be able to complete their own risk assessments, with the assistance of the team leader.

5.3 Standards guidance

To mitigate the risks to the environment, the team leader has budget to purchase a copy of ISO14001, which closely details the processes and proper means to lead a project in an environmentally correct way. It will be their job throughout the majority of the project to ensure the team's processes adhere perfectly to ISO14001 recommendations in order to mitigate the risks, and ensure accreditation for the product.

Furthermore, ISO9001 will provide guidance as to the quality processes behind product development, which includes risk mitigation and proper working standards that the team leader should impose onto the engineering workforce in order to keep them safe, and produce a quality product.

6. Ethics

6.1 Light pollution

The ethics of this project, being a safety based product, are quite sound if the engineering is completed effectively. Disruption to the local environment could be caused if the characteristics of the LEDs and their reflectors are over tuned however.

Light pollution of the local area could occur if the LEDs are too harsh, or if the flashing pattern draws *too* much attention to itself. If this is indeed the case, the likelihood of product miss-use will increase, as it would be more effective at causing chaos. So long as the electronics engineer completes proper LED research and the specification of the product are tuned well and within regulation, this shouldn't be an issue.

6.2 Waste

In terms of waste and chemical work, ISO standards should mitigate the risk of a negative environmental output to the point where it is unlikely that the team will have not considered all of the major factors contributing to this subject of ethics.

6.3 Ethical sourcing

In terms of ethical sourcing of materials, as long as market research is conducted thoroughly the only unavoidable issue is that of battery use, which it will be recommended they are recycled at the end of life. Lithium however is notorious for its unethical sourcing through the use of slave labour so it is highly recommended that lithium is avoided, or at the very least, sourced from somewhere that actively states that it will be acquired ethically.

In terms of electronic components, it is once again recommended that thorough market research is completed to ensure that components are created using ethical means. Sourcing components from within the EU/US would assure that workers are protected under regulation to be treated and compensated fairly for their work, under safe working conditions at a small increased cost of the component itself.

Conclusion

With these preparations, I am confident that the team would be safe to begin work in accordance with the existing time plans. The project manager will be present throughout the project to elucidate any doubts within the team, and the team leader will be present to support the project team from a managerial perspective, ensuring that the engineers can focus on the engineering that will make the product as best as it can be.

Figure 1 - Deliverables Gantt Chart..... 7

References

- [1] Barani, "Rain rate intensity classification," 19 January 2020. [Online]. Available: <https://www.baranidesign.com/faq-articles/2020/1/19/rain-rate-intensity-classification>. [Accessed 25 June 2025].
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- [4] Solidworks, "Solidworks Plans and Pricing," Solidworks, [Online]. Available: <https://www.solidworks.com/how-to-buy/solidworks-plans-pricing#scroll--3166>. [Accessed 11 July 2025].
- [5] Proteus, "Commercial Price List," Labcenter, [Online]. Available: <https://www.labcenter.com/pricing/comm/>. [Accessed 11 July 2025].

Appendix

Prevent Duty



**AN INTRODUCTION TO
THE PREVENT DUTY
AS IT AFFECTS
HIGHER EDUCATION**

CERTIFICATE OF COMPLETION

THIS ACKNOWLEDGES THAT

Name: David Reynard

HAS SUCCESSFULLY COMPLETED THE INTRODUCTION TO PREVENT E-LEARNING

Date: 23/06/2025

Equality & Diversity



This is to certify that
David Reynard
successfully completed the
Equality & Diversity Briefing
course with a score of
85%
on
28th May 2025

