

Polycarbonate Det Shield - Project Proposal

by Andrew Hurley

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Research Proposal

Title: *“Polycarbonate can be used to replace the steel and ballistic glass in a detonator shield without reducing safety performance.”*

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Student No: 1906810

Date: 28/02/2023

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2 Introduction

- 2.1.1 This project will investigate the potential of alternative materials in constructing 10-gram detonator shields, with the desired outcome of increasing visibility, decreasing overall mass, and maintaining safety performance.
- 2.1.2 10-gram detonator shields are used frequently within munitions breakdown processes, intended as protection for persons dismantling and handling primary explosives with a net explosive quantity of $\leq 10\text{g}$ (or secondary explosives and low explosives at relative NEQ's, e.g. TNT equivalence [1]).
- 2.1.3 The design certificate for the current 10-gram detonator no longer exists due to errors made during the digitisation process, so new detonator shields cannot be made to the exact specification.
- 2.1.4 Having no means of replacing shields realises an opportunity for both a capability update from the older design and a new drawing to certify for manufacture, future-proofing.

3 Background

- 3.1.1 With the increasing levels of global conflict, novel systems are constantly developing, industrial and improvised [2]. The munitions breakdown team are working on OME (Ordnance, Munitions and Explosives) with more significant safety considerations than legacy stores, with new compositions and safety features.
- 3.1.2 Detonator shields are essential and constantly utilised protective equipment throughout breakdown operations. Without the drawings and design certificate, the capability to hazard-type rate and create new shields is lost, leaving a critical protective device unable to be used with more hazardous novel stores.
- 3.1.3 Because of this, extreme safety measures [3] must be implemented, causing delays to work and costing customers more to have their work carried out.

3.2 Construction

- 3.2.1 Currently, the detonator shields used in Munitions Breakdown consist of a 5mm rolled steel plate and 5mm ballistic glass housed in a steel plate surround of similar thickness.
- 3.2.2



Figure 1 – 10-gram detonator shield [Front]

3.2.3

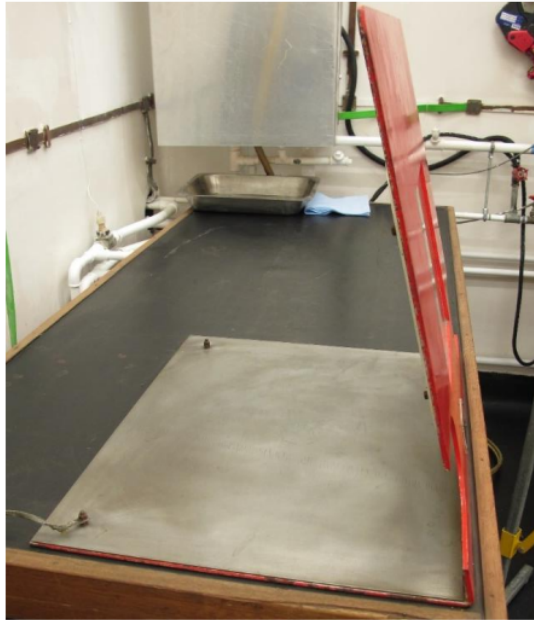


Figure 2 – 10-gram Detonator shield [Left Hand Side]

3.3 Alternatives

3.3.1 Polycarbonate is a strong material found in blast shields/cases. It is in testing for its use within the explosive industry, often as a shield for personnel protection from debris and explosive effects (Detonation wave, shock wave, heat, fragmentation) [4].

3.3.2

Physical Properties	Metric	English
Density	1.11 - 1.41 g/cc	0.0399 - 0.0509 lb/in ³
Filler Content	2.00 - 16.0 %	2.00 - 16.0 %
Water Absorption	0.0800 - 0.900 %	0.0800 - 0.900 %
Linear Mold Shrinkage	0.00100 - 0.0120 cm/cm	0.00100 - 0.0120 in/in
Melt Flow	0.200 - 18.0 g/10 min	0.200 - 18.0 g/10 min

Mechanical Properties	Metric	English
Hardness, Rockwell R	99.0 - 122	99.0 - 122
Tensile Strength, Ultimate	16.0 - 119 MPa	2320 - 17200 psi
Tensile Strength, Yield	65.0 - 146 MPa	9430 - 21200 psi
Elongation at Break	1.00 - 118 %	1.00 - 118 %
Modulus of Elasticity	2.07 - 15.9 GPa	300 - 2300 ksi
Flexural Yield Strength	59.8 - 179 MPa	8680 - 26000 psi
Flexural Modulus	1.06 - 14.5 GPa	154 - 2100 ksi

Figure 3- Polycarbonate material properties [5]

3.3.3

Physical Properties	Metric	English
Density	7.872 g/cc	0.2844 lb/in ³

Mechanical Properties	Metric	English
Tensile Strength, Ultimate	303 - 358 MPa	43900 - 51900 psi
Tensile Strength, Yield	180 - 240 MPa	26100 - 34800 psi
Elongation at Break	42 - 48 %	42 - 48 %
Modulus of Elasticity	200 GPa	29000 ksi
Bulk Modulus	160 GPa	23200 ksi
Poissons Ratio	0.29	0.29
Machinability	55 %	55 %
Shear Modulus	80.0 GPa	11600 ksi

Figure 4- AISI 1008 Steel Material Properties [6]

- 3.3.4 Polycarbonate's tensile properties are lower than the rolled steel at approximately 4.9 times lesser for ultimate tensile strength and 2.0 times lesser for yield strength. For compression and stretching, this would not be desirable.
- 3.3.5 The density of steel is 6.25 times more than that of polycarbonate, and the elasticity is over 100 times greater.
- 3.3.6 The reduction in density and increase in elasticity could allow for a lighter-weight detonator shield that could absorb the explosive shock of a detonation rather than a barrier reflecting incident waves and blocking heat transfer to the person working.
- 3.3.7 A shield made of majority polycarbonate would be primarily transparent, allowing greater ergonomics to the user and increased safety when concerned with the placement of OME; stores can be viewed without having to investigate behind the shield, putting the worker at greater risk should a hazard occur.

4 Aims and Objectives

4.1 Aims

- To provide a suitable replacement for the current 10-gram detonator shields using polycarbonate in the materials.
- To improve the ergonomics of the 10-gram detonator shields.
- Maintain or improve the safety performance of 10-gram detonator shields.

4.2 Objectives

- Create replacement 10-gram detonator shield designs.
- Create Three-dimensional models for 10-gram detonator shield designs.
- Use simulation software to test three-dimensional models against 10 *1g detonators.
- Measure and compare the mass of polycarbonate-based detonator shields.
- Measure explosive effects of personnel behind 10-gram detonator shields.

5 Experimental Design

5.1 Design Procedure – Original Shield

- Hand draw original shield design.
- Create a 3D model in AutoCAD/Solidworks.
- Create a simulation rig of 10 * 1g detonators firing at the shield screen.
- Values are taken at the point of personnel – Pressure, Temperature, Lumen and Decibels (dB), if possible.
- Record with screenshots and software data the state of the shields materials.
- Repeat five times.
- Record Data for comparative analysis.

5.2 Design procedure – Polycarbonate Shield

- Hand draw design
- Create a 3D model in AutoCAD/Solidworks.
- Create a simulation rig of 10 * 1g detonators firing at the shield screen.
- A record at the point of personnel – Pressure, Temperature, Lumen and Decibels (dB) if possible.
- Record with screenshots and software data the state of the shields materials.
- Repeat five times.
- Record Data for comparative analysis.

5.3 Post Comparison Original & Polycarbonate

- Review data and change design where failure can be seen in the polycarbonate shield.
- Create a 3D model in AutoCAD/Solidworks.
- Create a simulation rig of 10 * 1g detonators firing at the shield screen.
- A record at the point of personnel – Pressure, Temperature, Lumen and Decibels (dB) if possible.
- Record with screenshots and software data the state of the shields materials.
- Repeat five times.
- Record Data for comparative analysis.
- Repeat from 5.3

5.4 Data Evaluation

- Data will be reviewed, and anomalies and trends will be noted down.
- Shield mass is calculated from the volume of shield material multiplied by material density.

5.5 Risks & Limitations

- Human error – reading and reviewing the data should be done twice on different days to reduce error; a second set of eyes would also be ideal.
- Data lost – While simulations can be repeated, it is likely not to return the same results.

- Simulation software is only as good as the variables set up within the system. – Potential for different results in actual life trials should all variables not be recognised

6 Resources & Planning

6.1 Resources Needed

- Pens/pencils
- Paper
- Ruler
- Pair of compass
- Simulation computer
- Drawing office computer
-
- Simulation Software
- CAD software
- Microsoft Excel (Data logging)

6.2 Plan – timeline

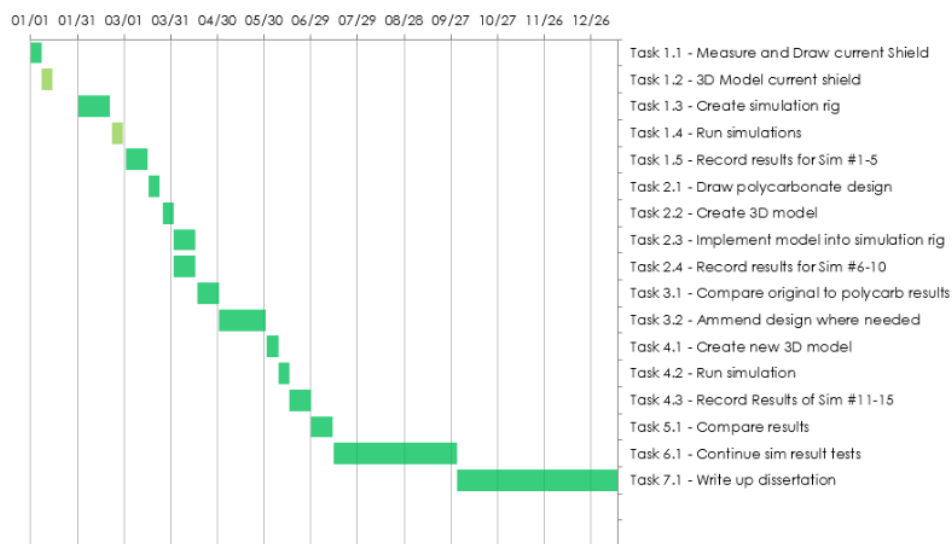


Figure 5- Gantt Chart for Major Project Timeline

7 Works Cited

- [1] P. W. Cooper, "Comments on TNT Equivalence," Sandia National Laboratories, New Mexico, 1994.
- [2] GICHD, "Explosive Ordnance guide for Ukraine," GICHD, Geneva, 2022.
- [3] J. M. Y. T. John Hurst, "A summary of the 'ALARP' principle and associated thinking," *Journal of Nuclear Science and Technology*, vol. 56, no. 2, pp. 241-253, 2018.
- [4] R. A. M. Kyle A. Perry, "Explosion testing of a polycarbonate safe haven wall," *Polska Akademia Nauk*, vol. 61, no. 4, pp. 809-821, 2016.
- [5] Mat Web, "Overview of materials for Polycarbonate, Conductive," MatWeb - Material Property Data, [Online]. Available: <https://www.matweb.com/search/DataSheet.aspx?MatGUID=7b07f03d84af4a4ba9ecd382c801b4f8>. [Accessed 01 04 2023].
- [6] Mat Web, "AISI 1008 Steel, CQ, DQ, and DQSK sheet, 1.6-5.8 mm thick," MatWeb - Material Property Data, [Online]. Available: <https://www.matweb.com/search/DataSheet.aspx?MatGUID=145867c159894de286d4803a0fc0fe0f>. [Accessed 01 04 2023].

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9 Ethics Form

ETHICS FORM – ~~SoAC~~ STUDENTS ONLY

APPLICATION FOR ETHICAL APPROVAL

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

This form must be completed and approved prior to undertaking any research activity.

SECTION A: About You (Principal Researcher)

1	Full Name:	Andrew Robert Hurley
2	Student Number:	1908810
3	Email address:	1908810@studnet.uwtsd.ac.uk / andrewir.0608@hotmail.com
4	Programme of Study:	OME Level 6 – Breakdown and Disposal
5	Director of Studies/Supervisor:	Gareth Collett

SECTION B: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific ~~codes~~ of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.	
1	UWTSD Research Ethics & Integrity Code of Practice	☒
2	UWTSD Research Data Management Policy	☒
3		☐

SECTION C: Details of Research Activity

1	Indicative title:	Polycarbonate can be used to replace steel and ballistic glass in a detonator shield without reducing safety performance.		
2	Proposed start date:	01/09/2022	Proposed end date:	01/03/2023
	Introduction to the Research (maximum 300 words in each section) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the three points below: • Purpose of Research Activity • Proposed Research Question • Aims of Research Activity • Objectives of Research Activity			

September 2021



Ethical Approval Form – ~~SoAC~~ Students Only

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	Demonstrate, briefly, how Existing Research has informed the proposed activity and explain - What the research activity will add to the body of knowledge - How it addresses an area of importance.
3	Purpose of Research Activity To develop upon the current in industry safety equipment using modern alternative materials, improving the ergonomics, ~~usability~~ and maintaining safety performance. (this box should expand as you type)
4	Research Question "Can Polycarbonate be used to replace steel and ballistic glass in a detonator shield, without reducing the safety performance?" (this box should expand as you type)
5	Aims of Research Activity Main aims - To reduce overall mass of the screen - To improve visibility to items being worked on - To maintain safety performance Stretch aims - To improve shield NEQ limit(s) - To improve safety performance (this box should expand as you type)
6	Objectives of Research Activity - Implement polycarbonate into the current design of the 10g detonator shield. - Test various shield material designs against 10 x 1g detonators fired at the screen. - Measure mass of polycarbonate shield to determine whether ergonomically improved. - Measure Anti-Static & Conducting properties compared to currently used steel baseplate. - Increase area of transparent material used in the shield to increase visibility. (this box should expand as you type)
	Proposed data collection methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity to collect data, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	This should describe how you intend to collect data. It should not include a discussion of the theoretical basis for your data collection methods. Please note, that if you intend to collect any audio/video recordings of interviews with participants then these will be classified as Personal Data under GDPR/DPA2018. If you intend to use these then note this in section H. - Modelling software simulation data (Exported as raw data and implemented into Excel) - Microsoft Excel Spreadsheets (formulating and organising data) - Written notebooks (will be written up digitally, checked and signed) - Screen recording/Screen shots of simulation software (.mp4, .jpg, .png) - Gauge data (Excel) - Microsoft Word (For written notes, journal notes, writing up test regimes etc.) (this box should expand as you type)

SECTION D: Scope of Research Activity

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	Will the research activity include:	YES	NO
1	Use of a questionnaire or similar research instrument?	☐	☒
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☐	☒
5	Use of video or audio recording?	☒	☐
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☐	☒
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☐	☒
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method:	☐	☒
	(this box should expand as you type)		

If you have ticked NO to every question then the research activity is (ethically) low risk and you may skip section E and continue to section F.

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION E: Intended Participants

	Who are the intended participants:	YES	NO
1	Students or staff at the University?	☐	☒
2	Adults (over the age of 18 and competent to give consent)?	☐	☒
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒

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7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.		
	Details of any other participant groups: Complete this only if your participants cannot give consent. This includes animals (this box should expand as you type)	☐	☒

Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?	
10	How many participants are expected? Ballpark figures are fine, but make sure that you explain how you will identify and contact your participants. None (this box should expand as you type)
11	Who will the participants be? N/A (this box should expand as you type)
12	How will you identify the participants? N/A (this box should expand as you type)

Information for participants:		YES	NO	N/A
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☐	☐	☒
14	Will you tell participants that their participation is voluntary?	☐	☐	☒
15	Will you obtain written consent for participation?	☐	☐	☒
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☐	☐	☒
17	If the research is observational, will you ask participants for their consent to being observed?	☐	☐	☒
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☐	☐	☒
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☐	☐	☒
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☐	☐	☒
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☐	☐	☒
22	If NO to any of above questions, please give an explanation You should be able to tick YES for all of these questions. If not, then explain why not in this box. (this box should expand as you type)			

Information for participants:		YES	NO	N/A
24	Will participants be paid?	☐	☐	☒
25	Is specialist electrical or other equipment to be used with participants?	☐	☐	☒

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26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☐	☒
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☐	☒
28	If YES to any question, please provide full details			
You should be able to tick NO for most of these questions. For any cases that you have ticked YES then provide details in this box. If you are using cameras/voice recorders to record interviews then please state that in this box. (this box should expand as you type)				

SECTION F: Anticipated Risks

Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them.			
1	Risks to participants For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information. If you have identified in section D that there are no participants then enter N/A and go skip to question 3.		
	<table border="1"> <tr> <td> Risk to participants: There are always risks. Do not write N/A unless you have no participants. (this box should expand as you type) </td> <td> How you will mitigate the risk to participants: N/A (this box should expand as you type) </td> </tr> </table>	Risk to participants: There are always risks. Do not write N/A unless you have no participants. (this box should expand as you type)	How you will mitigate the risk to participants: N/A (this box should expand as you type)
Risk to participants: There are always risks. Do not write N/A unless you have no participants. (this box should expand as you type)	How you will mitigate the risk to participants: N/A (this box should expand as you type)		
2	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities		
	N/A (this box should expand as you type)		
3	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest		
	<table border="1"> <tr> <td> Risk to the investigator: There are always risks. Do not write NA. Sitting (For prolonged time) Eye strain (Computer use) Fatigue (Computer use) Heavy lifting (Handling and Weighing of Shield) (this box should expand as you type) </td> <td> How you will mitigate the risk to the investigator: Regular movement breaks will be enforced to provide reduced strain to body. Display screen assessment will have been carried out to provide correct ergonomics for computer use be it chairs or monitor stands etc. Regular breaks from computer will be enforced to avoid over-use and fatigue when using a computer. Manual handling course will have been taken by investigator and correct procedure applied when handling items for this project. (this box should expand as you type) </td> </tr> </table>	Risk to the investigator: There are always risks. Do not write NA. Sitting (For prolonged time) Eye strain (Computer use) Fatigue (Computer use) Heavy lifting (Handling and Weighing of Shield) (this box should expand as you type)	How you will mitigate the risk to the investigator: Regular movement breaks will be enforced to provide reduced strain to body. Display screen assessment will have been carried out to provide correct ergonomics for computer use be it chairs or monitor stands etc. Regular breaks from computer will be enforced to avoid over-use and fatigue when using a computer. Manual handling course will have been taken by investigator and correct procedure applied when handling items for this project. (this box should expand as you type)
Risk to the investigator: There are always risks. Do not write NA. Sitting (For prolonged time) Eye strain (Computer use) Fatigue (Computer use) Heavy lifting (Handling and Weighing of Shield) (this box should expand as you type)	How you will mitigate the risk to the investigator: Regular movement breaks will be enforced to provide reduced strain to body. Display screen assessment will have been carried out to provide correct ergonomics for computer use be it chairs or monitor stands etc. Regular breaks from computer will be enforced to avoid over-use and fatigue when using a computer. Manual handling course will have been taken by investigator and correct procedure applied when handling items for this project. (this box should expand as you type)		
4	University/institutional risks For example: adverse publicity, financial loss, data protection		

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	Risk to the University: There are always risks. Do not write NA. Damage to image/reputation <i>(this box should expand as you type)</i>	How you will mitigate the risk to the University: The investigator promises to act with integrity and uphold the highest image for both their workplace and place of study. <i>(this box should expand as you type)</i>
5	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems	
	Risk to the environment: N/A (Simulation project) <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: <i>(this box should expand as you type)</i>

SECTION G: Feedback, Consent and Confidentiality

If you have identified in section D that there are no participants then enter skip this section and continue to section H.

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when? You don't need to email your participants with your final report. A good alternative is to set up an email address that they will be able to contact for further details or results. N/A – No participants <i>(this box should expand as you type)</i>
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation. If you are using a paper questionnaire then you should have the participants sign an appropriate consent form. These forms will count as personal data and should be noted as such in section J. If you are using an online questionnaire, then you should have a screen before the questions start that acts as a consent form, informing participants that by clicking on the NEXT button they are providing consent. N/A – No Participants <i>(this box should expand as you type)</i>
3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case. Do not collect names unless you really need them. Do not name participants or organisations in any research publications (including the thesis) without their explicit permission. N/A – No Participants <i>(this box should expand as you type)</i>

SECTION H: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 "GDPR" and the Data Protection Act 2018 "DPA")?	YES	NO
1	"Personal data" means any information relating to an identified or identifiable natural person ("data subject"). An identifiable natural person is one who can be identified, directly or indirectly, in	☐	☒

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	particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.		
	If YES, provide a description of the data and explain why this data needs to be collected:		
2	This includes audio/video data of participants, but can also include IP addresses and usernames. Names, addresses and emails also count, as do consent forms. <i>(this box should expand as you type)</i>		
	Does it involve special category data (as defined by the GDPR)?	YES	NO
3	"Special category data" means sensitive personal data consisting of information as to the data subjects' – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes).	☐	☒
	If YES, provide a description of the special category data and explain why this data needs to be collected:		
4	What counts as 'sensitive' will differ between cultures. Any information on behaviour that is not in accordance with cultural norms would count as sensitive personal data. <i>(this box should expand as you type)</i>		
	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	YES	NO
5	Manual files (i.e. in paper form)?	☒	☐
6	University computers?	☒	☐
7	Private company computers?	☒	☐
8	Home or other personal computers?	☐	☒
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	"Cloud" storage or websites?	☐	☒
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation: If possible, save your data on computers that are secure and regularly backed up. Many cloud services only provide GDPR-compliant storage for business customers. An example of suitable text is given below. All data will be kept in password protected cloud storage on the University Office 365 system which will not be shared. Audio/visual data will be transcribed and would be shown to participants to check accuracy of reporting. Any USB sticks used to store or transfer data will be password protected. All participants will be given a unique identifier to ensure confidentiality and this list will be kept securely in the password protected folder.		

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(this box should expand as you type)			
Data Protection			
	Will the research activity involve any of the following activities:	YES	NO
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☒	☐
16	Export of data outside the UK or importing of data from outside the UK?	☐	☒
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☐	☒
19	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and/or any international equivalent):		
	This includes data such as drafts of your thesis as well as experimental or survey data. An example of suitable text is given below. All data will be encrypted and kept in password protected cloud storage on the University Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected. All data transfers will be encrypted and password protected. All participants will be given a unique identifier to ensure confidentiality and this list will be kept securely in the password protected folder. The data will be stored until the completion of the project and then deleted. In accordance with the DPA2018, participants will have the right to ask to see what data is held relating to them, and this data will be deleted immediately if the participant requests this, in which case the data will not be used in the project. (this box should expand as you type)		
20	List all who will have access to the data generated by the research activity:		
	Normally the principal researcher, possibly also the supervisor and, if the project has an industrial partner, a representative of that partner. Possibly also external examiner or second marker? - Andrew Robert Hurley (Principal Researcher) - Stephen Rodrigues (Line manager) - Gareth Collett (Course Lead of OME Level 6) - Tony Bourne (Apprentice UWTSD ~~Liaison~~) - Rhydian Harris (Apprentice End point assessor) (this box should expand as you type)		
21	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	Usually the principal researcher. Andrew Robert Hurley (Principal Researcher) (this box should expand as you type)		
22	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form.		
	All data will be encrypted and kept in password protected cloud storage on the University Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected, and will be reformatted at the end of the project in order to destroy the data. The data will be stored until the completion of the project and then deleted. (this box should expand as you type)		

ETHICS FORM – SoAC STUDENTS ONLY

22	Confirm that you have read the UWTSD guidance on data management (see https://www.uwttd.ac.uk/library/research-data-management/)	☒
23	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	☒

SECTION I: Declaration

The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwttd.ac.uk/research/research-ethics/		
1	Signature of applicant:	Andrew R Hurley Date: 31/03/2023
2	Director of Studies/Supervisor:	Date:
3	Signature:	

FOR INTERNAL USE ONLY:

Ethical approval given		
1	Signature of assessor:	Date:
2	Name:	
3	Role:	

Polycarbonate Det Shield - Project Proposal

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

54/100

Intro / Aim & Objectives (150 words)		
Project title. Identification of a specific problem to be investigated. Well-defined aims and SMART objectives. Explaining why this project is worth doing. Discussion of what the project needs to do in order to be a success. Description any deliverables that will be produced at the end of the project Title sounds like a statement that polycarbonate can definitely be used as an alternative but the project is about whether it can be or not, try and rephrase the title to reflect that this is an investigation at this point and not a report. SMART objectives have been defined well but more emphasis needs to be placed on what would be considered a success for this project. Good description of proposed end of project deliverables.	20	12
Background to the Project / Literature Review (450 words)		
Description of how the work to be done in the project relates to the	20	12

work identified in the literature review. Discussion of any ethical issues raised by the project Identifying what has already been done within the field. Topic familiarity. Brief literature review using appropriate sources – 6-8 journal papers and book chapters rather than just websites. Selection of relevant models & concepts. Whilst polycarbonate has a lower density and higher elasticity than steel some of the disadvantages should also be considered e.g. cost effectiveness, how brittle it can become over time and exposure and the proneness to scratching for example by flying debris. These considerations could have been discussed with the remaining wordcount for this section. A range of references have been used however two are from the same website and one is quite dated. Consider using more up to date references where possible. Good use of images to illustrate current models.		
Project Design (200 words)		
Clear statement of which development methods are to be used and why they are appropriate. Clear statement of which tools are to be used and why they are appropriate.	30	16

Clear description of how data collected will be analysed A plan has been included however there are some points that are vague such as HOW things will be recorded, WHAT comparative analysis is going to be performed etc. A lot of the wordcount is taken up repeating the same thing for materials, this could have been condensed to allow for more detail to be included and allow for a clearer understanding of exactly how the experiment will be performed, how data will be collected and how it will be analysed.		
Resources / Planning (200 words)		
List of any deliverables. Clear diagram showing both timing and resource use. Completed ethics form. Limited and relevant appendices Resources have been listed but some are vague, such as what simulation software would be required? Gantt chart has been included but some of the timeframes but there is not much room for error, is there a contingency plan in place in case of delays? End of project deliverables have been discussed throughout in reasonable detail. Ethics form included but this would have	15	8

been better as an appendix as opposed to a subsection of the document.		
Document Presentation		
Correct spelling. Grammar and punctuation. Flow of narrative/fluency. Coherence. Word processed. Correct use of referencing with bibliography. Strict word limit for main text – 1000 words. Correct spelling and punctuation throughout, correct grammar for the most part. The section discussing physical properties could have been reworded slightly for ease of reading. Table of figures generally goes at the start after the table of content, not at the end. Whilst it is appropriate to number sections and subsections of a document it is not necessary to number every individual paragraph. IEEE referencing used correctly throughout. Does not remain in the word count of 1000 +/- 10% (17% under the word count), by making full use of the wordcount some sections could have been more detailed to give the reader a better understanding of the topic and project.	15	6
TOTAL	100	54

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