

# SEMS Affiliated Societies - Bid for funding

Societies affiliated to SEMS are invited to bid for financial support for Society activities that link to their aims and objectives and key initiatives in 2022-23.

Please complete this Cover sheet for your Bid and enclose:

- Your Societies Mission Statement/ Terms of Reference
- A Business Case

Name of Society QM Aurora Initiative	
Name of contact Alex Pinel Neparidze Ashwin Ramjee Iyer	Email address <a href="mailto:ex20348@qmul.ac.uk">ex20348@qmul.ac.uk</a> <a href="mailto:ex20046@qmul.ac.uk">ex20046@qmul.ac.uk</a>
Number of members 70 currently, but increasing every week to a rough maximum of around 80 students	
I have attached a Mission Statement or Terms of Reference for the Society	Tick Yes yes
I have attached a business case for the funding request, including: <ul style="list-style-type: none"><li>- a justification for the expenditure,</li><li>- a detailed breakdown of the money requested and</li><li>- details of additional funding streams (eg sponsors, ticket sales, merchandise etc) and how this funding will be useful</li></ul>	Tick Yes  yes
<b>Summary of Bid for money requested from the School</b>	
Details of expenditure	Amount in £
Rocket components	5791.47
Logistics	1950

## Declaration

If our bid is successful, we will support SEMS events including Welcome Events, Open and Offer Holder Days.

We will adhere to the financial regulations of the University and the processes of the SEMS Office including selection of suppliers, placement of orders via the [SEMS-orders@qmul.ac.uk](mailto:SEMS-orders@qmul.ac.uk) team and managing the budget within the funds awarded.

Print name and Sign Alex Pinel Neparidze – A.P.N. Ashwin Ramjee Iyer – A.I	Date 5 November 2022
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Please submit this form with other documents by **Monday 7 November – 12.00 noon**.

All bidders should expect to be contacted within 3 weeks of the submission date.

Please direct any queries to [SEMS-Office@qmul.ac.uk](mailto:SEMS-Office@qmul.ac.uk)



# Mission Statement

## Goals

The Aurora Initiative was created with the goal of designing, manufacturing and eventually launching a solid rocket fuel sounding rocket with an intended apogee of 9000m at the European Rocketry Challenge (EuRoC)([www.euroc.pt](http://www.euroc.pt)) in October 2023.

One of the steps most important to that was to build a strong cohesive team of students which we believe we have already accomplished.

This grant would allow us to purchase the materials to build on the designs we have already made and complete our primary mission of competing at EuRoC 2023.

## Background

The EuRoC is a large annual competition held every year by the Portuguese space agency to, in their own words:

*“...stimulate engineering students to design, build and launch their own vehicles. In a broader spectrum the competition aims to encourage students to study science, technology, engineering and math (STEM) and to the development of technological skills.”*

This is the largest competition of its kind in Europe and to the best of our knowledge the second largest across the world, beaten only by Spaceport America which we also debated as a potential goal but decided to forego it due to travel costs.

The competing teams are a diverse array with 20 teams at this year's competition (with 25-30 students per team this means around 600 students from across Europe). The competition is also sponsored by and partnered with a range of companies and government entities ranging from a variety of European and British companies, the Portuguese space agency as mentioned prior and the European Space agency (EESA).

**This is all to say that for us as representatives of Queen Mary University of London to participate in and succeed in this competition would bring significant international attention to the university.**

It would not only display the technical skills of the SEMS and EECS schools but also the opportunities at QMUL for ambitious students in STEM.

More of our reasoning and justifications are detailed in the first part of the business case.



# Business Case

## Initial conception and justification

QMUL is one of the country's leading universities to study Aerospace and Aeronautical engineering, ranking 16<sup>th</sup> on a national list<sup>1</sup> for the course and being the first university to have an aerospace department in the country. We have an extensive range of courses for students to attend along with state-of-the-art labs and equipment for research and teaching purposes.

However, when ambitious students attracted by such credentials arrive at the university they often feel as if they do not have sufficient extra-curricular activities that align with their interests in aerospace (specifically rocketry in this case). This was confirmed to us during our interview process when we were flooded with ambitious applicants who echoed the sentiment mentioned above.

The two universities at the top of the list mentioned prior (Imperial College London and University of Bath) already have their own student-led rocketry groups with the former having not only one but *three* separate rocketry groups with different purposes.

One of the groups at Imperial College London also received national attention for their project<sup>2</sup>.

Such groups allow students to:

1. Gain experience working in an industry-like setting as part of a larger group headed towards a singular goal
2. Gain first hand technical experience in designing, testing and manufacturing the respective parts of the rocket themselves.
3. Gain experience and exposure in the rocketry industry, providing them with the connections and technical knowledge to secure a job in the field following university.
4. Provide students with valuable extra-curriculars to add to their CVs to aid with masters placements or job applications after graduation.

These were some of the things we had in mind when we decided to start the Aurora Initiative close to 6 months ago.

Apart from the advantages for students, our presence at the EuRoC also brings international attention to QMUL and its aerospace program, especially if we were to do well and secure awards for our work.

Competitions like this are also on the rise as UK government schemes aim to bring attention to and fund similar competitions in the UK<sup>3</sup>. The Aurora Initiative would allow the university a way to engage in this area through the team and their projects in future years.

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<sup>1</sup> <https://www.thecompleteuniversityguide.co.uk/league-tables/rankings/aeronautical-and-aerospace-engineering>

<sup>2</sup> <https://www.thetimes.co.uk/article/imperial-college-london-students-take-on-top-gear-with-a-reusable-rocket-9s6sst8lf>

<sup>3</sup> <https://www.gov.uk/government/publications/call-for-proposals-uk-space-agency-spaceflight-competition-fund-for-rocketry-competitions>



November 3, 2022

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The final launch will happen at Ponte De Sur in Portugal near the 11-18<sup>th</sup> of October 2023.



## Team structure

Our current team is comprised of 70 students with more joining almost every week through our website, since we hit a comfortable number of around 60 and filled out the leadership roles, we've switched to a more selective process to limit the final number to a maximum of 80.

Shown below is the team structure we currently follow:

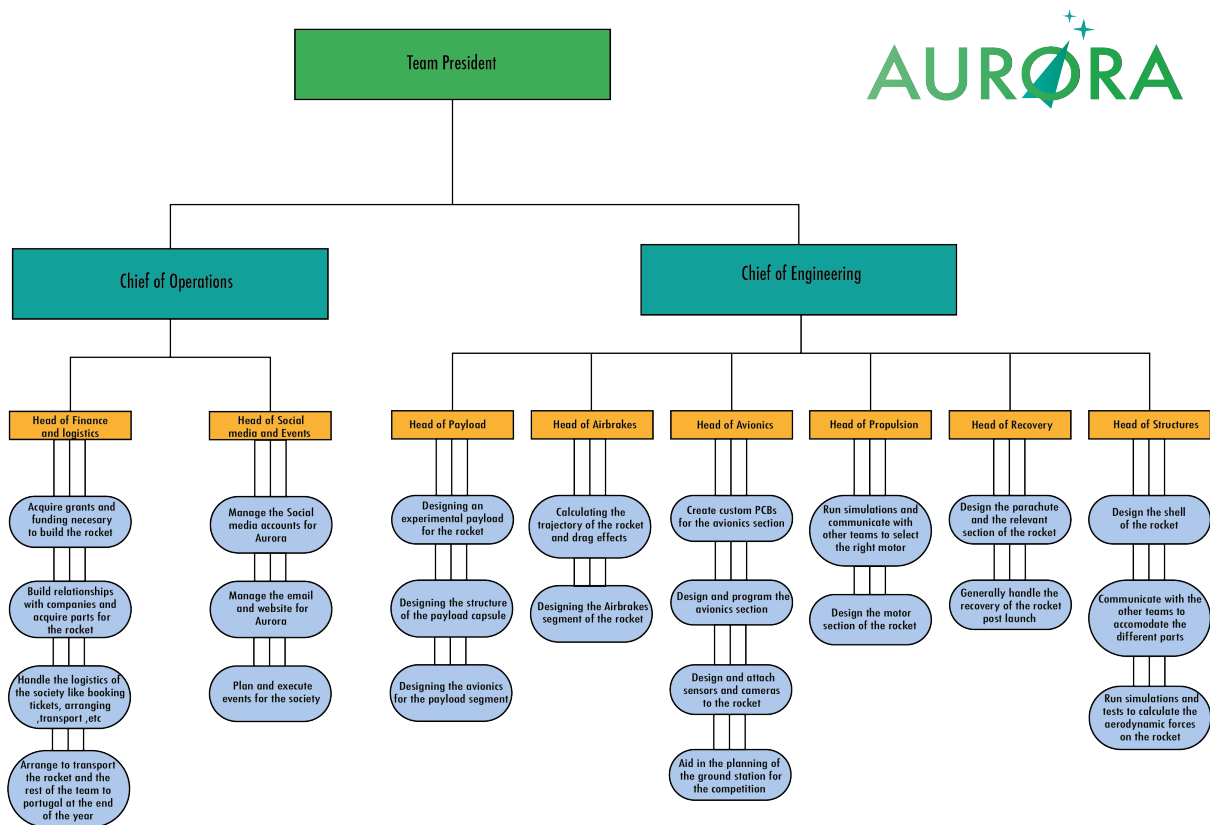


Figure 1 - Team structure



## Current progress

As we mentioned, while actual work only commenced a couple months prior, the founding leadership of Aurora have been working on various aspects of the project for around 6 months now.

### Initial setup

A significant amount of time and effort was spent before the recruitment process began to ensure a smooth start-up and workflow for the rest of the year. Both co-presidents have been committee members of the other large engineering societies before (Hyperlink and Formula Student) and know the problems that usually exist surrounding the starting phases of similar projects.

We spent this time filing to become an official society with the SU, sorting out budget plans (as outlined later in this document) and our eventual goals for the year.

We also spoke with **Dr. Angadh Nanjangud** (a.nanjangud@qmul.ac.uk) about the project who later agreed to being our **project supervisor**. We also spoke with **Dr. Fariborz Motallebi** who provided us with documentation of prior research projects on rocketry and the leftover materials and parts from such.

We've also had meetings with the makerspace staff (**James Wayland** and **Dennis Ife** have been incredibly supportive and helpful with the project so far) and the previous technical facilities manager **Benjamin Gridley** who provided us with use of the space along with some storage space in the archives. We also spoke to the health and safety advisor who approved of our plan for the following year.

We then reached out to and had online meetings over teams with the different rocketry teams in Europe to ask them about how they ran their group and dig their minds about other rocketry specific knowledge to hopefully skip over the initial awkward stages of projects like this.

In total we spoke to:

- AQUILIO ROCKET TEAM – DELFT – HOLLAND
- BME AEROSPACE – BME – HUNGARY
- CRANSEDS – CRANFIELD – UK
- DANSTAR – DTU – DENMARK
- ENDEAVOUR – UNIVERSITY OF EDINBURGH – UK
- EPFL ROCKET TEAM – EPFL – SWITZERLAND
- TU WIEN SPACE TEAM – TU WIEN - AUSTRIA
- SKYWARD EXPERIMENTAL ROCKETRY – POLYTECNICO MILAN – ITALY
- HYEND – UNIVERSITY OF STUTGARD – GERMANY

Their knowledge was invaluable and sped up our progress by several months. They provided us with not only their ideas and process but also their team structures, their complete budgets, preferred manufacturers, engine choices, tips on fundraising and sponsorships, timelines and even their complete engineering concept reports which we reference regularly.



We also had an **in-person** meeting with the **Imperial college London rocketry team ICLR** at their lab who again showed us their manufacturing techniques and gave us more insight into how the manufacturing processes should work, we also remain in contact with them and they have remained very helpful throughout the last few months.

## Current status

As of now our team members are hard at work in their teams on designing the different parts of the rocket. Based on the extensive research conducted throughout the last few months, and our interviews with other European teams, we have already completed an initial design plan along with CAD designs which I have attached with this document in the email. Additionally, we plan on utilising the scrap materials from our competition rocket along with the engine and electronics provided to us by Dr. Motallebi to conduct a test launch on the 18<sup>th</sup> of December.

This will allow us to test our more novel ideas engineering wise while also giving the team experience in manufacturing processes for when we start building our competition rocket in January.

Our operations teams have also been hard at work on the logistics of the project by emailing companies to find sponsorships and build connections, all future updates will be shown on our website ([www.qmaurora.com](http://www.qmaurora.com)).

## Safety concerns

We wanted to quickly address any safety concerns that might arise about the project. We have already cross checked everything we are doing with the relevant health and safety officials and have instructed all our members to complete all the necessary forms.

The project is of minimal security risk because:

- We will not be using any pyrotechnics in our designs, not even the conventional black powder recovery system which we have substituted with our own entirely mechanical clamp band recovery system.
- The actual engines for the rocket will be provided (after being purchased by us online of course) by the competition on site and assembly will be heavily supervised in Portugal.
- Manufacturing of our rocket will take place at the SEMS Maker Space under staff supervision.



# Funding

## Sources of funding

Our current sources of funding are mainly:

1. Membership fees: 10 pounds per member \* 75 members = 750 pounds
2. SU Society development fund<sup>4</sup>: 800 pounds

We are hoping to acquire sponsorships from related companies however, we do realise with this being our first year and due to current economic conditions this may be somewhat difficult.

## Total funding breakdown

Category	Supplier	Product name	Quantity	Total price (£)
Rocket Components	Euro Space Technologies	CTI Pro98 6GXL Hardware (1)	1	1040.59
		CTI N1560 Engine (2)	1	1388
		84Inch Parachute (3)	1	165.41
		24 Inch Parachute (4)	2	69.58
		ZAP Epoxy (5)	2	37.44
		AeroPack Retainer (6)	1	87.04
		CTI 3G G118 Engine (7)	1	33.92
		Pro29 3G Casing (8)	1	39.14
		Shipping		21.77
	Mouser Electronics	BMI088 IMU (9)	2	18.66
	Digi-Key	4538 Barometer (10)	2	10.38
	Amazon	Teensy 4.1(11)	2	84.02
	JLC PCB	PCB (12)	2	14.06
	PlyDirect	Birch Plywood (13)	1.5m <sup>2</sup>	65
	Eggtimer Rocketry	Eggtimer Classic (14)	2	60
	Al's Hobbies	5000MAH 8S 29.6V battery (15)	2	300
	The Arc Angels	Fibre Glass Sheet (16)	2.28m <sup>2</sup>	108
	SRAD Components (Estimated)	Flight Computer		200
		Clamp Band Release		100
		Composite Moulds		200
		Coupler		50

<sup>4</sup> The threshold for the SU society development fund is 75 members where we will go from being eligible for 800 pounds to 1500 pounds, although we will be aiming to reach this amount, we want to provide a conservative estimate as there may be members who do not pay their memberships and other problems.





		Telemetry & Software		200
		Payload (Biological experiment)		1000
		Avionics Bay		100
	EasyComposites	25g Fibre Glass fabric (17)	10m^2	32.5
	CPC	General Toolkit (18)	1	119.96
	RunCam	RunCam Split camera (19)	4	246
Logistics	Transport and Accommodation			3000
	Launch Costs			500
Sub - Total				9291.47
Total amount requested = 9291.47 - 1550				7741

## Justifications

Following are the justifications for some parts of the funding breakdown that may not be clear on first viewing.

### Euro Space Technologies

We will be buying most of the commercial off the shelf elements we need from <https://europacetechnology.eu/index.php> as they were heavily recommended to us by other teams, and are the official provider of EuRoC. We will be using them to purchase:

1. Our parachutes: Although these can be made at home, they are very prone to error, and we do not possess the technical knowledge and facilities to stitch our own parachutes.
2. Our engine parts: these will technically be provided at EuRoC, but they have been grouped under this umbrella for simplicity and to provide a price point estimate.
3. Epoxy: This is of course necessary to manufacture the airframe of the rocket.

### PCB and Electronics components

The products from Mouser Electronics, Digi-Key, Amazon and JLC PCB are the sensors and PCB boards we will need to form the avionics system. The plywood will be used for structural components and the Egg timer Classic is a **required part** by the EuRoC to provide redundancy to our control systems.

### Fibre Glass

We will be using fibre glass to construct the fuselage of the rocket; carbon fibre would be technically better as it is lighter but the increase in cost and its radio opacity means fibre glass is a better alternative.

### SRAD Components

As we do not know exactly how much these components will cost, we are using estimates we garnered from other university rocketry teams.

The Student Researched And Developed (SRAD) components include:



1. Flight computer: As per EuRoC regulations, we are required to fly the rocket with two independent and redundant flight computers, it is our goal this year to develop our own flight computer and avionics system and to compliment it with the well-known and flight proven EggTimer commercial computer.
2. Clamp Band Release System: This is our mechanical recovery system, essential for safe recovery of the rocket and for payload deployment. We have decided to make our own mechanical release system instead of using commercial pyrotechnic options due to safety and reliability concerns, our current design will involve a mix of composite materials and aluminium machined components.
3. Composite Moulds: Specialised moulds will be required for us to manufacture our fibre glass composite parts; we are currently in talks with the SEMS Maker Space exploring how to procure these moulds.
4. Coupler: To ensure adequate structural stability, different parts of the rocket must be firmly coupled. To achieve this, a specially designed aluminium coupler will be used.
5. Telemetry and Software: As the rocket flies, it must relay information back to the team in flight control, special software and antennae must be developed for use both in the rocket and in the ground.
6. Payload: A crucial part of EuRoC, all teams must include at least 1kg of payload. Our payload team is currently working on a novel biomedical experiment alongside some university academics such as Prof. Stoyan Smoukov, with potential reaching far beyond the field of rocketry.
7. Avionics Bay: All our electronics and sensors will be placed in a dedicated bay for ease of access and safety, our team is currently working on the design of the aluminium casing we will use to house all these components.

### CPC General Toolkit

This will contain not only the tools necessary for work here but will be an absolute necessity when the team goes to Portugal in October 2023.

### RunCam

One cannot launch a rocket without placing any cameras on it, not only do they provide amazing views but are also essential for post-flight analysis of the performance of our rocket. Due to their light weight, ease of use, and high resolution, RunCam Split cameras are widely used in rocketry competitions.

### Transport and Accommodation

This includes:

- The costs of transporting the rocket to and from Portugal.
- The costs of travel for the members who will be going to the competition. This will be partly subsidised by ticket sales but that is taken into account in the final figure.
- The costs of accommodation at Portugal.

These figures were given to us by Endeavour Rocketry (University of Edinburgh) who, as a UK based team, should have similar costs to us.



November 3, 2022

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### Launch costs

As relayed to us by Endeavour Rocketry, there will be a cost associated with attending the competition and using the launch site.



## References for Costing

1. [https://eurospacetechnology.eu/index.php?id\\_product=359&id\\_product\\_attribute=0&rewrite=pro98-6gxl-hardware-set&controller=product](https://eurospacetechnology.eu/index.php?id_product=359&id_product_attribute=0&rewrite=pro98-6gxl-hardware-set&controller=product)
2. [https://eurospacetechnology.eu/index.php?id\\_product=377&id\\_product\\_attribute=0&rewrite=pro98-6gxl-reload-kit&controller=product](https://eurospacetechnology.eu/index.php?id_product=377&id_product_attribute=0&rewrite=pro98-6gxl-reload-kit&controller=product)
3. [https://eurospacetechnology.eu/index.php?id\\_product=1410&id\\_product\\_attribute=0&rewrite=pml-parachute-84-inch&controller=product](https://eurospacetechnology.eu/index.php?id_product=1410&id_product_attribute=0&rewrite=pml-parachute-84-inch&controller=product)
4. [https://eurospacetechnology.eu/index.php?id\\_product=1290&id\\_product\\_attribute=0&rewrite=pml-parachute-24-inch&controller=product](https://eurospacetechnology.eu/index.php?id_product=1290&id_product_attribute=0&rewrite=pml-parachute-24-inch&controller=product)
5. [https://eurospacetechnology.eu/index.php?id\\_product=1328&id\\_product\\_attribute=0&rewrite=zap-epoxy-30-minutes&controller=product](https://eurospacetechnology.eu/index.php?id_product=1328&id_product_attribute=0&rewrite=zap-epoxy-30-minutes&controller=product)
6. [https://eurospacetechnology.eu/index.php?id\\_product=1400&id\\_product\\_attribute=82&rewrite=minimum-diameter-motor-retainer&controller=product#/72-diameter-for-98mm-rockets-with-3-8-16-stainless-steel-stud](https://eurospacetechnology.eu/index.php?id_product=1400&id_product_attribute=82&rewrite=minimum-diameter-motor-retainer&controller=product#/72-diameter-for-98mm-rockets-with-3-8-16-stainless-steel-stud)
7. [https://eurospacetechnology.eu/index.php?id\\_product=85&id\\_product\\_attribute=0&rewrite=pro29-3-grain-reload-kit&controller=product](https://eurospacetechnology.eu/index.php?id_product=85&id_product_attribute=0&rewrite=pro29-3-grain-reload-kit&controller=product)
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9. <https://www.digikey.co.uk/en/products/detail/bosch-sensortec/BMI088/8634936>
10. [https://www.digikey.co.uk/en/products/detail/adafruit-industries-llc/4538/16584123?utm\\_adgroup=Evaluation%20Boards%20-%20Expansion%20Boards%2C%20Daughter%20Cards&utm\\_source=google&utm\\_medium=cpc&utm\\_campaign=Shopping-Product-Development%20Boards%2C%20Kits%2C%20Programmers&utm\\_term=&productid=16584123&gclid=CjwKCAjw5P2aBhAlEiwAAAdY7dPqVTuCUi5KdBiDpl60X-TTBnqbDWYVdf8cDoj442XHQ2z1nfr0lRoC6cgQAvD\\_BwE](https://www.digikey.co.uk/en/products/detail/adafruit-industries-llc/4538/16584123?utm_adgroup=Evaluation%20Boards%20-%20Expansion%20Boards%2C%20Daughter%20Cards&utm_source=google&utm_medium=cpc&utm_campaign=Shopping-Product-Development%20Boards%2C%20Kits%2C%20Programmers&utm_term=&productid=16584123&gclid=CjwKCAjw5P2aBhAlEiwAAAdY7dPqVTuCUi5KdBiDpl60X-TTBnqbDWYVdf8cDoj442XHQ2z1nfr0lRoC6cgQAvD_BwE)
11. [https://www.amazon.co.uk/Teensy-4-1-With-Pins/dp/B08CTM3279/ref=pd\\_lpo\\_3?pd\\_rd\\_w=sMkMF&content-id=amzn1.sym.2d229339-2f42-4596-a90d-b81a4f52d6d3&pf\\_rd\\_p=2d229339-2f42-4596-a90d-b81a4f52d6d3&pf\\_rd\\_r=889MY7M42DAWWGPYP060&pd\\_rd\\_wg=Eivw0&pd\\_rd\\_r=22aa2d0e-5066-4970-b22d-a378b36f4267&pd\\_rd\\_i=B08CTM3279&psc=1](https://www.amazon.co.uk/Teensy-4-1-With-Pins/dp/B08CTM3279/ref=pd_lpo_3?pd_rd_w=sMkMF&content-id=amzn1.sym.2d229339-2f42-4596-a90d-b81a4f52d6d3&pf_rd_p=2d229339-2f42-4596-a90d-b81a4f52d6d3&pf_rd_r=889MY7M42DAWWGPYP060&pd_rd_wg=Eivw0&pd_rd_r=22aa2d0e-5066-4970-b22d-a378b36f4267&pd_rd_i=B08CTM3279&psc=1)
12. <https://cart.jlpcb.com/quote?orderType=1&stencilLayer=2&stencilWidth=100&stencilLength=100&stencilCounts=5>
13. <https://plydirect.co.uk/product/birch-plywood-cut-to-size/>
14. <http://eggtimerrocketry.com/home/altimeters-av-bay/>
15. <https://alshobbies.co.uk/lipo-packs/lipo-8s-226v/Kong-Power-5000mAh-8S-75C-Soft-Case-with-XT150-KP-5075-8>
16. [https://the-arc-angels.co.uk/shop/index.php?route=product/product&path=63&product\\_id=328](https://the-arc-angels.co.uk/shop/index.php?route=product/product&path=63&product_id=328)
17. <https://www.easycomposites.co.uk/25g-plain-weave-woven-glass-cloth>
18. [https://cpc.farnell.com/duratool/d02155/tool-kit-153pc/dp/TL14957?mckv=s\\_dc|pcrid|426684131426|keyword||match||plid||slid||product|TL14957|pgrid|100371162878|ptaid|pla-1763709638081|&CMP=KNC-GUK-CPC-SHOPPING-9262013734-100371162878-TL14957&s\\_kwcid=AL!5616!3!426684131426!!!network}|1763709638081!&gclid=CjwKCAjwtp2bBhAGEiwoAZZTuMr7IEsaEKHeo2RMTEZhiDDjjoS9qD760Rwb6pbf4C77YbjE8DF00xoCbloQAvD\\_BwE](https://cpc.farnell.com/duratool/d02155/tool-kit-153pc/dp/TL14957?mckv=s_dc|pcrid|426684131426|keyword||match||plid||slid||product|TL14957|pgrid|100371162878|ptaid|pla-1763709638081|&CMP=KNC-GUK-CPC-SHOPPING-9262013734-100371162878-TL14957&s_kwcid=AL!5616!3!426684131426!!!network}|1763709638081!&gclid=CjwKCAjwtp2bBhAGEiwoAZZTuMr7IEsaEKHeo2RMTEZhiDDjjoS9qD760Rwb6pbf4C77YbjE8DF00xoCbloQAvD_BwE)
19. <https://shop.runcam.com/runcam-split/>