



UK Research
and Innovation



Innovation Hub
Guide for Innovators: Getting
Your Prototype off the Ground
An Introduction to Experimental Flying

Introduction

This document provides guidance on regulations for innovators who want to conduct experimental flights on the pathway to developing innovative aircraft and concepts.

Advances in developing novel (e.g. electric) powertrains are driving the design and introduction of innovative aircraft designs, under concepts like Advanced Air Mobility (CAP 2122). We are seeing innovators making rapid advances in the design of Electric Vertical and Take-Off (EVTOL) aircraft. Other innovators are making significant progress with replacing fuel powertrains in existing aircraft with electric battery or hydrogen powertrains.

This guide is for innovators who want to conduct experimental flights to test their design and validate the performance of their aircraft, or showcase their innovation to the public, government, and investors. In it we explain which approvals are required to conduct experimental flights in the UK, and some of the restrictions that apply to experimental flights.

A separate guide has been released as CAP2289 for innovators who intend to plan or start the certification of an aircraft. Within that we explain which regulatory approvals are required, and the key stages of the certification process.

These guides have been designed to assist innovators and those outside of the aviation sector in developing their knowledge of initial airworthiness and how it works in practice. The guide offers an introduction to some of the most commonly used terms and processes enabled under the UK's regulatory framework. We have provided a number of links to outline the certification landscape for existing aviation and emerging concepts; and develop the knowledge of innovators beyond this document.

From the 31 December 2020, State of Design duties transferred from EASA to the CAA. As a result, we have responsibility for approving the design and production of all aircraft in the UK. International coordination still continues to play an important role in the CAA's approaches.





Experimental aircraft

Aircraft specifically designed or modified for research, experimental or scientific purposes, and likely to be produced in very limited numbers.

UK Basic Regulation, Annex 1



The true method of knowledge is experiment

William Blake

Experimental Aircraft Permit to Fly



Where the certification of a particular aircraft is not the goal, for example a prototype aircraft not intended for commercial use, the regulation presents alternative routes. Alternative (temporary) approvals will be considered in such instances to create a route for experimental activities, like flight testing.

The CAA can give the approval required to enable test flights for aircraft without a Type Certificate under either of the following:

- Permit(s) to Fly, or
- Experimental Flying – E Conditions



What is a 'Permit to Fly'?

A Permit to Fly (PtF) in the UK (issued under Part 21 or British Civil Airworthiness Requirements (BCAR), depending on the aircraft type) is issued by the CAA based on national and local determinations. Many other National Aviation Authorities offer their own PtF (or equivalents). In terms of airworthiness principles, they are aligned to global standards for the aircraft type to which it is being issued.

The CAA typically issues a PtF when a Certificate of Airworthiness cannot be issued (in the case of a prototype for example). A PtF may be an appropriate route for applicants who are seeking limited flying, for the purpose of testing an aircraft in support of development.

An individual PtF will usually include specifically defined conditions (flight test conditions), which will define any limitations and the types of flying that can be undertaken. For this reason, several PtFs may be needed over the course of a product's development.

Experimental Aircraft E Conditions



What are 'E Conditions'?

Operating an aircraft under E Conditions is a means to fly an experimental prototype or modified aircraft to test a concept in the air without having to:

- obtain a PtF,
- obtain a Certificate of Airworthiness (CofA),
- comply with B Conditions or
- comply with the normal procedures contained in CAP553 BCAR Section A, Chapters A8-1, A8-9 and A8-21 for CAA approved Design and Production Organisations.

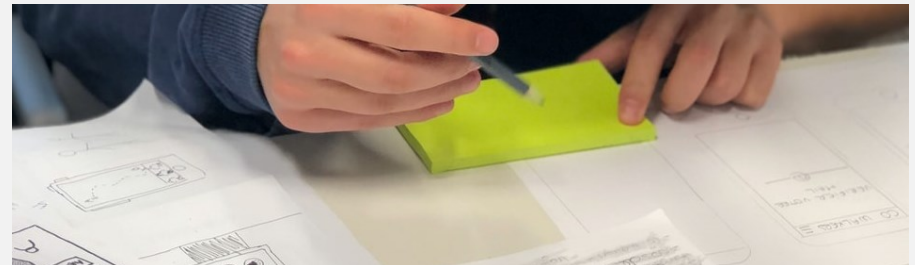
The CAA's General Aviation team leads the E Conditions process and for some individuals or organisations test flights might begin with this route.

The E conditions route is not intended to be a substitute for the certification process and applicants using this route will not be credited for E conditions tests under the certification process. Therefore, where an applicant is aiming for certification, but not yet ready to start the full certification process, the PtF route may be a better option.

There are restrictions on eligibility for this route which are compatible with the intended limited use of E Conditions, and any approval would be timebound. In particular an applicant would need to meet the following requirements (non-exhaustive):

- the aircraft will need to be UK-registered;
- an Identified Test Area for the flights must be fully detailed;
- the aircraft must have a maximum take-off weight (MTOM) of 2,000kg;
- passengers or cargo cannot be carried during E Conditions operation;
- commercial operations, including hire and reward, cannot be performed under E Conditions.

Other countries have their own experimental flying regimes, though the terminology to describe this and the conditions relating to this will vary.



Experimental Aircraft Foreign Approvals



Does the CAA recognise national experimental approvals or Permits to Fly (PtF) from other regulators?

There are circumstances when the CAA will consider an overseas PtF or experimental approval from another country to issue a permission or exemption for UK activities. This will be considered on a case by case basis.

In these circumstances the CAA, in addition to making its own assessments on the aircraft and applicant, will seek assurances and evidence from its overseas counterparts.



Innovation is driving demands for increased test flying

What types of organisations commonly contact the CAA for test flying permissions? Example cases:

- “Our organisation has completed its R&D to develop a prototype aircraft. We are ready to test the concept through a demonstration/ flight test programme.”
- “Our organisation has taken a certified aircraft and replaced its propulsion system with one we have designed. We are ready to test the now-significantly-modified aircraft through a demonstration/ flight test programme.”
- “Our non-UK registered organisation completed a successful test flight programme under a national or location-specific approval in the US. We now want to perform a demonstration/ flight test programme in a UK location.”

New technologies have driven more demand, and more variety, in the tests and research being carried out under the design and production processes for new products. Tests can include the use of simulations and other on-the-ground processes, to carry out sophisticated modelling to help identify risks and solutions. This enables modifications, or changes to be made to the design, before for example the prototype aircraft embarks on live trials or test flights.

Despite this, testing of the aircraft in-flight and concomitant demonstration of its systems and the aircraft as a whole ‘in action’ remains key to the development of new products and future air operations.

With increased demand for tests and trials, other considerations come into play. Such as safe use of airspace and most effective methods for the collection and presentation of performance and other test data. This creates challenges and opportunities for the industry and the regulator.

Further Information

More detailed information and guidance relating to experimental flights can be found by following the links below.

References

- UK Basic Regulation [Link](#)
- CAA Scheme of Charges [Link](#)
- Permits to Fly (PtF) [Link](#)
- Flight Conditions [Link](#)
- E Conditions [Link](#)
- Advanced Air Mobility: Taking A Use Case Approach (CAP 2122) [Link](#)

The Innovation Hub does not provide regulatory approvals or define CAA Policy. Approvals will be assessed independently by our regulatory teams and their decision about whether or not to grant an authorisation or approval will be subject to current regulatory requirements. Whilst the Innovation Hub endeavours to ensure the accuracy of its guidance and materials, the nature of innovation is one of forecasting, continuous development and change and you should seek independent advice on your specific circumstances

Tell us what you think

We want to hear your views on this publication and the themes it explores under airworthiness in relation to new aircraft.

To submit **feedback** please contact innovation@caa.co.uk



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