



Civil Aviation Authority
SAFETY NOTICE
Number: SN-2020/010



Issued: 22 June 2020

Unmanned Aircraft – Responses to abnormal operations and in-flight failures

This Safety Notice contains recommendations regarding operational safety.

Recipients must ensure that this Notice is copied to all members of their staff who need to take appropriate action or who may have an interest in the information.

Applicability:	
Aerodromes:	Not primarily affected
Air Traffic:	Not primarily affected
Airspace:	Not primarily affected
Airworthiness:	Not primarily affected
Flight Operations:	All Unmanned Aircraft Operations
Licensed/Unlicensed Personnel:	Not primarily affected

1 Introduction and purpose

- 1.1 **The law requires that** 'The remote pilot of a small unmanned aircraft may only fly the aircraft if satisfied that the flight can safely be made.' (Air Navigation Order Article 94(2)). The remote pilot's ability to identify and respond correctly to unexpected in-flight emergencies, system failures or abnormal circumstances has always been integral to lawful flight.
- 1.2 **The UK Aircraft Accident Investigation Branch (AAIB)** recently completed an investigation into an accident concerning a DJI M600 Unmanned Aircraft (UA). Shortly after take-off, the remote pilot observed a GPS-COMPASS ERROR and the UA began to drift with the wind and maintain altitude. The UA had detected a conflict between the Global Positioning System (GPS) signal and its internal compass and reverted to a semi-manual flight mode. In this mode, the UA retained some stabilisation via barometric and internal sensors but was unable to prevent itself drifting downwind.
- 1.3 The remote pilot made multiple attempts to use the return to home function, but as the UA was no longer using GPS this did not work. Flying the UA using the manual controls was possible throughout, but the remote pilot did not attempt this. The UA continued to drift downwind until it crashed into a residential area. There were no injuries.
- 1.4 Soon after the loss of the first UA, the remote pilot launched a second, identical, UA to locate the crash site of the first. The second UA suffered a SIGNAL INTERFERENCE error shortly after take-off and was immediately landed without further incident.

1.5 **The purpose of this safety notice** is to provide recommendations and guidance that will enable all remote pilots, UA operators and Recognised Assessment Entities (RAEs) / National Qualified Entities (NQE) to act and:

- a) reduce the likelihood of similar accidents in the future
- b) provide more assurance to the CAA that future flights of UA will be safely made.

1.6 **In this safety notice** the term 'emergency' includes any abnormal operations, unusual circumstances and in-flight failures.

2 Recommendations

2.1 This Safety Notice **very strongly recommends** that all **UA remote pilots** *should avoid*:

a) flying UA immediately after another UA has experienced an unexplained loss of control *in the same operational environment* unless it is absolutely necessary.

2.2 This Safety Notice **strongly recommends** that all **UA remote pilots** act to ensure that:

- a) before each flight they are confident in their ability to *identify* and *respond* correctly to any likely emergency
- b) before each flight they make reasonable effort to consider any factors that could make an emergency more likely to occur
- c) they are familiar with the visual and audible warnings presented to the remote pilot by their UAS that indicate abnormal operations and in-flight failures
- d) they are familiar with their own human limitations and the limitations of their UAS.

2.3 This Safety Notice **strongly recommends** that all **UA operators** and **remote pilots** act to ensure that:

- a) remote pilots regularly practise their identification of, and response to, emergencies in order to reduce the effects of skill fade
- b) remote pilots maintain competence to fly their UA in whatever manual flying mode may be available
- c) operations manuals assure the CAA that an operation is safe enough by describing:
 - complete and effective emergency procedures
 - schedules for remote pilot practise of emergency procedures

2.4 This Safety Notice **strongly recommends** all **RAEs/NQEs** act to reinforce the contents of this Safety Notice to those UAS operators and remote pilots who utilise their services.

3 Guidance – designing procedures for responding to emergencies

3.1 Good procedures will maximise the ability of the remote pilot to:

- a) **identify** the emergency by:
 - describing the symptoms and indications of abnormal operations and in-flight failures
 - describing how the loss of one aircraft system impacts other systems/functions

- explaining any third-party applications that are used to control the UA and how they may help identification of emergencies or may make identification more difficult.

b) **respond** correctly to the emergency by:

- describing which abnormalities and in-flight failures require immediate intervention by the remote pilot
- ensuring that responses are practised regularly enough, especially those involving skills that may reduce without recent practise (see 'skill fade', below)
- explaining any third-party applications that are used to control the UA and how they may help the response to emergencies or may make responding more difficult.

3.2 The competence of the remote pilot is a primary factor in any operating authorisation that is issued by the CAA. The ability to identify and respond correctly to emergencies is an implicit part of being 'competent', and 'remaining competent' through regular practise. Appropriate procedures for responding correctly to abnormal operations and in-flight failures must be included in every operations manual.

4 Guidance – preparing for emergencies

4.1 **Make training realistic.** Emergencies can happen at any time. To prepare for this, it is useful to practise within a realistic scenario and introduce random indications of abnormal operations and in-flight failures. This will more fully prepare the remote pilot for a real, unexpected, emergency.

4.2 **Fault diagnosis.** The identification of a developing problem is equally as important as the response to it when it actually happens. Concentrate on spotting the symptoms and indications of abnormal operations and in-flight failures, rather than simply focussing on the subsequent response that is required. There is reduced value in a remote pilot possessing excellent semi-manual flight mode flying skill if they are slow to recognise that their aircraft has switched to this mode. The ability to progress from identification to response is especially important when dealing with unusual events that require immediate intervention by the remote pilot.

4.3 **Skill fade.** This is a reduction in the ability to carry out a skill effectively because of a lack of recent practise. The AAIB's accident report stated that neither the remote pilot or the observer had practised any emergency procedures since completing their practical assessment at an NQE. Skills that are susceptible to fade, should be practised regularly, in order to prevent them being lost.

5 Guidance – making emergencies less likely

5.1 Preventing an emergency is better than dealing with one. Remaining within acceptable technical and common-sense limits of the following aspects will reduce the likelihood of emergencies occurring.

a) Human limitations – such as fatigue, ergonomics, aptitude, cognitive ability, cold exposure etc.

b) UA operating limitations – such as system redundancy, environmental operating envelope etc.

c) Operational limitations – such as limiting the operation to safer activities, requiring certain safety mitigations to be present. For example, permissions issued by the CAA have *operational conditions* which help reduce the safety risk posed to uninvolved persons.

6 Guidance – identifying causes of Global Navigation Satellite System (GNSS) and compass loss or degradation

6.1 When designing appropriate procedures to help identify what may cause a loss or degradation of GNSS or compass, these factors must be considered. The list is not exhaustive, and operators should be aware of other potential causes of GNSS or compass loss or degradation.

a) Signal Loss:

- buildings or terrain mask signals
- lower number of satellites leading to reduced satellite coverage in the operational area or reduced positional accuracy.
- Reduced positional accuracy due to Dilution of Precision (DOP) or other factors – such as multipath and atmospheric effects.

b) Electromagnetic interference or distortion:

- high voltage wires
- metal structures, including underground structures
- any notifications of unusual electromagnetic activity, for example, GNSS jamming and similar activity will be subject to NOTAM
- nearby radio frequency transmissions
- operators may consider the use of spectrum analysers or similar equipment to map the electromagnetic environment. However, these are no guarantee that the environment will remain suitable.

c) UAS technical failure/damage may prevent proper GNSS or compass function:

- other UAS in-flight failures may result in the UAS deactivating its GNSS capabilities.

7 Queries

7.1 Any queries or requests for further guidance as a result of this communication should be addressed to uavenquiries@caa.co.uk with the subject line, 'Safety Notice – Unmanned Aircraft – responses to abnormal operations and in-flight failures', or by post to the following address:

UAS Unit
Safety and Airspace Regulation Group
Civil Aviation Authority
Aviation House
Beehive Ring Road
Crawley
West Sussex
RH6 0YR

8 Cancellation

8.1 This Safety Notice will remain in force until it is incorporated into CAA Policy and Guidance material.