Safety and Airspace Regulation Group

UK Civil Aviation Authority

Unmanned Aircraft System Operations in UK Airspace – Specific Category UAS Modification Policy

CAP 722G First Edition

Published by the Civil Aviation Authority, 2024

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The latest version of this document is available in electronic format on the CAA website.

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Revision History

First Edition May 2024

Initial issue.

Abbreviations and glossary of terms

The abbreviations and glossary of terms for the entire CAP 722 series of documents are centralised within the CAP 722D “Abbreviations and Master Glossary”.

Foreword

Aim

CAP 722G provides a definition and associated processes for a technical change to an Unmanned Aircraft System (UAS), which is described in Assimilated Regulation (EU) 2019/947 AMC1 UAS.SPEC.030(2).

UAS.SPEC.030(2) requires a UAS Operator to apply for an update to their Operational Authorisation following any significant change to the operation.

AMC1 to this regulation currently sets out that a technical change may be considered a significant change.

This policy sets out that some technical changes are not significant, and so do not require a variation to an OA, as described in figure 1.

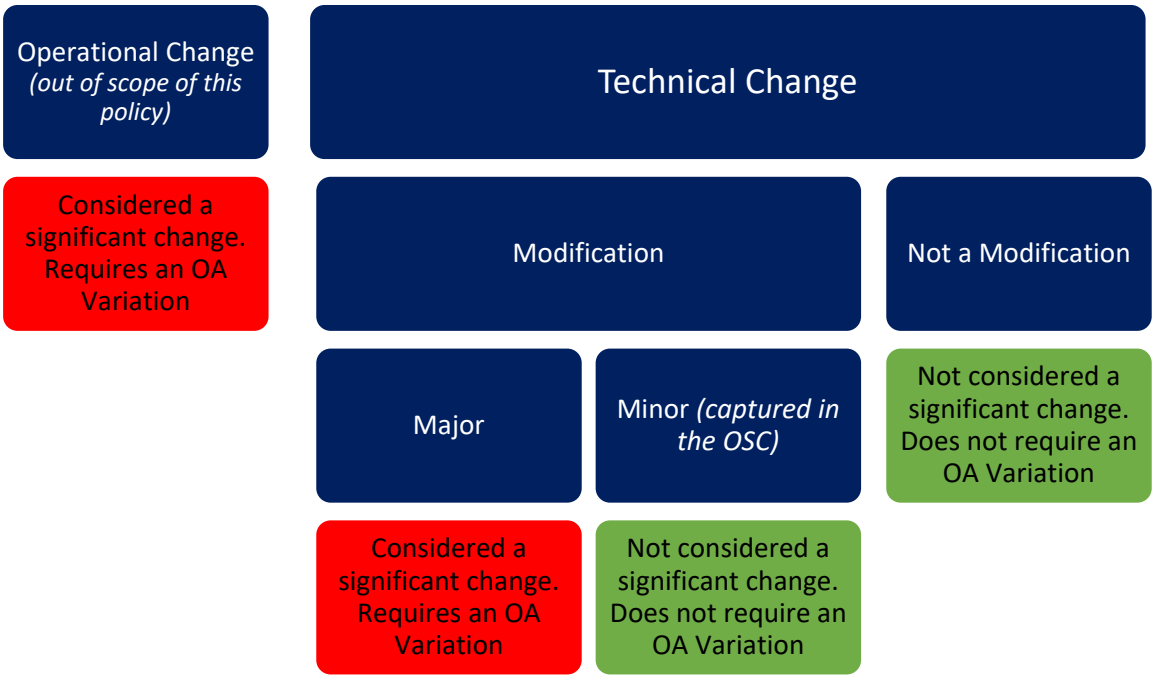

Figure 1: Definition of a technical change.

Note: a change may be considered a technical or operational change. This policy only covers technical changes.

Content

This document consists of four main sections:

- Definition of a modification
- Capturing a modification in the OSC
- Minor modification verification process
- UAS modification flowchart

How to use this document

This document is applicable to Specific Category UAS Operator Applicants, who wish to be able to make modifications to their UAS during the OA validity period, without requiring a variation to their OA.

The Applicant should first familiarise themselves with the entire document.

The Applicant should then follow the process in section 2 to capture future UAS modifications in their Operating Safety Case (OSC); this step is a pre-requisite to enabling UAS modifications to be made during the validity period of the OA without having to apply to the CAA for a variation to the authorisation.

The Applicant should then follow the process in section 1.2 and 4 (flowchart) when they make their modification.

This document uses terminology explained thereafter:

‘Shall’ indicates an instruction that needs to be followed in order to comply with this policy.

‘Should’ indicates a strong recommendation; the Applicant would need to provide clear justification for not following the recommendation.

‘May’ indicates an instruction where discretion may be applied by the Applicant.

Policy and scope

This policy is optional and provides flexibility to an Operator wishing to make modifications to their UAS during the validity period of their OA. The Operator may only make minor modifications to their UAS; major modifications will require an application to the CAA for a variation to their OA.

This policy is only applicable to an OA in the Specific Category that has been delivered under the CAP 722A process.

This policy should be applied at the same time as an application is made to the CAA for an OA. The verification process, change management process and technical data required from the Applicant in this policy must be included by the Applicant in their OSC (e.g. in the operations manual) and assessed as part of CAP 722A process.

Availability

The AMC and GM to UK Regulation (EU) 2019/947 and the latest versions of the CAP 722 series documents are available on the CAA website Publications section.

The CAA has a system for publishing further information and guidance, which can be found on the CAA website under the Skywise section, which can be filtered for information and subject matter relevant to UAS.

Point of contact

Unless otherwise stated, all enquiries relating to this CAP should be made to:

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1. Definition of a modification

1.1. General definition

A technical change to the UAS is considered a modification if it is any of the following:

- A change to the structure.
- A change to the material.
- A change to the paint scheme.
- Adding, removing or modifying system functions or sub-functions.
- Adding, relocating, modifying or removing equipment.
- A change to equipment part number outside of the Designer's recommendations.
- Adding, relocating or removing payload.
- A firmware/software update.

Other technical changes are likely not considered as modifications. As an example, adding a label on the UAS is a technical change that would typically not be considered a modification.

If a technical change has been determined to be a modification, it shall be classified as either minor or major per section 1.2.

1.2. Classification of a modification

The Operator shall determine if a modification is minor or major through the following process:

1. Determine if the modification is already captured in the OSC per section 2.

    a. If true, the modification is **minor**. Do not follow this process further and follow the minor modification verification process in section 3.

    b. If not, go to step 2.

2. The modification is **major**. Apply to the CAA for a variation to the OA.

1.3. Definition of a minor modification

A minor modification is a modification to the UAS that does not invalidate the safety claim made in the OSC.

Minor modifications are modifications that have been captured in the OSC.

A minor modification is not considered a significant change to the OA per UAS.SPEC.030(2).

See section 2 for the process of capturing a modification within the OSC.

1.4. Definition of a major modification

A major modification is a modification to the UAS that is not considered a minor modification.

A major modification is considered a significant change to the OA per UAS.SPEC.030(2).

2. Capturing a modification in the OSC

2.1. General requirements for all modifications

At the time of application for an OA, following the CAP 722A process, the Applicant shall consider whether they expect to make modifications to their UAS during the validity period of the OA. If so, the Applicant shall capture these modifications in their OSC as follows:

Step 1 – Describe the expected modifications. This is ideally achieved by the Applicant knowing the specific design characteristics of the future modification(s) and describing them in the OSC. If such level of detail is not known at the time of application, an alternative method is to define the 'envelope' of the modification, which provides a bounded extent of the future changes. Sections 2.2 and 2.4 provide examples of defining a modification envelope.

Step 2 – Conduct the safety risk assessment per CAP722A Volume 2 para. 2.4 and Volume 3 on the resulting UAS configurations.

Step 3 – Describe the process that verifies the modification when it is carried out, per section 3 of this policy. This demonstrates an appropriate level of change management process.

Completion of the above steps makes it possible to claim that all UAS configurations considered in the OSC are cleared to operate under the OA.

A modification that has been captured in the OSC brings the following privileges:

- It is automatically classified as minor.
- It does not require the Operator informing the CAA of the modification, nor to provide the CAA with any data when the modification is made, unless specifically requested by the CAA during the oversight process.

Instructions specific to capturing payload changes, firmware/software updates or R&D modifications in the OSC are further detailed in the following sections.

2.2. Capturing payload changes

This section is applicable to the following situation:

- The Operator intends to install a payload on the UAS that is not part of the original UAS design, and the operation is not defined as an R&D operation in the OSC. The Operator may or may not be the UAS Designer.

The ideal method to achieve section 2.1 step 1 is to describe the payload equipment and demonstrate to the CAA that the equipment is suitable for installation on the UAS. If the equipment is not known at the time of application, an alternative method shall be to define a payload 'envelope' and demonstrate to the CAA that the envelope has been correctly defined.

The following is an example of a list of characteristics that would altogether define the envelope of the payload; this list is non-exhaustive and may vary with the type of payload:

- Maximum payload dimensions – The Applicant may demonstrate this by showing on drawings and/or pictures a measurement of the maximum volume around the payload's attachment point, where no mechanical interference will exist between the payload and the UAS frame, considering the maximum amplitude of all possible movements of the payload relative to the UAS frame.
- Maximum payload weight – The Applicant may demonstrate this with the Designer's specification for Maximum Take-Off Mass (if available), or by flight testing the UAS with a dummy mass load.
  Note: in determining the maximum payload weight, the Applicant shall also consider its effect on the UAS flight envelope (e.g. reduced maximum operating altitude) and demonstrate that it still satisfies the intended operation.
- Payload's centre of gravity (CG) limits - The Applicant may demonstrate this with the Designer's specification for CG limits (if available), or by flight testing the UAS with a dummy mass load.
- Maximum payload power requirements – The Applicant may demonstrate this with the Designer's specification for power requirements (if available) or by ground (if applicable) and flight testing the UAS with a dummy electrical load.
  Note: in determining the maximum payload power requirements, the Applicant shall also consider its effect on the UAS range and demonstrate that it still satisfies the intended operation.
- Payload's compatibility with the UAS equipment – One example (there may be others) is the absence of electro-magnetic interference with other equipment onboard the airframe. The Applicant may demonstrate this with a combination of the Designer's specification for electro-magnetic compatibility, ground and flight testing of the UAS.

If the payload equipment is known, its suitability for installation on the UAS may be demonstrated in a similar way to a payload envelope as described above, i.e. by means of Designer's specifications and/or ground or flight test.

For a payload change, the process to capture it in the OSC is:

Step 1 – Describe the payload equipment or define a payload envelope and demonstrate its suitability/correctness.

Step 2 – Per section 2.1 step 2.

Step 3 – Per section 2.1 step 3.

2.3. Capturing firmware/software updates

This section is applicable to either of the following situations:

- The Operator is not the UAS Designer and receives a firmware/software update from the UAS Designer. The Operator does not hold the knowledge of the firmware/software update and therefore cannot assess the impact of the update on the existing risk assessment. The UAS Designer is relied upon to have correctly validated their update before dispatching it to the UAS.
- The Operator is the UAS Designer, the operation is not defined as an R&D operation in the OSC, and the firmware/software update only brings general improvements and bug fixes without adding, removing or fundamentally changing a function or sub-function in the UAS.
  Note: if the operation is not defined as R&D but the firmware/software update does modify the functionality of the UAS, the Designer shall follow the general process in section 2.1.

For a firmware/software update, the process to capture it in the OSC is:

Step 1 – Not applicable.

Step 2 – Not applicable.

Step 3 – Per section 2.1 step 3.

2.4. Capturing R&D modifications

This section is applicable to the following situation:

- The Operator is the UAS Designer, and the sole intent of the operation is to develop the UAS, also known as an R&D operation.

An R&D operation is characterised by the fact that during the OA validity period:

- The UAS might change in size and mass,
- The UAS functions might change (including firmware/software changes),
- The UAS equipment might change,
- All of the above for the sole purpose of developing the UAS, where the operation is flight testing in nature.

The ideal method to achieve section 2.1 step 1 is to describe the detailed design of all future modifications. If such level of detail is not known at the time of application, an alternative method shall be to define a modification 'envelope', such as but not limited to:

- Main UAS design characteristics/features: rotorcraft/fixed wing/VTOL, propulsion configuration, payload, etc.
- Maximum UAS size, mass, speed.
- Expected UAS functionality.

As part of achieving section 2.1 step 2, mitigations shall address the containment of the unproven UAS platform within the operational volume. These mitigations may be of operational and procedural nature, e.g. operating in controlled ground area/segregated airspace, pre-flight risk assessments, gradual expansion of the flight envelope, etc. These mitigations may also be of technical nature, e.g. installation of proven FTS and GNSS on each new UAS configuration with power source and control means fully independent from those of the UAS.

For an R&D modification, the process to capture it in the OSC is:

Step 1 – Describe the detailed design of all future modifications. If not known, define a modification envelope.

Step 2 – Per section 2.1 step 2. Mitigations in place will address the containment of the unproven UAS platform.

Step 3 – Per section 2.1 step 3.

Operators conducting both R&D and routine operations

Note: the term routine operation is used here to describe any operation which is not R&D in nature.

R&D and routine operations shall be captured in separate OSCs and be granted individual OAs; this is because the operational risk is different, and mitigations in place for R&D operations will be different from those for routine operations. Where an OA for a routine operation is sought, the UAS design configuration issued from R&D shall be frozen and assessed for the routine operation in a separate OSC; if the UAS is later modified through continued R&D, the new design configuration must again be frozen and assessed in a separate OSC, for the routine operation.

3. Minor modification verification process

3.1. Verification process for minor modifications (except R&D)

The Operator shall verify a minor modification before commencing the next operation. This acts as a safety net for any failure that might occur from the modification, e.g. the payload equipment itself or its installation, or from an error that developed in the firmware/software update itself or during its installation, etc. This also demonstrates an appropriate level of change management process.

This process does not apply to an R&D modification, which is addressed in section 3.2.

The verification process is:

1. Verify that the modification remains within the modification envelope defined in the OSC.
   Note: this step is not applicable to firmware/software updates as defined in section 2.3.
   a. If the modification is outside the envelope defined in the OSC, the modification shall be considered as **major**. Do not follow this process further and apply to the CAA for a variation to the OA.

   b. If not, go to step 2.

2. Identify the functions and sub-functions captured in the OSC per CAP 722A Vol.2 table 28 that are affected by the modification. If it is not possible to identify them specifically, then all functions/sub-functions captured in the OSC shall be considered as affected by the modification.
   Note: for firmware/software updates as defined in section 2.3, use the Designer's patch notes if available to identify affected functions and sub-functions.

3. Perform a flight test in controlled ground area and low risk airspace that verifies the affected functions and sub-functions, e.g. control and stability, satellite connection, etc. There shall be a clear link between the affected functions/sub-functions and the pass/fail criteria in the flight test plan.

4. Update the procedures that are affected by the modification, as applicable. E.g. the installed payload might reduce the aircraft attitude envelope, affect training needs, create new maintenance requirements, etc.

5. Make the crew and personnel with maintenance responsibilities aware of the modification and any training needs resulting from it.

3.2. Verification process for R&D modifications

The verification process for an R&D modification is:

1. Re-conduct the CAP722A safety risk assessment process on the modified UAS configuration and confirm whether an existing risk is increased, or a new hazard is introduced by the modification, as dictated by CAP 722A para. 2.3.24.
   Note: an existing risk may also increase if, not the risk itself, but one of its mitigations is affected by the modification.

   a. If true, the modification shall be considered as **major**. Do not follow this process further and apply to the CAA for a variation.

   b. If not, go to step 2.

2. Flight test the UAS to verify all functions and sub-functions captured in the OSC per CAP 722A Vol.2 table 28, and to verify the existing mitigations, over the entire flight envelope.
   Note: a stepped approach should be adopted after each modification where the initial flight(s) verifies the modification in a safe manner, before resuming normal R&D operations.

3. Update the procedures that are affected by the modification, as applicable. E.g. operational, maintenance, etc.

4. Make the crew and personnel with maintenance responsibilities aware of the modification and any training needs resulting from it.

For R&D operations, the CAA may request at any time the full documentation set demonstrating that modifications to the UAS do not invalidate the safety claim made in the OSC; this includes any updated procedures.

4. UAS modification flowchart

Figure 2 summarises the general process for a UAS modification during the validity period of the OA.

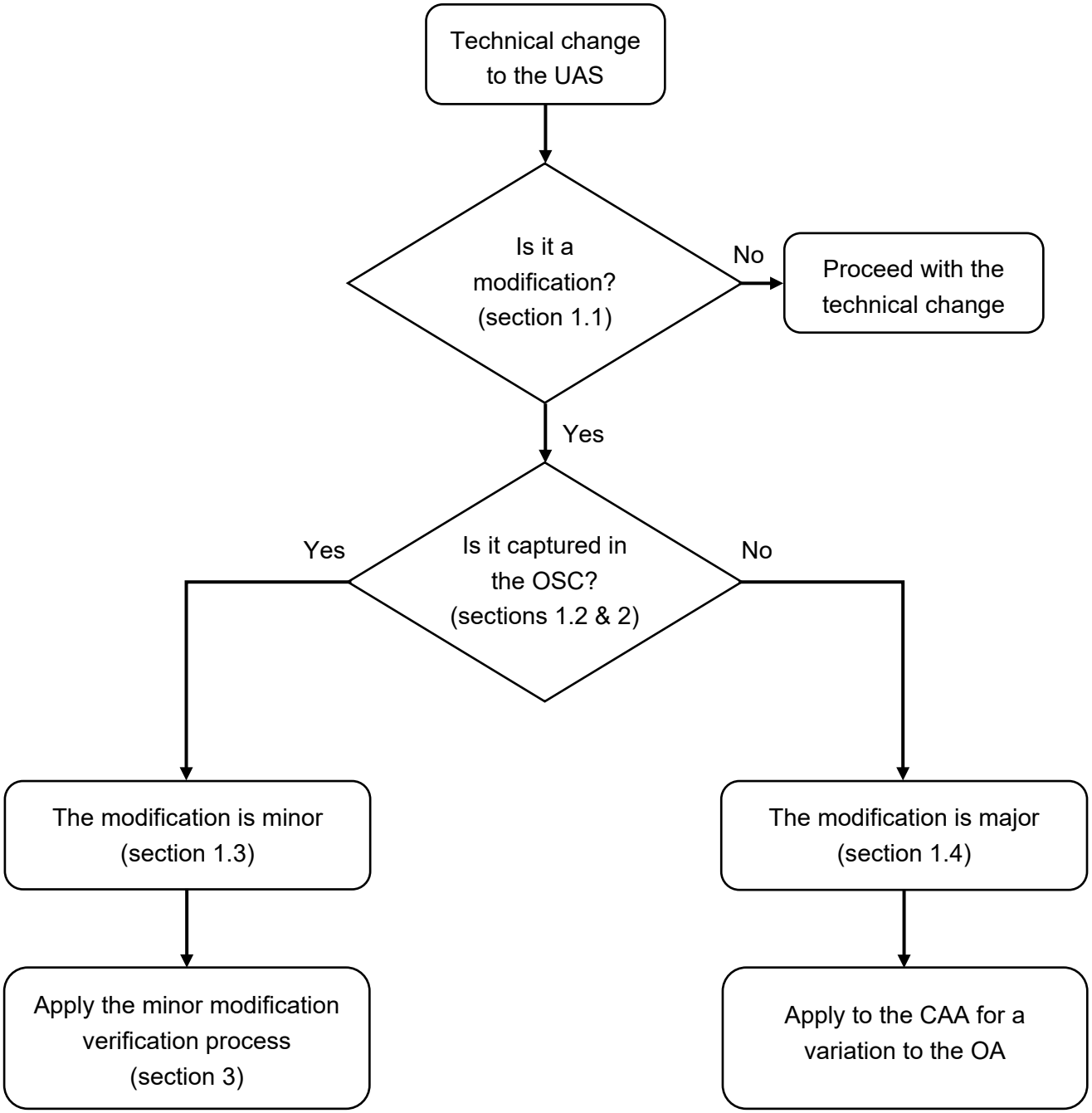

Figure 2: flowchart to determine and address a UAS modification.