

Guidelines

on

**Design verification for UAS operated in
the ‘specific’ category**

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1. List of acronyms

AMC	Acceptable Means of Compliance
COTS	Commercial Off-The-Shelf
ConOps	Concept of Operations
DOARI	Design Organisation Approval Review Item
DV	Design Verification
DVP	Design Verification Programme
DVR	Design Verification Report
EASA	European Union Aviation Safety Agency
FTS	Flight Termination System
GM	Guidance Material
MoC	Means of Compliance
NAA	National Aviation Authority (of an EASA Member State)
OSO	Operational Safety Objective
SAIL	Specific Assurance and Integrity Level
SC	Special Condition
SORA	Specific Operation Risk Assessment
TC	Type Certificate
UAS	Unmanned Aircraft System
VTOL	Vertical Take-Off and Landing

2. Background and applicability

Background

In 2018, a new Basic Regulation (Regulation (EU) 2018/1139) was adopted, followed by the new European Commission Implementing Regulation (EU) 2019/947 (applicable as of 31 December 2020) and Delegated Regulation (EU) 2019/945 (applicable as of 1 July 2019). These documents set the new UAS regulatory framework, which is a proportional risk-based approach to UAS. Its pillar is the identification of three categories of operation: ‘open’, ‘specific’ and ‘certified’.

While the ‘open’ category includes strict operational limitations, the ‘specific’ category has the potential to capture a wide range of UAS operations. The detailed provisions for the ‘certified’ category of operations have not yet been adopted at the issuance date of these Guidelines.

For operations in the ‘specific’ category, an operational authorisation issued by the competent authority of registration is required, unless the operation is covered by a standard scenario. This operational authorisation will be based on the outcome of the risk assessment conducted in accordance with Article 11 of Regulation 2019/947. As an acceptable methodology for such risk assessments, EASA published the specific operation risk assessment (SORA) as AMC to Article 11.

The SORA consolidates the ground and air risk analyses within the specific assurance and integrity level (SAIL), which drives the required activities. The SAIL is a figure from I to VI, leading to the identification of operational safety objectives (OSOs) to be met with a certain level of robustness (i.e., integrity and assurance), which tend to increase with an increasing SAIL.

Applicability of these guidelines

An EASA DVR is required for the following cases:

- If an operation is classified as SAIL IV, and/or
- Mitigation means linked with design when claimed at high robustness, and/or
- For the verification of the ‘enhanced containment’ as currently defined by SORA¹ when no declarative MoC can be applied

These guidelines are applicable for any design verification project.

Note:

Even if not required, manufacturers of UAS used for SAIL IV operations, may voluntarily apply for a Type Certificate (TC) or a Restricted Type Certificate (RTC) according to Regulation (EU) 748/2012 (Part 21). In such cases, EASA will apply the certification process defined in Part 21, complemented by the content of DOARI 2020-01² for the initial investigation of the design organisation.

Who can apply for a DVR

Any natural or legal person having access to the relevant design and technical data to be able to demonstrate compliance with the applicable technical requirements is eligible as an applicant for a DVR.

¹ SORA is currently under review. Version 2.5 is planned to be adopted by EASA after JARUS disposition of comments from public consultation.

² https://www.easa.europa.eu/sites/default/files/dfu/doari_2020-01_consultation_paper.pdf

3. Provision of a design verification service in the specific category – medium risk

EASA provides detailed information about the DVR on its website³. In case of remaining questions that are not addressed in this set, please contact the EASA under the following email address:

DVR-Preapplication@easa.europa.eu

A pre-application meeting of maximum duration of one hour can be arranged to clarify specific aspects of the DVR application and subsequent project.

3.1. Application phase

The applicant should accomplish the following steps:

1. Establish the typical operation the UAS is intended to be used for, the operational assumptions and relevant limitations, including for which environmental and operational conditions the UAS is designed to be operated (e.g., night operations, weather conditions), which buffers/corridors dimensions are envisioned, if credit is requested based on the use of ground or air risk mitigation means, if enhanced containment would be required
2. Develop a representative SORA for the typical operation.
3. Submit to EASA an application for a design verification using the application form “Application for UAS design verification”⁴.
4. Provide at least the following minimum set of data, following the completion instructions of the application form:
 - A detailed description of the design (including main characterisation drawings and system architecture) as well as configurations to be verified.
 - A risk assessment according to SORA and the description of the typical operations the UAS is expected to conduct that will include as applicable:
 - a. the proposed operating characteristics and limitations.
 - b. the intended use of the product and the kind of operations for which the design verification is requested.
 - c. the relevant parts of the typical operations that drive design aspects.
 - d. the characterisation of the operational volume and ground risk buffers in terms of both the ground and air risks.
 - e. the identified final ground risk class, residual air risk class and SAIL; and
 - f. any applicable restrictions, limitations, or assumptions about adjacent areas and design-related mitigation means which may influence the applicable specification or the MoCs.
 - The **design verification basis**, identifying those paragraphs that are applicable to the UAS for which the verification is required.

³ <https://www.easa.europa.eu/en/domains/civil-drones-rpas/specific-category-civil-drones>

⁴ <https://www.easa.europa.eu/en/document-library/application-forms/focserv00198-001>

- A **design verification programme** (DVP) for the demonstration of compliance, including the proposal for the list of MoC intended to be used and the related compliance documents.
- A project schedule, including the major milestones.

Note: In case of the first-ever application the applicant will be requested to register on the EASA website.

Note: EASA will not approve neither the SORA nor the operation(s). This information will be used to define in the DVR the limitations that the UAS operator should use when applying to the NAA for an operational authorisation.

The scope of a design verification can cover one or more of the following points:

- The full design of the UAS for its compliance with design related OSOs defined in the SORA process, to meet the required level of robustness for the applicable SAIL.
- The mitigation means linked with the design.
- The enhanced containment function.
- Parts installed on a UAS contributing to the safety performance⁵.

With this service, EASA provides a no-technical-objection (NTO) for the verified domains and does not certify or approve the unmanned aircraft, the command unit or the operation.

The purpose of the service is to provide the applicant with an independent assessment of the design related OSOs, mitigation means and/or enhanced containment based on which the NAA could rely when issuing operational authorisations.

The applicant remains responsible for those aspects of the design which fall within the scope of the design verification application, as detailed above.

In case of a reduced scope of the design verification to particular functions/features, the verification will be limited to the elements needed for demonstrating compliance to specific paragraphs (i.e., Light-UAS.2511 for enhanced containment and Light-UAS.2512 for mitigation means). For example, if the objective of the design verification is to show compliance to the enhanced containment requirements and the UAS has a separate “stand-alone” flight termination system (FTS), the DVR might be limited to that system. Otherwise, if the containment function is deeply integrated in the UAS architecture, the investigation could be extended to other UAS functions and equipment needed to ensure the correct operation of the containment function. In both cases, the DVR would be relative to the specific UAS configuration and installation. The same applies to DV projects focused on mitigation means linked with the design.

Only after a full UAS DVR is issued, EASA is open to evaluate the possibility of issuing DVRs for specific UAS components (e.g., engines, autopilot, FTS...) once the limitations and the interfaces between the sub-system and the UAS are clarified.

⁵ Parts installed on the UAS will initially be evaluated only within the frame of a full design verification project. EASA is open to evaluate a stand-alone DVR for those parts only after the interfaces between the part and the UAS are clarified within a full DV project.

Determination of the design verification basis

The design verification basis should be agreed early in the process. The applicant should consider the Special Condition for Light UAS - Medium Risk⁶. If needed, adaptations may be considered.

Environmental protection

Applicants are strongly encouraged to carry out noise measurement according to appropriate procedures, and to report the noise levels to EASA. EASA may decide on its participation to the measurement campaign on a case-by-case basis.

EASA has issued the [Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category \(Low and Medium Risk\)](#)⁷ Those guidelines deliberately cover a wide variety of designs. Additionally, they now encompass a template for a typical noise report, as well as a calculation spreadsheet that facilitates the adjustments of measured noise levels according to the recommended procedures. Applicants and declarants are strongly encouraged to make use of these tools.

Applicants and declarants are also encouraged to provide the resulting noise levels to EASA, under the form of a noise report for which a template is attached to the Guidelines. In the short term, this can be done by sending an email to noise@easa.europa.eu, until an online repository is available (currently undergoing development).

As part of future rulemaking activities, EASA or a NAA may establish noise limits for UAS, in which case, the applicant will need to declare compliance with those limits.

Design verification programme (DVP)

The DVP is a document that allows the applicant and EASA to manage and control the evolving UAS design, as well as the process of compliance demonstration by the applicant.

The applicant will propose its DVP, including the MoCs. Once agreed with EASA, the applicant will conduct the verification activities (appraisals, analyses, tests...) and document them accordingly.

3.2. Design verification process

EASA will assess the submitted application, and upon its acceptance, enter the design verification phase. The DVR will be issued to the applicant who will be responsible of retaining all relevant design information, drawings and test reports to ensure continued airworthiness of the product and the continued validity of the DVR.

The applicant should demonstrate compliance with the design verification basis and the environmental protection provisions, as applicable, and should propose the means (MoCs) by which such compliance is planned to be demonstrated.

Since the SC Light-UAS is objective-based, these MoCs need to achieve the following:

- Describe/clarify how the SC Light UAS paragraph applies to the UAS configuration.
- Describe/specify concrete UAS design-related auditable or measurable specifications and,

⁶ https://www.easa.europa.eu/sites/default/files/dfu/special_condition_sc_light-uas_medium_risk_01.pdf

⁷ <https://www.easa.europa.eu/en/document-library/product-certification-consultations/guidelines-noise-measurement-unmanned-aircraft>

- Define how to demonstrate compliance with this data (e.g., design review, calculation/analysis, laboratory tests, ground tests, flight tests etc.)

To achieve these targets, the applicant may:

- Make use of the MoCs published by EASA⁸
- Propose MoCs based on either published existing technical specifications or industry standards and their relevant sections⁹
- Propose new MoCs if no MoC from the above two points is considered appropriate.

Proposed Means of Compliance (when not directly applying MoC published by EASA or other published standards)

As stated above, the proposed DVP should include the MoCs. The applicant could present the detailed MoCs in separate documents, when considered necessary.

The proposed MoCs should specify in each case at least:

- The design objective that is to be achieved.
- The activities to be carried out and their planning.
- The parameters which are considered relevant and their rationale.
- The references to industrial standards, airworthiness specifications or other GM/AMC (if any).
- The pass/fail criteria.

In practice, the MoCs should clarify the safety objective derived from the Design Verification Basis' paragraph and should allow EASA Certification Experts to understand the adequateness of the proposed MoC as well as how the applicant intends to show compliance to that paragraph.

EASA may accept MoCs based on extensive product tests complemented by further design criteria substantiations, depending on the safety objectives and the operational risk. Such a methodology may help in addressing the verification of products based on COTS with limited evidence of development standards.

Please refer to Annex 1 for an example illustrating the development of means of compliance.

Qualitative and quantitative assessments

To ensure proportionality between risk and safety requirements, the low and medium risk of the specific category (SAIL I through IV) mainly rely on qualitative requirements. Applicants are reminded that a quantitative approach may not only be disproportionate, but it may be particularly challenging for less experienced applicants and shift the focus away from the overall safety objective.

In case a safety analysis is proposed to show compliance to some requirements in the design verification basis, the applicant should initially perform a qualitative assessment. If the qualitative assessment is not conclusive then a quantitative assessment should be considered.

Electrical lift/thrust/power systems

⁸ For a list of MoC published by EASA, please consult [Design verification report | EASA \(europa.eu\)](#)

⁹ Some potentially applicable standards could be found within the publications of AW Drones under [Home page - AW-Drones](#)

These systems will be verified as part of the UAS design, and therefore, the MoCs need to consider their qualification and their integration. The SC for Light-UAS already indicates various pertinent design objectives, with further considerations to be addressed in the MoC.

Tactical Mitigation Performance Requirements (TMPR)

In the frame of design verification projects, if applicable, EASA will investigate the correct installation of the tactical mitigation means (in accordance with manufactures instructions), their safe system integration as well as the pilot interface. EASA will ensure that those means are not detrimental for the safe operation of the UAS and that the UAS will comply with the associated latencies command-to-execution and maneuvering capabilities. Applicants should consider these elements when preparing their DVP.

However, the design verification will not investigate the actual performance of the tactical mitigation means, and it will not ensure that they would have an appropriate outcome or be adequate to the operation.

When issuing the operational authorisation to a UAS operator using a UAS with a DVR, the competent authority will evaluate the appropriateness of the TMPR to address the residual air risk for the volume of airspace where the operation is carried out.

3.3. Issuance of a Design Verification Report

The outcome of the design verification process is an EASA document, referred to as Design Verification Report, stating that EASA is satisfied with the verified compliance demonstration provided by the applicant. The DVR includes limitations and any conditions or assumptions under which it holds its validity. The conditions will be those linked with the type of operation, as described in the SORA provided in support of the application and resulting from the UAS design verification.

4. Fees and Charges

Fees and charges applied by EASA are defined by Regulation (EU) 2019/2153, in which fees for UAS are not yet included. EASA, therefore, charges an hourly rate considering the time spent on the project by EASA staff. EASA charges the actual time spent on the evaluation of the project only, and additional time spent to improve the regulatory framework is financed by other means.

Considering the variety of potential projects in this category, an estimate applicable to all cases cannot be provided. EASA expects that the effort spent for the verification of the design of the subject UAS should not exceed 180 working hours (WH) per year in case of typical complexity ⁽¹⁰⁾

5. References

5.1. EU Regulations

- Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft (OJ L 152, 11.6.2019, p. 45)

¹⁰ Simple projects or verification limited to mitigation means may require a limited effort while more complex projects may require a larger number of hours to be spent by EASA staff. Elements like numbers of UAs controlled in parallel, or complexity of the design of the single UA or the Command Unit would be taken into consideration.

- Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems (OJ L 152, 11.6.2019, p. 1)
- Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts, and appliances, as well as for the certification of design and production organisations (OJ L 224, 21.8.2012, p. 1)
- Commission Implementing Regulation (EU) 2019/2153 of 16 December 2019 on the fees and charges levied by the European Union Aviation Safety Agency, and repealing Regulation (EU) No 319/2014 (OJ L 327, 17.12.2019, p. 36–65)

5.2. EASA ED Decisions/ Special conditions/DOARI

- Executive Director Decision 2019/021/R of 9 October 2019 issuing Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) No 2019/947 'Rules and procedures for the operation of unmanned aircraft'
- Special Condition for Light UAS - medium risk
- DOARI 2020-01

ANNEX 1 – GUIDANCE FOR DEVELOPING MEANS OF COMPLIANCE

This guidance is intended to illustrate EASA's expectations regarding the proposal of Means of Compliance in the frame of a Design Verification Project. The example is not exhaustive, but it aims at providing relevant information to be considered when developing an acceptable MoC.

For the illustration, consider Special Condition Light-UAS.2235.

Light-UAS.2235 Structural strength and deformation

(a) The structure must be shown not to fail throughout the limit flight envelope with sufficient margin to ensure the applicable safety objectives are met.

(b) The structure must be shown not to interfere with safe operation throughout the limit flight envelope.

(c) The effects of the operating environment must be taken into account when complying with sub paragraphs (a) and (b).

Objective(s) of the MoC

The requirements of the Special Condition Light-UAS are set in an objective based manner, rather than prescribing detailed technical specifications. These objectives are technology-agnostic and could be applied independently of the UAS configuration. Consequently, when proposing Means of Compliance, the applicant should consider how these paragraphs apply to their design.

Light-UAS.2235(a) requires the flight envelope(s) to be defined, this is done in accordance with Subpart B of the Special Condition. The definition of the flight envelope will depend on the UAS configuration: it will be different for a fixed-wing, a rotary-wing, or a VTOL.

The same paragraph requires to show that the structure will not fail throughout the limit flight envelope **with sufficient margin** to ensure the applicable safety objectives are met. Therefore, the applicant should define the adequate margin (safety factor) between the loads of the limit envelope and the loads at which the structure no longer performs its intended function. This could be either a structural failure or an excessive deformation such that the UAS can no longer operate safely.

Compliance demonstration activities

Once the UAS safety objectives are identified, the applicant should define adequate activities to show that these objectives are met, i.e., that the UAS' design complies with that paragraph. Following with our example, an applicant may contemplate showing compliance to Light-UAS.2235(a) by means of analysis and laboratory test(s).

The applicant may carry out a load analysis for the most critical points of the limit flight envelope (the choice of those points should be justified). The way these loads will be estimated should be specified. The estimated loads could then be multiplied by the proposed safety factor (i.e., sufficient margin) to obtain the ultimate loads.

Once the loads are estimated, the applicant should show that the structure is able to resist these. This may be achieved with a test. The applicant may apply the ultimate loads to a part or to the entire structure and verify its integrity. The applicant may refer to an industry standard describing the test procedure or propose its own.

Reference(s) to industrial standards or applicable GM/AMC (if applicable)

Industrial standards, GM&AMC to the Certification Specification for lower-end products (small aeroplanes, light rotorcrafts) or other Special Conditions issued by EASA may not keep into account the specificities of UAS. Nevertheless, they may be well suited for many common aspects and could be proposed as they are or in an adapted form.

Qualifications

If the applicant intends to take credit of some equipment's qualification this should be stated. For example, sometimes pressure vessels or fuel tanks could have been tested by the manufacturer. If evidence of such qualification is available, the applicant may be able to claim credit for it.

Pass/fail criteria

The applicant should define the pass/fail criteria. In the example of Light-UAS.2235(a) the criterion is no failure of the structure. In some cases, the failure could be evident, in some other case some post-test assessment or inspection might be required.

Additional considerations

It may be noted that concurrently with the structure/part loading test the applicant may also show compliance (at least in part) to Light-UAS.2235(b). For example, the deflection of the loaded wing may interfere with the operation of the control surfaces of a fixed wing UA. This may interfere with the safe operation of the UAS. Therefore, during the load tests the applicant may show that the control surfaces can still operate safely. Depending on the UAS architecture, structural deformations may cause other safety issues like (but not limited to) excessive pressure on energy storage systems or blockage of energy distribution lines. The applicant should anticipate, to the extent possible, these potential issues in advance.

Some materials are particularly sensible to the environment. For example, temperature and humidity have an appreciable impact on composite materials' properties. This could have an impact on the load tests/analyses to be performed and the parameters to be recorded during these activities. Otherwise, a conservative additional safety factor could be proposed for composite structures to address this effect. In other cases, according to the CONOPS, the UAS may be expected to operate in particularly hostile environments (very cold, very hot, corrosive...). This may have to be reflected in the Means of Compliance to address Light-UAS.2235(c).