Initial Airworthiness Special Condition

Light Unmanned Aircraft Systems - Medium Risk

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Special Condition for Light Unmanned Aircraft Systems - Medium Risk

INTRODUCTORY NOTE:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public consultation, in accordance with EASA Management Board Decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

IDENTIFICATION OF ISSUE:

Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 and Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on Unmanned Aircraft Systems are the cornerstones of the new European UAS regulation. They define the overarching subdivision of UAS operations into three categories - Open, Specific and Certified - and the thresholds between these categories.

The Open Category is characterised by a set of operational restrictions depending on the subcategory of operation (A1, A2 or A3) and technical requirements depending on the UAS Class. The compliance with the technical requirements is determined by market regulation mechanisms linked to the placing of CE Marking on products made available on the European Union market. One of the most important operational restrictions is that all the subcategories of operation must be operated in visual line of sight.

The Specific Category of Operation is based on a risk assessment performed by the Operator according to Article 11 of the Implementing Regulation and on an operational authorisation provided by the Competent Authority based on that risk assessment. EASA has adopted AMC and GM to Commission Implementing Regulation (EU) 2019/947 (referred to as EASA AMC and GM in this document) which includes the accepted methodology for the risk assessment.

At the time of the writing of this SC, rulemaking on the certified category of operation is ongoing.

This Special Condition addresses airworthiness specifications for UA operated in the specific category.

Until today, the certification basis of UAS has been either derived from manned aircraft CS integrated with Special Conditions to address specific UAS aspects, or defined with Special Conditions based on documentation developed and published by JARUS (joint authorities on rulemaking for unmanned air systems). In both cases the approach has been prescriptive. Objective based CS are deemed more appropriate for UAS.

Therefore, EASA decided to develop a dedicated SC for light UAS, which will be applied in accordance with point 21.B.80 when the Agency has to determine the certification basis for light unmanned aircraft, considering that no existing CS is applicable to those aircraft.

The objective airworthiness standards proposed in this SC are intended to be applied for future UAS projects for which a TC/RTC is applied for and which fall within its scope. This SC may also be elected to be complied with by applicants which already applied for type certification and where EASA has already established the certification basis based on other standards.

Most UAS designs have a limited MTOM up to a few hundreds kg. Especially considering the expansion of urban operations, the vast majority of upcoming UAS operations is expected with UAS of limited mass. The operation of such UAS may often fall in the specific category, where operational approval is provided by the Competent Authorities but the design of the UAS shall be certified by EASA for high risk operations[1] or may be certified for lower risk ones (refer to EASA AMC and GM for comprehension of the overall policy).

Once more experience has been gained with the certification of UAS with the application of the SC light UAS, EASA intends to transpose this SC into a CS.

For UA of higher maximum take-off mass, closer to traditional aircraft or capable of carrying persons the certification basis may be established on the basis of existing manned aircraft CS (CS-23/27, CS-25/29), complemented with appropriate airworthiness standards from a CS-UAS, yet to be created, focussed only on UAS-peculiar elements.

The Agency's intent to organise the future CS is presented in Figure 1.

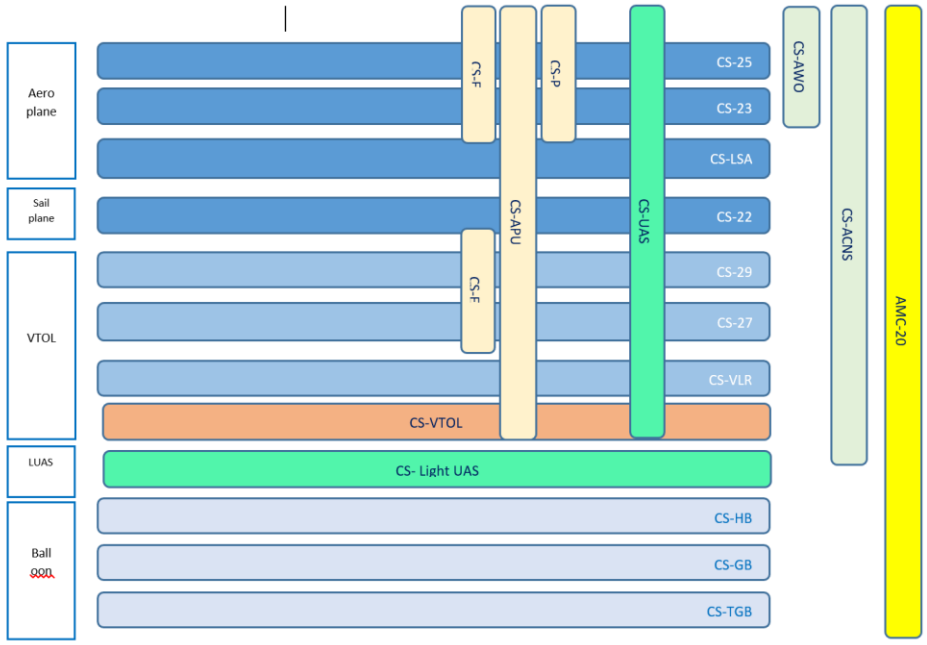

Fig.1 CS Organisation

The certification basis for UAS certification projects ongoing and in the near future will be established consistently with the longer term strategy identified above, on the basis of special conditions.

1 High risk operations are herein defined as those operations in SAIL V or VI. The terms "high risk", "medium risk", "lower risk" are used throughout this document in a broad sense i.e. to identify the level of risk as commensurate to the level of harm a potential mishap could lead to. It does not negate however other standard accepted definitions.

An objective-based, operation centric and proportional approach to UAS certification

When appropriate, EASA establishes certification specifications or special conditions in an objective based manner, rather than prescribing detailed technical specifications. Examples are CS-23 Amendment 5 and the recent SC VTOL. Such an approach is also deemed to be appropriate for UAS as it provides a safe environment while leaving flexibility to certify various design concepts in an area where the technology and design solutions rapidly evolve.

With no occupant on-board, the risk inherent to any UAS operation is strictly dependent on the characteristics of the operational volume, and of the adjacent ones which the UA might inadvertently enter. An operation-centric and risk-based approach is therefore also necessary in the context of UAS certification. Every UAS certification application shall be linked to a characterization of the operational volume, buffers and adjacent volumes, in terms of both ground and air risks, and any restriction, limitation and mitigation means which are assumed to be applicable for its operation. The definitions will be in line with the EASA AMC and GM. The TC issued on that basis will only permit operations in this context.

Suitable means of compliance (MOC) with this SC will be key to ensure proportionality and to ensure that the same certification basis is suitable for a very wide range of designs including a range of MTOM. No MOCs are presented so far, as they will be developed in a second stage and, when considered necessary, the most significant ones may be publicly consulted. Where MOC will not yet be defined by the Agency the applicant can propose, within the certification programme, means on how they plan to demonstrate compliance. As always, EASA will carefully evaluate those for the purpose of the certification project, and where appropriate, may also use them as a basis for the development of MOC or AMC in the future.

Applicability

This SC is applicable to UAS:

- Not intended to transport Humans
- Operated with intervention of the remote pilot or autonomous [2]
- With MTOM up to 600 Kg
- Operated in the specific category of operations, medium risk

"Medium risk" is herein utilized to refer to those operations classified at SAIL III and IV (see also note 1). A voluntary certification for operation in SAIL III and IV is always possible. Additionally, as explained by the EASA AMC and GM, the Competent Authority may still require an EASA validation of the compliance of the UAS and/or its components with the design related OSOs (Operational Safety Objectives) and mitigation means, in accordance with point (2)(17) of Article 40 of Regulation (EU) 2019/947. Such validation should be requested in all cases in which the Competent Authority decides to not relay on the Operator's declaration for OSOs and mitigation means linked to design. In this case EASA will validate the achievement of the design

2 Autonomous operation, as defined by Regulation (EU) 2019/945, means an operation during which an unmanned aircraft operates without the remote pilot being able to intervene.

integrity and mitigation means [3], and will issue a type certificate (or restricted type certificate) which will provide evidence that all design related OSOs, design related mitigation means and containment requirement are complied with.

Although the consulted Special Condition contained in its scope also SAIL V and VI, the adopted Special Condition restrict the scope to SAIL III and IV which, as reflected by current EASA certification projects, have to be tackled with priority. EASA plans to adopt a Special Condition for SAIL V and VI in the course of 2021.

It is recognized that the EASA AMC and GM does not always assign the same level of robustness to OSOs of SAIL III and IV. Where possible, this SC differentiates its objective specifications for SAIL III and IV. Means of Compliance will introduce further proportionality to take into account the difference of OSOs robustness between SAIL III and IV.

This SC does not mandate the use of certain equipment that might be required for specific operations, such a Transponder, ADS-B, Flight Recorders. When this equipment is required, it will have to be installed according to the standards of Subpart F of this SC.

The SC is considered to be applicable to various designs but additional SC may have to be prescribed in accordance with point 21.B.75, e.g. in those cases in which the product includes specific technology novelties or design and operation may be considered unconventional (e.g.: autonomous operations, lighter-then-air).

Methodology and principle at the base of the SC

In order to develop this SC, EASA has analysed and compared the JARUS CS-UAS, previous EASA published RPAS special conditions and EASA SC VTOL. The JARUS CS-UAS and EASA SC VTOL are both based on CS 23 Amendment 5. Another document considered for reference has been the FAA Yamaha Fazer certification basis, keeping in mind the low associated operational risk. As the SC covers certification for operations in the specific category, the determination of airworthiness objectives of Light-UAS has taken into consideration design-related OSOs determined by the EASA AMC and GM which is based on the JARUS SORA.

The certification of light UAS with highly integrated systems will be fundamentally based on a safety assessment that includes thrust / lift / power systems and also interaction with structures. Applying 2510 systematically to all systems enables a flexible approach on system levels and achieves the overall safety objectives for the unmanned aircraft. This approach was introduced for distributed propulsion (lift/thrust/power) in the SC VTOL and this SC has consequently adopted to this approach.

Requirement of previous CSs considered as input have been reviewed with the aim of defining the simplest possible SC but avoiding gaps or redundancies among subparts.

Mitigation Means

According to the EASA AMC and GM, mitigation means M1, M2 and M3 when applied, may determine a reduction of the initial ground risk class (iGRC).

Mitigations means not linked with the UAS design and claimed in the determination of the SAIL or affecting the certification basis or the associated MoC, will not be subject to verification in the frame of a TC

3 For further detail on mitigation means see dedicated chapter

application, but will be discussed with EASA in the frame of compliance to Light UAS 2005 and may lead to airworthiness limitations.

Mitigation means linked with design and claimed in the determination of the SAIL or affecting the certification basis or the associated MoC, will be subject to compliance demonstration in accordance with the specifications reported by SC Light UAS.

Definitions

The terminology used with this Special Condition is addressed under Subpart A General, with the exception of the definitions of terms already used in the Implementing Regulation, in Delegated Regulation (EU) 2019/945, and in the EASA AMC and GM (namely the terms and abbreviations UA, UAS, Remote Pilot, Operator, Command Unit, VLOS, BVLOS, Operational Volume, adjacent areas).

This SC uses the term “remote crew” to indicate the crew made up of the remote pilot in control of the UA and any other personnel actively involved in the operation of the UA. The terms has already been used by other EASA SCs.

CONTENTS

SUBPART A – GENERAL

Light-UAS.2000 Applicability and Definitions

(a) This Special Condition prescribes objective airworthiness standards for the issuance of the type certificate, and changes to this type certificate, for Unmanned Aircraft (UA):

(1) intended to be operated in the Specific category and whose operation is demonstrated to be medium risk;

(2) with MTOMs not exceeding 600 kg;

(3) not transporting humans; and

(4) operated with intervention of the remote pilot or autonomous.

(b) For the purposes of this Special Condition, the following definition applies:

(1) 'normal flight envelope' means the flight envelope associated with routine operations and/or prescribed conditions;

(2) 'operational flight envelope' means the flight envelope associated with warning onset;

(3) 'limit flight envelope' means the flight envelope that is set by the unmanned aircraft design limits;

(4) 'continued safe flight and landing' means, that the UA is capable of continued controlled flight and landing, possibly using emergency procedures, if applicable, without requiring exceptional remote pilot skill. Upon landing, UA damage may occur as a result of a failure condition;

(5) ´ancillary equipment´ means the equipment required for the safe operation of the UA that is not installed in the UA or the Command Unit and that is not part of the specified C2 Link and that is identified and specified in the type design of the UAS.

Note:
Additional SC may have to be prescribed in accordance with point 21.B.75, e.g. in those cases in which the product includes specific technology novelties or design and operation are unconventional, such as UA operated autonomously, lighter-than-air UA or UA operated at very high altitude.

Light-UAS 2005 Definition of the operational scenario

The applicant needs to define the limitations associated with the operational scenario within which a safe flight and landing will be demonstrated.

Note:
Every application should include a characterization of the operational volume and ground buffers in terms of both ground and air risk, the identified SAIL, and any applicable restriction, limitation, assumption about adjacent areas and design-related mitigation means which may influence the applicable specification or the means of compliance. The definitions will be in line with the EASA AMC and GM.

"Safe flight and Landing" must be interpreted from the perspective of ground and air risk posed to people.

Light-UAS.2010 Accepted Means of Compliance

(a) An applicant can comply with this Special Condition using an acceptable means of compliance (AMC) issued by EASA, or another means of compliance which may include consensus standards, when specifically accepted by EASA.

(b) An applicant requesting EASA to accept a means of compliance must provide the means of compliance to EASA in an acceptable form and manner.

SUBPART B - FLIGHT

Light-UAS.2100 Mass and centre of gravity

(a) Limits for mass and centre of gravity that provide for the safe operation of the UA are to be determined.

(b) The design must comply with each airworthiness standard of this Subpart at critical combinations of mass and centre of gravity within the unmanned aircraft's range of loading conditions using acceptable tolerances.

(c) The condition of the UA at the time of determining its empty mass and centre of gravity must be defined and repeatable.

Light-UAS.2102 Approved Flight envelope and environmental conditions

(a) The applicant needs to determine the normal, operational and limit flight envelope for each flight configuration used in operations. The flight envelopes determination must account for the most adverse conditions for each flight configuration.

(b) In defining these envelopes, environmental conditions for which operations are approved need to be considered.

(c) For adverse weather conditions for which the UAS is not approved to operate, appropriate operating limitations must prevent inadvertent operation within those adverse conditions or the UAS must have means to detect and avoid or safely exit those conditions.

Note:
The flight envelopes might be combined or adapted to the accepted MOC at project level. The MOC will specify the envelopes as applicable for the design and operation of the UA to ensure protection of limitations with appropriate margins such as structural design loads or controllability limits such as a minimum safe speed for each flight configuration and phases of flight;

Environmental conditions should include meteorological conditions such as wind, rain and icing as well as external factors that may interfere with the performance of systems such as HIRF

Light-UAS.2105 Performance data

(a) The performance of the UA must be adequate to ensure the safety of the intended operation in the operational envelope.

(b) Sufficient data on the performance of the UA needs to be determined and provided in the Flight Manual to provide the remote crew with the necessary information and relevant operational parameters to ensure a safe minimum performance for the intended flight operation.

(c) The UA must be able to meet the scheduled performance in still air and standard atmospheric conditions at sea level and up to the ambient atmospheric conditions for the operational flight envelope.

(d) The procedures used for determining performance are executable consistently in atmospheric conditions expected to be encountered in operation and by a remote crew of average skill.

(e) Losses due to atmospheric conditions, cooling needs, installation, downwash considerations, and other demands on power sources as applicable, as well as system failure conditions in accordance with Light-UAS.2510, must be taken into account.

Note:
MOC will specify the performance as applicable for the design and operation of the UA and take into account:

- The UA minimum performance required for take-off;

- The UA minimum climb performance;

- The UA maximum hovering altitude;

- The UA minimum descent performance;

- At critical combinations of flight parameters:

  - The area required to land and come to a stop, assuming approach paths applicable to the UA; and

  - The approach and landing speeds, configurations, and procedures;

- For UA intended to load and unload cargo or other ballast when the UA is in flight or hovering, performance data within the operational limitations for Loading and Unloading; and

- For UA intended to fly with external cargo or a payload relevant performance data at critical combinations of flight parameters.

Light-UAS.2135 Controllability, manoeuvrability and stability

(a) The UA must be controllable and maneuverable within the limit flight envelope and must be controllable and maneuverable, without requiring exceptional skill or alertness on the part of the remote crew, within the operational flight envelope:

  (1) in all loading conditions for which certification is requested;

  (2) during all phases of flight including transitions;

  (3) with likely flight control or thrust/lift/power system failure; and

  (4) during configuration changes

(b) Within the approved flight envelope the UA must show suitable stability by natural or artificial means, or a combination of both.

Light-UAS.2160 Vibration and buffeting

Within the limit flight envelope there must be no excessive vibration or buffeting.

SUBPART C -STRUCTURES

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).

Light-UAS.2240 Structural durability

Effective inspections or other procedures that are designed to prevent structural failures due to foreseeable causes of strength degradation during the operational life of the UA must be developed. Inspections and procedures must be specified in the Instructions for Continued Airworthiness (ICA) as prepared in accordance with Light-UAS.2625.

Light-UAS.2250 Design and construction principles

(a) The design of each part or assembly must be suitable for the expected operating conditions of the UA.

(b) Design data must adequately define the part or assembly configuration, its design features, and any materials and processes used.

(c) The suitability of each design detail and part having an important bearing on safety in operations must be determined.

Light-UAS.2260 Materials and Processes

Materials and manufacturing process must be suitable for the intended use and must result in adequate and reproducible properties and performance.

SUBPART D –DESIGN AND CONSTRUCTION

Light-UAS.2300 UA flight control systems

The flight control systems must be designed to allow proper performance of their functions and protect against likely hazards.

Light-UAS.2305 Landing gear systems

(a) The landing gear system, if installed, must be designed to:

(1) provide stable support and control to the UA during surface operation; and

(2) account for probable system failures and the operation environment.

(b) The UA must be designed to absorb the kinetic energy of the landing performance.

(c) Adverse landing conditions must not cause damage to the essential systems of the UA, which could lead to a hazardous or catastrophic event if not detected.

Light-UAS.2325 Fire protection

The UA must be designed to minimize the risk of fire initiation and propagation such that ground hazards for people and infrastructure are properly mitigated.

Light-UAS.2335 Lightning protection

(a) If the intended operation does not exclude exposure to lightning, the UAS must be protected against the catastrophic effects of lightning.

(b) If the intended operation excludes exposure to lightning, limitations must be developed to prohibit flight, including take-off and landing, into conditions where the exposure to lightning is likely.

Light-UAS.2340 Design and construction information

The applicant needs to define the following design and construction information:

(a) operating limitations, procedures and instructions necessary for the safe operation of the UA;

(b) instrument markings and placards;

(c) any additional information necessary for the safe operation of the UA; and

(d) inspections or maintenance instructions to assure continued safe operation.

Light-UAS.2350 Forced landing or a crash

Where the emergency procedure contains a forced landing or a crash:

(a) the UA must be designed with sufficient self-containment features to minimise possible debris, fire or explosions extending beyond the forced landing or crash area; and

(b) the Flight Manual for the crew must contain the characteristics of the forced landing or crash area.

Light-UAS.2370 Transportation, assembly, reconfiguration and storage

Where a UAS or part of the System is designed to be transportable, assembled and disassembled or reconfigured for transportation or storage:

(a) the conditions defined for the transportation and storage must not adversely affect the airworthiness of the UAS;

(b) incorrect assembly must be prevented by proper design provisions; and

(c) instructions for transportation, disassembling/assembling or reconfiguration and storage and the respective handling must be provided.

Light-UAS.2375 Payload Accommodation

(a) The provisions for installation or accommodation of payload internal or external to the UA and for loading and releasing of payload must be designed to:

(1) minimize hazards to the UA or to third parties during normal operation, and

(2) in case of dangerous goods, not result in high risk for third parties in case of an accident.

(b) The applicant needs to provide limitations, procedures and instructions as required for the safe operation with payload.

Light-UAS.2380 Ancillary Equipment not permanently installed on the UA

Where the UA is intended to be used in combination with ancillary equipment not permanently installed on the UA that is required for the safe operation of the UA:

(a) the type design of the UA shall specify the performance and, when required, the design of the ancillary equipment;

(b) all necessary instructions, information and limitations for the safe and correct interface between the UA and such ancillary equipment needs to be provided in the Flight Manual or a Ground Handling Manual as appropriate; and

(c) the UA must be designed to operate safely using the ancillary equipment under the anticipated operating conditions.

SUBPART E –LIFT/THRUST/POWER SYSTEM INSTALLATION

Light-UAS.2400 Lift/Thrust/Power systems installation

The Lift/Thrust/Power system installation includes each part of the UA that is necessary for lift/thrust/power generation and affects the control or the safety of the Lift/Thrust/Power systems.

(a) Each component of the Lift/Thrust/Power system installation must be designed, arranged, and installed in accordance with applicable airworthiness standards of Subparts C, D and F.

(b) Compliance needs to be substantiated via test, validated analysis, or a combination thereof or through evidence of certification of systems or components to acceptable specifications.

(c) The hazards in the event of a malfunction or failure of the Lift/Thrust/Power Control Systems and the Lift/Thrust/Power System Installation need to be assessed and mitigated in accordance with the airworthiness standards Light-UAS.2500 and Light-UAS.2510.

(d) The Lift/Thrust/Power system installation must take into account anticipated operating conditions and environmental conditions, for which the UA is certified, in addition to foreign object threats.

(e) The Lift/Thrust/Power system installation must take into account for

(1) anticipated operating and environmental conditions, including foreign object threats;

(2) sufficient clearance of moving parts to other unmanned aircraft parts and their surroundings; and

(3) likely hazards in operation, including hazards to ground personnel.

(f) All necessary instructions, information and limitations for the safe and correct interface between the lift/thrust/power system and the UA need to be available.

Light-UAS.2405 Lift/Thrust/Power System Integrity

The integrity of the Lift/Thrust/Power system including mounting and accessory attachment must be demonstrated throughout the limit flight envelope of the UA.

Light-UAS.2410 Lift/Thrust/Power Endurance and durability

Each Lift/Thrust/Power System must be subject to

(a) an endurance demonstration of sufficient duration with respect to cycles and power settings in accordance with Light-UAS.2415;

(b) a durability demonstration to show that each part of the system has been designed and constructed to minimize the probability of failure of the system and sub-systems between overhaul periods, or between replacement intervals of parts; and

(c) an operational demonstration to verify the performance of the system throughout its declared operating range and operational limitations.

Light-UAS 2415 Lift/Thrust/Power Calibration, Ratings and Operational Limitations

(a) Each Lift/Thrust/Power System must be subject to calibration tests as necessary to establish its power characteristics.

(b) The Lift/Thrust/Power System must produce, within its stated limits, the lift/thrust/power demanded at all required flight conditions, taking into account environmental effects and conditions.

(c) Ratings and operational limitations need to be established as required for the safety of the operation.

Note:
MOC will specify ratings and operating limitations and any other information necessary for safe operation of the UA taking into account:

- Operating limitations including any limitation required to be monitored to ensure the safe operation of the system and its associated sub-systems.

- Ratings for Take-off Lift/Thrust/Power and for Maximum Continuous Lift/Thrust/Power, as well as for Emergency Ratings.

- The maximum permitted duration for ratings other than Maximum Continuous Lift/Thrust/Power Rating

Light-UAS.2430 Energy storage and distribution systems

(a) Each system must:

(1) provide compatible and uninterrupted energy as required with adequate margins to ensure safe functioning of the supported systems; and

(2) provide information and warnings to the remote crew regarding normal and degraded modes and remaining energy as required to be available for the remote crew to safely operate the UA.

(b) Each storage system must be designed and installed to:

(1) ensure that in normal operation or probable failure no explosive, toxic, or corrosive gases or fluids may accumulate in hazardous quantities or may damage structures or adjacent essential equipment or systems;

(2) maintain safe operating temperatures, pressures, or any other identified parameter, during normal operation;

(3) provide means of protection, or controlling to prevent hazardous conditions during normal operation or probable malfunction; and

(4) minimize hazards during ground handling, refilling or recharging, storage and exchange of the storage device or its components if such a function is provided.

SUBPART F – SYSTEMS AND EQUIPMENT

Light-UAS.2500 Systems and equipment function - General

(a) Light-UAS.2500, 2505 and 2510 are general airworthiness specifications applicable to systems and equipment installed in the UAS and should not be used to supersede any other specific Light-UAS airworthiness specifications.

(b) Equipment and systems required to comply with type certification requirements, airspace requirements or operating rules, or whose improper functioning would lead to a hazard, must be designed and installed so that they perform their intended function throughout the operating and environmental limits for which the UA is certified.

Note:
Improper functioning of equipment and systems may be caused by intentional unauthorised electronic interaction (IUEI). The applicant should also consider cybersecurity threats as possible sources of 'improper functioning' of equipment and systems. In showing compliance with Light-UAS.2500(b) for equipment and systems whose improper functioning could lead to an unacceptable threat, the guidance of AMC 20-42 may be considered. This AMC provides acceptable means, guidance and methods to perform security risk assessment and mitigation for UAS information systems.

Light-UAS.2505 General Requirement on Equipment Installation

Each item of installed equipment must be installed according to limitations specified for that equipment.

Light-UAS.2510 Equipment, Systems and Installation

(a) The equipment and systems identified in CS-Light UAS.2500, considered separately and in relation to other systems, must be designed and installed such that:

(1) hazards are minimized in the event of a probable failure;

(2) it can be reasonably expected that a catastrophic failure condition will not result from any single failure; and

(3) if the SAIL is IV, a means for detection, alerting and management of any failure or combination thereof, which would lead to a hazard, is available.

(b) Any hazard which may be caused by the operation of equipment and systems not covered by Light-UAS.2500 must be minimized.

Note:
1 The term 'probable' needs to be understood in its qualitative interpretation, i.e. 'Anticipated to occur one or more times during the entire system/operational life of an item.'

2 The term 'failure' needs to be understood as an occurrence that affects the operation of a part, or element such that it can no longer function as intended (this includes both loss of function and malfunction). Errors may cause failures, but are not considered to be failures. Some structural or mechanical failures may be

excluded from the criterion if it can be shown that these mechanical parts were designed according to aviation industry best practices;

3 The term "hazard" needs to be understood as a failure condition that relates to major, hazardous or catastrophic consequences.
4 MOC for Light-UAS.2510 (medium risk) will be defined by EASA at a later stage.
5 (a)2 is transposed from OSO 10/12 of EASA AMC and GM "*when operating over populated areas or assemblies of people it can be reasonably expected that a fatality will not occur from any single failure of the UAS or any external system supporting the operation*"

Light-UAS.2511 Containment

(a) No probable failure of the UAS or of any external system supporting the operation must lead to operation outside the operational volume.

(b) When the risk associated with the adjacent areas on ground or adjacent airspace is significantly higher than the risk associated with the operational volume including the ground buffer:

(1) the probability of leaving the operational volume must be demonstrated to be acceptable with respect to the risk posed by a loss of containment;

(2) no single failure of the UAS or of any external system supporting the operation must lead to its operation outside the ground risk buffer; and

(3) software and airborne electronic hardware whose development error(s) could directly lead to operations outside the ground risk buffer must be developed to a standard or methodology accepted by the Agency.

Note:
Compliance with the airworthiness standard referred to in point (a) should be substantiated by a design and installation appraisal and should include at least:

- The design and installation features (independence, separation and redundancy);

- Any relevant particular risk (e.g. hail, ice, snow, electro-magnetic interference, etc.) associated with the operation.

The EASA AMC and GM indicates how to determine whether the risk associated with the adjacent areas on the ground or adjacent airspace is significantly higher than the risk associated with the operational volume *(paragraph 2.5.3, Step #9)*

Compliance with the airworthiness standard referred to in points b (1) and (2) should be substantiated by analysis and/or test data with supporting evidence.

The use of the term 'directly' means that a development error in a software or an airborne electronic hardware would lead the UA outside the ground risk buffer without the possibility for another means to prevent the UA from exiting the operational volume.

Factors to be taken into account to determine the extension of the adjacent area include, but are not limited to, the Concept of Operations (CONOPS), the UA endurance range, and the failure modes which may lead to the exit of the UA from the operational volume.

The applicant should be aware that compliance with (a) only may constitute an obstacle for approval of the same operation in different settings with sufficient flexibility, as adjacent areas may easily change depending on the location. The EASA TC will provide the assumptions about the adjacent areas according to which Light-UAS.2511 has been demonstrated.

The probability referred to in (b.1) will be stipulated on the base of AMC to Light-UAS.2511. Elements to be taken into account include the assumptions proposed by the applicant for adjacent areas, the design of the UAS, the quantitative requirement expressed by AMC to CIR 947/2019 for "step 9", further elements which may arise from application of SC Light-UAS 2510.

Light-UAS.2512 Mitigation Means linked with Design

Design features intended to be used as mitigation means must be demonstrated with the adequate level of performance.

Note:
The level of performance will be determined considering integrity criteria for mitigation means expressed in the EASA AMC and GM

For mitigation means linked to ground risk the performance demonstration will be covered by the TC (e.g. the integration of a parachute or a frangible design). For tactical mitigation means linked with air risk, as per CIR 947/2019 the performance justifying the mitigation may have to be agreed upon with a different Authority when an operational authorization is applied for (e.g. the use of ADS-B for air risk mitigation must be discussed and agreed with the competent Authority of the Member State responsible for the affected volume of airspace). In the second case, the TC will validate the integration of the equipment in the UAS configuration, not the claimed mitigation.

Light-UAS.2515 Electrical and electronic system lightning protection

For a UAS where exposure to lightning is likely, each electrical or electronic system that performs a function, the failure of which would prevent the continued safe flight and landing or emergency recovery of the UA, must be designed and installed such that:

(a) the function at the UAS level is not adversely affected during or after the time when the UAS is exposed to lightning; and
(b) the system recovers normal operation of that function in a timely manner after the UAS is exposed to lightning unless the system's recovery conflicts with other operational or functional requirements of the system.

Note:
Lightning protection applies to the UA, the CU and the C2 link.

Light-UAS.2520 High-Intensity Radiated Fields (HIRF) Protection

For a UAS where the exposure to HIRF is likely each electrical and electronic system that performs a function, the failure of which would prevent the continued safe flight and landing or emergency recovery of the UA, must be designed and installed such that:

(a) the function at the UAS level is not adversely affected during or after the time when the UAS is exposed to the HIRF environment; and

(b) the system recovers normal operation of that function in a timely manner after the UAS is exposed to the HIRF environment, unless the system's recovery conflicts with other operational or functional requirements of the system.

Note:
A maximum HIRF Clearance Environment in which systems referred to in (a) and (b) of Light-UAS.2520 are not adversely affected could be defined appropriate for the operation / CONOPS. Associated limitations in the Flight Manual should be implemented in order to avoid operations where the defined HIRF Clearance Environment is exceeded.

Light-UAS.2528 UAS Envelope protection Function

(a) Where required for safe operation, the UAS must ensure that the UA remains within the limit flight envelope under foreseeable operating conditions, consistent with the system safety objectives of Light-UAS.2510.

(b) Characteristics of any envelope protection feature and combinations thereof must be appropriate for the phase of flight and type of maneuver.

(c) Limit values of protected flight parameters must be compatible with:

(1) structural limits;

(2) required safe and controllable maneuvering of the UA under anticipated operating conditions with adequate margins on specified limits;

(3) prevention of hazardous and catastrophic failure conditions;

(4) applicable lift/thrust/power system limitations; and

(5) dynamic effects due to maneuvering, lift/thrust/power system characteristics and external effects.

Note:
The UAS envelope protection function might be provided by systems or the inherent characteristics of the UA e. g. through a stall resistant design.

Light-UAS.2529 UAS Navigation Function

The UAS must ensure that the UA remains within the applicable spatial limitations or if applicable the intended flight path in all flight phases.

Note:
Spatial limitations are derived in the context of compliance to 2005

Light-UAS.2530 UA External lights

When required by operational rules:

(a) lights required for conspicuity at night must have the intensities, colors, and other characteristics to allow an observer to distinguish the UA from a manned aircraft;

(b) any position lights and anti-collision lights, must have the intensities, flash rates, colors, fields of coverage, position and other characteristics to provide sufficient time for another aircraft to avoid a collision;

(c) any position lights, must include a red light on the port side of the UA, and a green light on the starboard side of the UA spaced as far laterally apart as practical and a white light facing aft as far to the rear of the UA as practicable;

(d) a strobe light must be installed; and

(e) Taxi and landing lights, if installed, must perform as expected.

Note:
In (b) "sufficient time" should be intended as a function of ownship system latencies (decision time, processing time, communications latency, etc.), ownship dynamics and manoeuvring performance, and the relative velocity between the traffic pair.

Strobe Light: UA with relatively small wingspans may lack the physical separation required to prevent the red and green position lights from appearing to converge into a single light source and this may limit their use for collision avoidance.

Light-UAS.2575 Command, Control and Communication Contingency

(a) Where the safe operation of the UA requires command, control and communication functionality, the UAS must initiate adequate contingency procedures following a command, control or communication function loss or a degraded status which no longer ensures safe operation of the UA by the remote crew.

(b) The contingency procedures must be specified in the Flight Manual for the remote crew for each operational situation.

Note:
This airworthiness standard is linked with the C2 Link and has been kept under Subpart F as it relates not only with C2 Link but with how equipment and systems will manage the loss of command, control and communication.

SUBPART G – REMOTE CREW INTERFACE AND OTHER INFORMATION

Light-UAS.2600 Command Unit Integration

(a) This subpart is applicable to the UA in combination with Command Units to remotely control the UA.

(b) The type design of the UA must specify the Command Unit design and identify all equipment and systems of the CU that are essential for the crew to operate the UA.

(c) Equipment and systems of the CU must be designed and installed in accordance with subpart F.

(d) The type design of the UA needs to specify the design of the CU to the level of detail required to ensure compliance with this special condition and the identified design assurance levels.

(e) All necessary instructions, information and requirements for the safe and correct interface between the CU and the UA must be available.

(f) The Flight Manual shall address all combinations of Command Unit models accepted to control the UA.

(g) Design provisions and procedures for safe transfer of control within and between command units, remote crew handovers, and control link switchovers as foreseen for the operation need to be developed.

(h) Design provisions and procedures for safe handling during operation and when applicable for configuration, storage and transportation of the CU need to be defined.

(i) Procedures for installation and maintaining the CU in a condition for safe operation need to be made available in the Instructions for Continued Airworthiness (ICA) as prepared in accordance with Light-UAS.2625.

(j) The applicant needs to perform satisfactorily integration tests with all approved models of CU as necessary to verify the validity of the declared conditions and limitations and to ensure that the CU will operate satisfactorily and reliably using any C2 Link as specified under the anticipated operating conditions.

Light-UAS.2602 Command Unit

(a) The Command Unit must be adequate to support the command and control of the UA for the intended operations.

(b) The CU must provide an adequate work environment and human machine interface to allow for the safe execution of operations. The CU must allow the remote crew to perform their duties without excessive concentration, skill, alertness, or fatigue and its design shall consider human factors principles.

(c) The applicant needs to design the system controls and displays so that the remote crew can monitor and perform defined tasks associated with the intended functions of systems and equipment. The system and equipment must be designed to minimise the flight crew errors and must account for flight crew errors which could result in additional hazards.

Light-UAS.2605 Command Unit Installation and operation information

(a) The minimum number of crew members or the acceptable UA to crew ratio for safe operation of the CU and UAS must be established.

(b) Each item of installed equipment related to the remote crew interface must be labelled, if applicable, as for its identification, function, or operating limitations, or any combination of these factors.

(c) There must be a discernible means of providing system operating parameters required to operate the UA including warnings, cautions, and normal indications, to the responsible remote crew.

(d) Information concerning an unsafe system operating condition must be provided in a timely manner to the crew member responsible for taking corrective action. The information must be clear enough to avoid likely crew member errors.

(e) Information related to safety equipment must be easily identifiable and its method of operation must be clearly marked.

Light-UAS.2610 Instrument markings, control markings and placards

(a) The CU must display in a conspicuous manner any placard and instrument marking necessary for operation.

(b) The design must clearly indicate the function of each control, unless obvious.

(c) The applicant needs to include instrument marking and placard information in the Flight Manual.

Light-UAS.2615 Flight, navigation, and thrust/lift/power system instruments

Installed systems must provide the remote crew member, who sets or monitors parameters for the flight, navigation, and lift/thrust/power system the information necessary to do so during each phase of flight. This information must:

(a) be presented in a manner that the crew members can monitor the parameters and trends, as needed to operate the UA; and

(b) include limitations, unless the limitation cannot be exceeded in all intended operations.

Light-UAS.2620 Flight Manual

The applicant needs to provide a Flight Manual containing the following information:

(a) operating limitations and procedures, for the intended operation;

(b) performance information;

(c) loading information;

(d) procedures and limitations for transportation, reconfiguration and storage;

(e) instrument marking and placard information; and

(f) any other information necessary for the safe operation of the UAS.

Light-UAS.2625 Instructions for Continued Airworthiness (ICA)

(a) The applicant needs to prepare Instructions for Continued Airworthiness that are appropriate for the UAS design and intended operation.

(b) The Instructions for Continued Airworthiness must contain a Section titled 'Airworthiness limitations' that is segregated and clearly distinguishable from the rest of the document. This Section must contain a legible statement in a prominent location that reads: 'The Airworthiness limitations Section is approved and variations must also be approved'.

SUBPART H – C2 LINK

Light-UAS.2710 General Requirements

(a) This subpart is applicable for C2 Link command, control and communication function required for the safe operation of the UA.

(b) C2 link performances must be specified as part of the Type Design of the UA

(c) C2 Link Performance needs to be provided in the Flight Manual.

Light-UAS.2715 C2 Link Performances

(a) The C2 link performance must be adequate to ensure safe operation and must be protected from external interference.

(b) The C2 Link system message sequencing must be such to preserve the safety of the operation.

Note:
Usage of frequency spectrum is not approved as part of the Type Certificate

As per EASA AMC and GM and EASA SC-RPAS.C2-01 the main parameters that can be utilized to qualify the performance of a C2 link (RLP) and of other communication links (e.g. RCP for communication with ATC) include, but are not limited to, effective range, latency, availability, continuity, integrity.

C2 Link system and performances shall be addressed as part of Light-UAS.2510.

Light-UAS.2720 C2 Link Performance monitoring

If required for safe operation:

(a) the UAS remote crew must have the means to continuously monitor C2 link performance and ensure that it continues to meet the identified required operational performance; and

(b) appropriate technical and procedural means must be provided to the remote crew to establish and maintain the C2 link, including, where applicable, the interaction with the Command & Control Communication Service (C2CSP). The Applicant needs to provide these means within the Flight Manual.

Light-UAS.2730 C2 Link Security

(a) Information exchange between the Command Unit and the UA via the C2 Link must be secure to prevent unauthorized interference with the UA.

(b) The C2 Link system must enable the UA to unambiguously and at any time ensure that it is controlled by an authorized Command Unit.