



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

UAS / RPAS AIRWORTHINESS CERTIFICATION “1309” System Safety Objectives and Assessment Criteria

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July 2013

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FOREWORD

1. This document was prepared by EUROCAE Working Group 73 “Unmanned Aircraft Systems (UAS)”.
2. EUROCAE is an international non-profit making organisation in Europe. Membership is open to manufacturers and users of equipment for aeronautics, trade associations, national civil aviation administrations, and, under certain conditions, non-European organisations. Its work programme is principally directed to the preparation of performance specifications and guidance documents for civil aviation equipment, for adoption and use at European and world-wide levels.
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4. EUROCAE performance specifications and other documents are recommendations only. EUROCAE is not an official body of the European Governments. Its recommendations are valid as statements of official policy only when adopted by a particular government or conference of governments.
5. The purpose of this EUROCAE report is:
 - on one hand, to summarize the results of the debates and reviews which took place within the EUROCAE Working Group WG73 on selected major topics relating to Unmanned Aircraft System (UAS) / Remotely Piloted Aircraft System (RPAS) Objectives and Assessment criteria
 - on the other hand, to provide a set of subsequent recommendations to the official bodies, such as the EASA and European Commission, as identified in the European RPAS Steering Group Roadmap issued in June 2013 (Annex 1, line 13B).
6. The report aims at eventually supporting the establishment of a specific UAS Acceptable Means of Compliance AMC1309 to be included in a future set of Civil UAS Certification Specifications to be issued by EASA, as a follow up of the current EASA Policy Statement – Airworthiness Certification of Unmanned Aircraft Systems (UAS) E.Y013-01, 25th August 2009 and of the EUROCAE ER-004 Volume 3, “A Concept for UAS Certification and Airworthiness Approval – UAS Airworthiness Certification”. As such, it is principally oriented towards UAS currently under the remit of EASA (above 150 kg) albeit that some principles and recommendations could be utilized for Unmanned Aircraft below 150 kg as well.
7. Copies of this report may be obtained from

EUROCAE
102 rue Etienne Dolet
92240 MALAKOFF
FRANCE

Tel: 33 1 40 92 79 25

Fax: 33 1 46 55 62 65

Email: eurocae@eurocae.net

Web Site: www.eurocae.net

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Unmanned aircraft are considered to be aircraft and hence, in a way, similar to manned aircraft, need a Type Certificate. This Type Certificate is to cover the airworthiness of the entire Unmanned Aircraft System (UAS) / Remotely Piloted Aircraft Systems (RPAS)¹, as specified in the Type design. The UAS airworthiness requirements shall eventually be laid down in codes like the EASA Certification Specifications (CS). Of these requirements, requirement 1309 is of major importance since it sets the System Safety Objectives and Assessment criteria, which are elaborated in the associated AMC (Acceptable Means of Compliance) in conjunction with a complete set of airworthiness requirements. In particular, this AMC.1309 provides a methodology to identify and classify the failure conditions severities and to derive the required probability requirements and Design Assurance Levels (DAL).

It has been recognized by all stakeholders that the UAS Type Certification basis should adapt the airworthiness requirements and criteria used for manned aircraft, in order to take due account of the specific character of UAS applications, including the shift of the risk² from the crew and passengers on board to the third parties on the ground³ or in the air.

Defining the appropriate System Safety Objectives and Assessment criteria for UAS at an early stage of the UAS rule-making process is crucial for both UAS development manufacturers and authorities since it has a direct impact on

- The overall safety level of UAS operations
- The architecture (e.g. redundancies and complexity) of the UAS
- The related amount of substantiation, development and certification effort and subsequent economic repercussions.

The current manned aircraft certification specifications, requirements and acceptable means of compliance are primarily stated in CSxx.1309 and corresponding AMC and may considerably differ depending on the applicable airworthiness code (CS 23, CS 25, CS VLA, CS 27, CS 29, CS VLR). This is typically the case for the failure probability requirements or for the single failure criteria.

While some overall principles have been proposed (see section 4.1), there are no firm and detailed criteria yet which have been agreed that would allow conducting System Safety Assessment in a similar way as performed in the case of manned aircraft Type Certification.

1.2 SCOPE AND PURPOSE

EUROCAE WG-73 has reviewed and debated the topics related to UAS Safety objectives and assessment criteria.

This document addresses UAS applications with no people onboard (see note 1).

The purpose of this EUROCAE report is, on one hand to sum up the results of these debates and reviews on selected major topics (see section 3) and on the other hand to provide a set of subsequent recommendations to the official bodies, such as the EASA and European Commission, as also identified in the ERSG Roadmap (ref.[8]).

¹ The term unmanned aircraft will be used in this document which addresses both UAS and RPAS.

² In this document, the term "risk" combines both severity and probability of occurrence.

³ The term "on the ground" is used generically throughout the document but should be understood as on any surface where a risk to a third party may occur.

The report is to support the establishment of a specific UAS AMC 1309 to be included in a future set of UAS Type Certification requirements as a follow up of the current EASA Policy Statement – Airworthiness Certification of Unmanned Aircraft Systems (UAS) E.Y013-01, 25th August 2009 (ref. [3]), and of EUROCAE ER-004 Volume 3 (ref. [4], “A Concept for UAS Certification and Airworthiness Approval – UAS Airworthiness Certification”). As such, it is principally oriented towards UAS currently under the remit of EASA (above 150 kg) albeit that some principles and recommendations could be utilized for Unmanned Aircraft below 150 kg as well.

NOTE 1: *It is assumed that standard practices and safety assessment methodology (qualitative and quantitative) to assess Unmanned Aircraft System against the proposed Safety Objectives and criteria as currently detailed in manned AMC 1309 may be largely replicated in the case of UAS and therefore are not covered by this document.*

NOTE 2: *This document addresses unmanned aircraft with no people on board. Unmanned aircraft with people on board (but no crew on board) are likely to be subject to a different set of airworthiness requirements and safety objectives.*

1.3

STRUCTURE OF THE DOCUMENT

This document is structured as follows

- Section 1 presents a general introduction, the scope and purpose and the structure of the document.
- Section 2 identifies the main references of the supporting documents⁴.
- Section 3 reviews the considered approaches and provides a review of UAS "1309" topics which are under focus and have been subject to continuous debate over the past years. It includes reference to a EUROCAE WG-73 survey illustrating the outstanding consensual and non-consensual areas resulting from these debates.
- Section 4 and related appendices provide for each topic listed in Section 3 :
 - o A statement of the issue
 - o A summary overview of different related approaches as proposed by various stakeholders and debated within EUROCAE WG-73
 - o A subsequent recommendation.
- Section 5 presents the general conclusions of this report.

⁴ Only officially published documents are referred here. Other draft documents such as internal EUROCAE WG-73 Work Papers have also supported this document. Some other documents, not officially released, are quoted in the appendices.

1.4 ABBREVIATIONS

Abbreviation Term	Meaning
AC	Advisory Circular
AMC	Acceptable Means of Compliance
ARP	Aerospace Recommended Practice
ATC	Air Traffic Control
AWO	All Weather Operations
AWFT	Air Worthiness Focus Team
C2	Command and Control
CA	Collision Avoidance
CAT	Commercial Air Transport
CFR	Code of Federal Regulations
CS	Certification Specification
CS – AWO	Certification Specification for All Weather Operations
DAL	Design (or Development) Assurance Level
DGA	Délégation Générale pour l'Armement
EASA	European Aviation Safety Agency
EC	European Commission
EDA	European Defence Agency
ERSG	European Commission RPAS Steering Group
EUROCAE	European Organisation for Civil Aviation Equipment
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FINAS	Flight In Non-Segregated Airspace
FP	Flight Path
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
JAA	Joint Aviation Authorities
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
MIDCAS	Midair Collision Avoidance System (EDA project)
NATO	North Atlantic Treaty Organization
NPA	Notice of Proposed Amendment
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
SA	Separation Assurance
SMS	Safety Management System
STANAG	NATO Standardization Agreement

Abbreviation Term	Meaning
TCAS	Traffic Collision Avoidance System
TF	Task Force
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
USAR	UAV Systems Airworthiness Requirements
VFR	Visual Flight Rules
VLA	Very Light Aircraft
VLR	Very Light Rotorcraft
VMC	Visual Meteorological Conditions
WG-73	(EUROCAE) Working Group 73

CHAPTER 2

REFERENCES

- [1] JAA-EUROCONTROL Task Force Final Report: A Concept for European Regulations for Civil Unmanned Aerial Vehicles (UAVs): 11th May 2004.
- [2] EASA A-NPA 16/2005 dated February 2005.
- [3] EASA Policy Statement – Airworthiness Certification of Unmanned Aircraft Systems (UAS) E.Y013-01, 25th August 2009.
- [4] EUROCAE ER-004 Volume 3: “A Concept for UAS Certification and Airworthiness Approval – UAS Airworthiness Certification”.
- [5] STANAG 4671 (USAR) Ed 1, 3 September 2009: Unmanned Aerial Vehicles System Airworthiness Requirements.
NOTE: This STANAG is based on the USAR, developed by the French Military Authorities, and later updated by NATO FINAS group to STANAG 4671.
- [6] ICAO Circular 328 AN/90 Unmanned Aircraft System.
- [7] ICAO Annex 2 Amendment 43.
- [8] Roadmap for the integration of civil Remotely-Piloted Aircraft Systems into the European Aviation System, Final Report from the European RPAS Steering Group, June 2013.

CHAPTER 3

UAS 1309 TOPICS UNDER DEBATE

EUROCAE WG-73 has extensively discussed topics related to UAS Safety Objectives and Assessment criteria. These can be listed as follows:

- Overall guiding principle
- Interrelation between Airworthiness and Operational Aspects
- Failure Severity Definition and Classification
- Quantitative Probability Requirements
- UAS Categorization.

Different approaches regarding above topics have been reviewed and debated within EUROCAE WG-73, whose members represent industry, authorities, research institutes, and airspace users.

Considering the complexity of the issue, EUROCAE WG 73 organized a survey in order to review and better identify the different interpretations and rationales relating to the following topics:

- Current EASA Guiding Principles as stated in EASA Policy (ref. [2])
- Probability Requirements
- Airworthiness versus Operations.

This survey has identified the extent to which the stakeholders have consensus on these topics, and where there is, currently, no consensus. This survey has proven to be useful in better formulating the common and parallel approaches or rationales behind those consensual and non-consensual areas; its results are summarized in Appendix 1 and are subsequently taken into account in the following sections of this report.

CHAPTER 4

CONSIDERED APPROACHES - SUBSEQUENT RECOMMENDATIONS

This section provides for each topic identified in previous section the following:

- A statement of the issue
- An overview of different approaches still outstanding as proposed by various stakeholders and debated within EUROCAE WG-73 over the past years
- A subsequent recommendation.

4.1 OVERALL GUIDING PRINCIPLE

4.1.1 Statement of the issue

The issue here is to define an overall guiding principle that may be used as the starting point to develop more detailed quantitative UAS System Objectives and Assessment criteria for designers, manufacturers and operators of these systems.

4.1.2 Considered approaches

Appendix 2 provides the detailed wording of some outstanding principles as currently formulated by different bodies. One may summarize the different formulations as follows:

- (a) Broad terms with reference to manned aircraft safety or risk level ("Equivalent safety" or "Do not harm more") such as EASA UAS Airworthiness Policy ref. [3]
- (b) Broad terms with no direct reference to manned aircraft safety level ("Minimize hazards to persons, property or other aircraft") such as ICAO Annex 2 Amendment 43 ref. [7] or recently issued ERSG Roadmap ref. [8]
- (c) Broad terms with reference to a minimum level of airworthiness corresponding to EASA CS-23 or FAA FAR Part 23 requirements whilst recognizing the specific characteristics of UAS such as NATO STANAG 4671 ref. [5].

EASA UAS Airworthiness Policy ref. [3] is confined to risk on the ground while other references address risk in the air as well. See also section 4.2.

4.1.3 Recommendations

The above outstanding guiding principles bear the following difficulties:

- (a) The comparison with manned aircraft bears inherent difficulties of interpretation due to the different nature of unmanned aircraft and due to the shift of the risk from the crew and passengers on board to the third parties on the ground or in the air
- (b) The concept of minimizing the hazard, while being not specifically related to manned aircraft, leaves room for interpretation
- (c) Reference to a specific minimum level such as CS-23 may be a possible approach but may be too specific at the level of an overall guiding principle.

It is thus proposed to state an overall guiding principle as follows

UAS shall be designed and operated in such a manner that the risk to third parties on the ground or in the air is acceptable.

Detailed interpretation of this principle is covered under section 4.4.