



**JARUS WG6 - EUROCAE WG73 AIRWORTHINESS  
AMC RPAS.1309 "CONCILIATION" TEAM REPORT**

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The views expressed in this document represent the consensus views of the members of the JARUS WG6 - EUROCAE WG73 Airworthiness "1309" conciliation team mentioned above, for further consideration by relevant regulatory bodies, and may not necessarily represent the views of their associated bodies.

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## ABSTRACT

This report presents the results of the discussions between members of the Airworthiness Subgroup of EUROCAE WG73 and JARUS WG6 as a conciliation team that was established in order to analyse and review their different approaches with regard to a future civil AMC RPAS.1309, and conciliate their views as far as possible.

The conciliation team reviewed eight "1309" related major topics that were identified in comparison between EUROCAE ER-010 and JARUS AMC RPAS.1309 issue 2 as currently proposed to form the basis of a future AMC RPAS.1309. This report describes the common understandings that the conciliation team reached on the eight topics and the associated recommendations in EUROCAE ER-010, as well as on the rationale and underlying assumptions behind the detailed criteria related to these topics in JARUS AMC RPAS.1309 issue 2.

The conciliation team identified ways to reconcile the positions of JARUS WG6 and EUROCAE WG73 for most of the topics, identified the dependencies necessary to reconcile the remaining positions (including dependencies on other JARUS WGs) while also considering the emerging European regulatory framework ('three pillars concept') and the recommended proportionate and risk-based approach therein.

It is intended that, wherever relevant, the results of this conciliation effort, as described in this report, will be reflected in the next issue of JARUS AMC RPAS.1309 (Issue 3) and potentially within the subsequent EASA NPA, although the NPA is outside the scope of the conciliation team responsibility.

Follow-up actions have also been defined, namely: proposing to create some generic RPAS FHA examples to be used as additional guidance and as validation of a classification based on high-level failure scenarios and severity definitions, and to continue the coordination between JARUS WG6 and EUROCAE WG73 with regard to the risk assessment methodology to be applied for the "Specific category" of RPAS.

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## **1 INTRODUCTION**

### **1.1 GENERAL BACKGROUND**

Annex 1 of the European RPAS Roadmap (Ref. [1]), issued in June 2013, calls for two inputs to the process that should eventually lead to the issuance of an EASA Decision on AMC RPAS.1309 for safety objectives for airworthiness of civil RPA > 150 kg:

- One from JARUS (line 13A): “Draft RPAS safety objectives for airworthiness (RPA of any weight)”;
- One from EUROCAE WG73 (line 13B): “WG73 Report on alternative approaches on UAS safety objectives for airworthiness of RPA > 150 Kg and subsequent recommendations”.

JARUS WG6 officially released Issue 1 of JARUS AMC RPAS.1309 (together with a scoping paper) for public comments in March 2014. The comments received have been reviewed by JARUS WG6 members and addressed in Issue 2 (Ref. [3] and [4]) of the documents. The final publication of these papers was, however, halted pending on the results of the JARUS WG6 – EUROCAE WG73 AW Subgroup conciliation team.

EUROCAE WG73 technical report ER-010, titled "UAS / RPAS Airworthiness Certification - "1309" System Safety Objectives and Assessment Criteria" (Ref. [2]), was formally issued in July 2013. ER-010 summarizes the results of a review of the topics related to UAS safety objectives and assessment criteria, and focuses on eight high level RPAS "1309" related topics and provides recommendations for these.

Considering the differences between these two reports, the idea of a conciliation team between the two groups was launched in February 2015 under the initiative of the JARUS Chairman and in due coordination with the EUROCAE WG73 Leadership team. This conciliation team should set the ground for the future EASA NPA about AMC RPAS.1309 by achieving consensus on these differences as much as possible before this NPA would be released for public comments.

This conciliation team was subsequently created, with three members of JARUS WG6 and three members of the Airworthiness Subgroup of EUROCAE WG73; the Statement of Work (SOW) was established and agreed on June 9<sup>th</sup>, 2015 (see Appendix 1).

### **1.2 PURPOSE OF THE REPORT**

The report provides the results of the discussions held by the members of the conciliation team in line with the agreed SOW and the working methodology described in section 3.

It is intended that, wherever relevant, the results of this conciliation effort, as described in this report, will be reflected in the next issue of JARUS AMC RPAS.1309 (Issue 3) and potentially within the subsequent EASA NPA, although the NPA is outside the scope of the conciliation team responsibility.

### **1.3 STRUCTURE OF THE REPORT**

This document is structured as follows:

- Section 1 presents an overall introduction, including the general background, the purpose and the structure of the report.
- Section 2 identifies the main references related to this report.
- Section 3 describes the working methodology applied by the conciliation team.
- Section 4 evaluates the possible impact of recent changes in the proposed European regulatory framework for drones, notably the ‘three pillars concept’ proposed by EASA.
- Section 5 presents the final joint conciliation statements in relation to major 1309 topics, in line with the working methodology described in Section 3.
- Section 6 presents the main conclusions and proposed follow-up actions.
- Section 7 presents the list of abbreviations used in this report.
- Appendix 1 provides the agreed Statement of Work for the conciliation team.
- Appendix 2 reviews the major 1309 topics providing for each of them the statement of the issue, the ER-010 recommendations, the initial JARUS WG6 statement and the EUROCAE WG73 initial response, which have eventually led to the joint conciliation statements presented in Section 5.



## 2 REFERENCES

- [1] Roadmap for the integration of civil Remotely-Piloted Aircraft Systems – June 2013  
Report from European RPAS Steering Group – Annex 1: A Regulatory Approach for the integration of civil RPAS into the European Aviation System
- [2] EUROCAE ER-010 dated July 2013 : UAS / RPAS Airworthiness Certification, "1309"  
System Safety Objectives and Assessment Criteria
- [3] JARUS AMC RPAS.1309 Issue 2 dated April 2015, Safety Assessment of Remotely Piloted Aircraft Systems
- [4] Scoping paper to JARUS AMC RPAS.1309 Issue 2 dated April 2015
- [5] European Union Riga Declaration dated March 6th, 2015 on Remotely Piloted Aircraft (Drones) : "Framing the future aviation"
- [6] EASA A-NPA 10/2015 July 2015 Introduction of a regulatory framework for the operation of drones
- [7] JARUS WG6 – EUROCAE WG73 Conciliation Team - Minutes of meeting held on 25 June 2015
- [8] JARUS WG6 – EUROCAE WG73 Conciliation Team - Minutes of meeting held on 13-14 October 2015

### 3 WORKING METHODOLOGY

In line with the agreed Statement of Work (see Appendix 1), the working methodology that has been applied was based upon the review of:

- Eight major "1309" related topics identified in EUROCAE ER-010, and the recommendations associated with these:
  - Overall guiding principle
  - Interrelation between airworthiness and operations
  - Failure severity definition and classification
  - Quantitative probability requirements: risk on the ground
  - Quantitative probability requirements: risk in the air
  - Fail safe criteria
  - Development Assurance Levels (“DAL”)
  - RPAS categorization.

*Note: Whilst the above list does not necessarily represent an exhaustive list of all the 1309 related topics, it was established by EUROCAE WG73 because of their major impact on future AMC RPAS.1309 and because of the variety of opinions expressed about them.*

- The rationale and assumptions behind the detailed criteria in JARUS AMC RPAS.1309 (Issue 2) for these eight topics.
- The possible way(s) to reconcile the differences between these two approaches, while also considering the emerging European regulatory framework (‘three pillars concept’) and the recommended proportionate and risk-based approach therein.

The conciliation team decided to perform this review by using a "conciliation matrix" (see Appendix 2) as a working tool which indicates for each of the eight above mentioned topics:

- ER-010 Statement of the Issue
- ER-010 Recommendation
- Initial JARUS WG6 statement related to this topic, referring to Issue 2 of the proposed JARUS AMC RPAS.1309
- Initial EUROCAE WG73 statement, in response to the above initial JARUS WG6 statement.

During the second meeting (Ref. [8]), the conciliation team drafted a joint conciliation statement for each of the eight topics; the finalized version of this statement is presented in Section 5 of this report.

In order to achieve the results presented in this report, the conciliation team had:

- A kick-off meeting on June 25th, 2015 (minutes as per Ref. [7])
- A WebEx conference on July 14th, 2015 in order to launch the work on the conciliation matrix, and
- A face-to-face meeting on October 13-14th 2015 (minutes as per Ref. [8]).

#### 4 IMPACT OF RECENT CHANGES IN REGULATORY FRAMEWORK

After the issuance of EUROCAE ER-010 in September 2013 and the first issue of JARUS AMC RPAS.1309 in March 2014, the European Commission issued the Riga Declaration (Ref. [5]) on March 6<sup>th</sup>, 2015, which proposes to apply a proportionate and risk-based approach when establishing a new regulatory framework for RPAS (re-designated as "drones" in this Declaration).

EASA subsequently published A-NPA 10/2015 (Ref. [6]) with a new regulatory framework for the operation of drones and introducing the so-called 'three pillars' concept by defining three basic categories, which may be summarized as follows:

- "Open": by considering parameters such as VLOS, maximum altitude and distance from airport, and maximum weight, there is no need for a dedicated further risk assessment and involvement of a Civil Aviation Authority (CAA).
- "Specific" (one operational approval certificate only, under the operator responsibility) corresponding to the following parameters:
  - It does not meet the criteria of the open category
  - It is a new category introduced in order to issue RPAS operational approval outside the traditional regulatory framework.

The risks are mitigated by an operations centric risk assessment, through a risk assessment model which still has to be established.

- "Certified", characterized by the fact that it will use the traditional regulatory framework and set of certificates (including TC/RTC and operational approval); an appropriate RPAS certification basis will have to be defined, considering also the kind of envisaged operations.

Whilst A-NPA 10/2015 is currently subject to the normal EASA consultation and rule-making process, it has had to be assumed that the underlying principles will remain unchanged. Consequently, the conciliation team agreed to take due consideration of these emerging principles in its discussions, with the understanding that:

- The "1309" requirement and related AMC will only be required in the framework of the "Certified" category.
- The application of the "1309" methodology may however be used as a support to the risk assessment for the "Specific" category.
- The overall levels of safety achieved when applying the risk assessment method under the "Specific" category should be comparable to those achieved when applying the process under "Certified" category.

Should fundamental changes arise after the completion of the EASA rule-making process as compared to the above assumptions, the conclusions of this report may have to be re-visited.

## **5 MAJOR "1309" TOPICS: SUMMARY REVIEW AND RESULTS**

As stated above under Section 3, Appendix 2 provides the detailed review of the major 1309 related topics (eight selected items) leading to a conciliation statement jointly established by the members of the conciliation team. This Section presents these joint conciliation statements, each preceded by the statement of the issue.

### **5.1 OVERALL GUIDING PRINCIPLE**

#### **5.1.1 STATEMENT OF THE ISSUE**

An overall guiding principle that may be used as the starting point to develop more detailed quantitative UAS system probability requirements should be defined.

#### **5.1.2 JOINT CONCILIATION STATEMENT**

- a) The members of the conciliation team agree with the principle of designing and operating RPAS in such manner that the risk to third parties on ground or in the air is acceptable.
- b) The interpretation(s) and the way(s) to convert this guiding principle into safety objectives are addressed in sections 5.4 and 5.5.

### **5.2 INTERRELATION BETWEEN AIRWORTHINESS AND OPERATIONS**

#### **5.2.1 STATEMENT OF THE ISSUE**

Considering the specific character of UAS operations and the stronger interrelation between RPAS airworthiness and operational aspects, recommendations should be made as to whether the conventional manned approach of splitting requirements for TC and requirements for operational approval may or may not be applicable in the case of RPAS.

#### **5.2.2 JOINT CONCILIATION STATEMENT**

- a) The members of the conciliation team agree that the approach to consider the operational environment and operations that might have a direct impact on RPAS airworthiness and safety requirements in all categories is currently envisaged by EASA's three pillar concept.
- b) It was also agreed that this approach cannot be addressed by the AMC RPAS.1309 alone but should be covered by the entire RPAS regulatory framework, namely as currently envisaged by EASA in the three pillars concept.

### **5.3 FAILURE SEVERITY DEFINITION AND CLASSIFICATION**

#### **5.3.1 STATEMENT OF THE ISSUE**

Manned failure severity provides a scheme to classify the severity of failures according to their impact on safety, notably of the aircraft and its occupants. Since RPAS do not carry occupants, this classification may have to be reviewed and tailored to the specific character of RPAS.

#### **5.3.2 JOINT CONCILIATION STATEMENT**

- a) The members of the conciliation team agree that JARUS AMC RPAS.1309 Issue 2 provides high-level severity definitions which are considering potential end effects on third parties, RPAS crew and separation assurance.

- b) ER-010 in Appendix 4 contains a classification guideline based on high level (single and multiple) failure scenarios.
- c) It is agreed that it would be useful to coordinate to provide examples of Functional Hazard Assessments that would correlate these classifications based on high level failure scenarios and high-level severity definitions for particular RPAS and associated operations.
- d) These examples will also contribute to validating both the classification based on high level failure scenarios (as proposed in EUROCAE ER-010) and the severity definitions (as proposed in JARUS AMC RPAS.1309).

## **5.4 QUANTITATIVE PROBABILITY REQUIREMENTS: RISK ON THE GROUND**

### **5.4.1 STATEMENT OF THE ISSUE**

Although the exact wording of requirement 1309 for manned aircraft differs among the distinctive codes, in general terms it sets requirements for the design of equipment, systems, and installations based on the occurrence probability and severity of failures which could affect continued safe flight and landing. In assessing the acceptability of a design, the need to establish rational probability values for manned aircraft has been recognized (e.g. FAA AC 23.1309 or EASA AMC 25.1309) based on accident rates to establish acceptable probabilities of these failures.

Likewise, any AMC RPAS.1309 needs explicit quantitative probability requirements; the issue is how these can be established, while reflecting in an appropriate manner the safety of third parties on the ground.

### **5.4.2 JOINT CONCILIATION STATEMENT**

- a) As a starting point, ER-010 recommends defining a specific target value for the acceptable probability for ground fatalities expressed in probability of a ground fatality per flight hour in line with the principle set forth in Item 1 (see paragraph 5.1); it should be used to subsequently derive an acceptable RPAS probability requirement.
- b) JARUS WG6 worked on the principle that "RPAS must not present a greater risk to persons or property on the ground or in the air than that attributable to manned aircraft of equivalent category".
- c) The members of the conciliation team agree with the principle that for a product under the "Certified" category, the risk to third parties on the ground posed by unmanned aircraft shall be not more than the one implicitly posed by an equivalent manned aircraft.
- d) JARUS WG6 further elaborated the concept in Section 11 of the Scoping Paper to demonstrate that this principle can be achieved for an unmanned aircraft under the "Certified" category (assumed to be allowed to fly in similar operating conditions as the equivalent manned aircraft) by maintaining the accident rate for the unmanned aircraft the same as for the equivalent manned aircraft.

- e) The members of the conciliation team agree that, under the assumption of equivalency, this approach meets the goal set forth by ER-010 (i.e. derive an acceptable RPAS probability requirement). It does that, however, by deriving the acceptable RPAS probability requirements under the principle that risk to people on ground by the unmanned aircraft shall be kept the same as the risk by an equivalent manned aircraft, in deviation from the ER-010 recommendation which proposed to set a specific target value for the probability of ground fatalities. Nevertheless the members of the conciliation team agree that, with the given equivalency assumptions, the method proposed in JARUS AMC RPAS.1309 is valid.

*Note: Using the risk equation stated in Issue 2 of the Scoping Paper to JARUS AMC RPAS.1309 paragraph 11.1(f) 'Risk = f (accident rate, population density, impact dynamics, area of impact)' this is tantamount to assuming that, in this case, the parameters "population density", "impact dynamics", "area of impact" for an unmanned aircraft and its equivalent manned aircraft are the same because of this equivalence.*

- f) For those unmanned aircraft for which equivalence with manned aviation cannot be achieved, such as when the RPAS is much smaller than any manned aircraft, the JARUS WG6 proposed a flat-lined accident rate of  $10^{-4}/\text{fh}$ . This proposed target is not in line with the ER-010 recommendation of setting a specific target value for the risk before deriving the RPAS accident rate requirements.
- g) However, a conciliation opportunity could arise as the safety target value approach recommended by ER-010 is intended to be used to support the risk assessment methodology being developed by WG6. This methodology will be required under the "Specific" category which includes those cases not covered under the equivalency assumption.
- h) This risk assessment methodology could also provide valuable inputs for the "Certified" category for those cases that are not covered in JARUS AMC RPAS.1309 Issue 2.
- i) It could also be used to validate the results of the methodology set forth in JARUS AMC RPAS.1309 Issue 2 and ensure appropriate consistency between the risk levels of the "Specific" and "Certified" categories.
- j) The members of the conciliation team recommend that further coordination between JARUS WG6 and EUROCAE WG73 is established (with appropriate procedures).

## 5.5 QUANTITATIVE PROBABILITY REQUIREMENTS: RISK IN THE AIR

### 5.5.1 STATEMENT OF THE ISSUE

Although the exact wording of requirement 1309 for manned aircraft differs among the distinctive codes, in general terms it sets requirements for the design of equipment, systems, and installations based on the occurrence probability and severity of failures which could affect continued safe flight and landing. In assessing the acceptability of a design, the need to establish rational probability values for manned aircraft has been recognized (e.g. FAA AC 23.1309 or EASA AMC 25.1309) based on accident rates to establish acceptable probabilities of these failures.

In addition, for unmanned aircraft, separation assurance and collision avoidance may rely more on equipment to perform these tasks.

Similar to the issue of the safety of third parties on the ground, the question is how quantitative probability requirements should be established for the airworthiness approval of unmanned aircraft equipment performing these tasks in a manner consistent with the overall safety target set for mid-air collision.

#### **5.5.2 JOINT CONCILIATION STATEMENT**

- a) The proposal in JARUS AMC RPAS.1309 Issue 2 sets a possible method to define probability and development assurance requirements for DAA functions.
- b) This method does consider the accounting of probabilities related to external factors such as ATC, airspace. However, in absence of target level of safety for the various combinations (e.g. different aircraft, RPAS, airspaces) it suggests the use of the "protection function" criteria set forth in the ED-79A.

*Note: The failure scenarios in ER-010 that are mentioned in Section 5.3 also include scenarios for the failure of separation assurance and collision avoidance (distinctively envisaged).*

- c) The members of the conciliation system agree to postpone the discussion on this topic until the work of other groups dealing with DAA will be completed.

### **5.6 FAIL-SAFE CRITERIA**

#### **5.6.1 STATEMENT OF THE ISSUE**

The fail-safe criteria is applied in manned aviation by either strict enforcement (regardless of probability) or with consideration of failure probability. For RPAS it is recommended to combine both approaches by taking into account the probability and by trying to minimize single failures leading to fatal injuries.

#### **5.6.2 JOINT CONCILIATION STATEMENT**

- a) The members of the conciliation team agree that the 'no single failure' criterion on catastrophic failure conditions is a sound design principle.
- b) The members of the conciliation team also agree that for systems for which the 1309 requirement applies, the 'no single failure' criterion shall also apply.
- c) The extent of the applicability of the 1309 requirement to an RPAS system can only be clarified when defining the initial airworthiness requirements for that RPAS system.

### **5.7 DEVELOPMENT ASSURANCE LEVELS ("DAL")**

#### **5.7.1 STATEMENT OF THE ISSUE**

The definition of Development Assurance Levels (DAL) as appropriate to RPAS should be established.

#### **5.7.2 JOINT CONCILIATION STATEMENT**

- a) The members of the conciliation team agree that the DAL should be determined in a manner consistent with the probability objectives set forth in the future AMC RPAS.1309.

- b) It is well understood that development of software and airborne electronic hardware to a given DAL does not imply the assignment of a failure rate to that software or airborne electronic hardware.
- c) However, when applying the DAL processes and activities, to remain coherent with the probability requirement associated with failure condition severity classification for different classes of RPAS, the members of the conciliation team agree that:
  - DAL A development gives confidence that the manifestation of a possible remaining error is consistent with a quantitative safety objective  $\leq 10^{-9}/\text{fh}$ .
  - DAL B development gives confidence that the manifestation of a possible remaining error is consistent with a quantitative safety objective of  $10^{-7}/\text{fh} \leq P < 10^{-9}/\text{fh}$ .
  - DAL C development gives confidence that the manifestation of a possible remaining error is consistent with a quantitative safety objective of  $10^{-5}/\text{fh} \leq P < 10^{-7}/\text{fh}$ .
  - DAL D development gives confidence that the manifestation of a possible remaining error is consistent with a quantitative safety objective of  $>10^{-5}/\text{fh}$ .

## 5.8 RPAS CATEGORIZATION

### 5.8.1 STATEMENT OF THE ISSUE

The issue is whether the detailed AMC RPAS.1309 failure probability requirements apply to all types of unmanned aircraft or whether they may vary according to some categorization of RPAS.

### 5.8.2 JOINT CONCILIATION STATEMENT

- a) Similarly to item 4 (see paragraph 5.4), a conciliation opportunity could arise as the safety target value approach recommended by ER-010 is intended to be used to support the risk assessment methodology being developed by WG6.
- b) This methodology will be required under the “Specific” category which includes those cases not covered under the equivalency assumption and potentially requiring additional categorization.
- c) This novel approach could also provide valuable inputs for the “Certified” category for those cases not covered in JARUS AMC RPAS.1309 Issue 2. It could also be used to validate the results of the methodology set forth in JARUS AMC RPAS.1309 Issue 2.
- d) The members of the conciliation team recommend that further coordination between JARUS WG6 and EUROCAE WG73 is established (with appropriate procedures).



## **6 CONCLUSIONS AND FOLLOW-UP ACTIONS**

### **6.1 MAIN CONCLUSIONS**

The members of the conciliation team agree on the following main conclusions:

- a) The objectives set forth for the conciliation team in the agreed Statement of Work (Appendix 1) have been satisfactorily achieved.
- b) They have jointly reviewed the eight 1309 major topics and associated recommendations that were identified in EUROCAE ER-010 in comparison with JARUS AMC RPAS.1309 issue 2.
- c) They have reached a common understanding about the recommendations in EUROCAE ER-010 about these topics, as well as on the rationale and underlying assumptions behind the detailed criteria related to these topics in JARUS AMC RPAS.1309 issue 2.
- d) The conciliation team identified ways to reconcile the positions of JARUS WG6 and EUROCAE WG73 for most of the topics, identified the dependencies necessary to reconcile the remaining positions (including dependencies on other JARUS WGs) while also considering the emerging European regulatory framework ('three pillars concept') and the recommended proportionate and risk-based approach therein.

### **6.2 FOLLOW-UP ACTIONS**

The members of the conciliation team recommend the following follow-up actions:

- a) JARUS AMC RPAS.1309 Issue 2 should be published to the general public together with its scoping paper and this report.
- b) The results of this report, as expressed in the various joint conciliation statements, should be reflected in the next issue 3 of JARUS AMC RPAS.1309 and the subsequent EASA NPA on this subject.
- c) EUROCAE WG73 and JARUS WG6 should coordinate an activity to create some generic RPAS FHA guiding examples that would also allow validating EUROCAE ER-010 and JARUS AMC RPAS.1309 with regard to a classification based on high level failure scenarios and to high level severity definitions.
- d) EUROCAE WG73 and JARUS WG6 should continue their coordination with regard to the risk assessment methodology to be applied for the "Specific" category.

## 7 ABBREVIATION LIST

AC	Advisory Circular
AMC	Acceptable Means of Compliance
A-NPA	Advanced – Notice of Proposed Amendment
ATC	Air Traffic Control
AW	Airworthiness
CAA	Civil Aviation Authority
DAA	Detect And Avoid
DAL	Development Assurance Level
EASA	European Aviation Safety Agency
ED-79A	EUROCAE - Guidelines for Development of Civil Aircraft and Systems (parallel to SAE ARP 4754A)
ER-010	EUROCAE – Technical Report: UAS / RPAS Airworthiness Certification, "1309" System Safety Objectives and Assessment Criteria
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FH	Flight Hour
FHA	Functional Hazard Analysis
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
NPA	Notice of Proposed Amendment
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RTC	Restricted Type Certificate
SOW	Statement Of Work
TC	Type Certificate
UAS	Unmanned Aircraft System
VLOS	Visual Line Of Sight
WG	Working Group

## APPENDIX 1: JARUS WG6 – EUROCAE WG73 AIRWORTHINESS CONCILIATION TEAM SOW

### JARUS WG6 - EUROCAE WG73 AIRWORTHINESS RPAS AMC 1309 "CONCILIATION" TEAM

#### 1. Introductory background

European RPAS Roadmap issued in June 2013 had called for two inputs to the process that should eventually lead to the issuance of an EASA Decision on AMC 1309 for civil safety objectives for airworthiness of RPA > 150 kg:

- One from JARUS (line 13A)
- One from Eurocae WG73 (line 13B).

JARUS WG6 has released a first draft AMC 1309 for public comments in March 2014 and is currently in the process to revise it considering the comments that have been received.

Eurocae WG73 technical report, reference ER-010, entitled "UAS / RPAS Airworthiness Certification - "1309" System Safety Objectives and Assessment Criteria" has been formally issued and focuses on high levels RPAS "1309" related topics and provides subsequent recommendations.

Considering the differences between these two reports, a conciliation team between the two groups is being created with the main objective of setting the ground for the future EASA NPA that would be as much consensual as possible before its release for public comments.

#### 2. Team composition

The conciliation team shall be limited to three members of each group as follows :

- JARUS WG6 :
  - Lorenzo Murzilli (leader): [lorenzo.murzilli@bazl.admin.ch](mailto:lorenzo.murzilli@bazl.admin.ch) (LM)
  - Jonathan Hughes: [Jonathan.Hughes@caa.co.uk](mailto:Jonathan.Hughes@caa.co.uk) (JH)
  - Alexandra Florin: [alexandra.florin@easa.europa.eu](mailto:alexandra.florin@easa.europa.eu) (AF)
- EUROCAE WG73 Airworthiness
  - Michael Allouche (leader): [mallouche@iai.co.il](mailto:mallouche@iai.co.il) (MA)
  - Hans Brants: [brants@nlr.nl](mailto:brants@nlr.nl) (HB)
  - Andrew Jones: [Andrew.Jones@uk.thalesgroup.com](mailto:Andrew.Jones@uk.thalesgroup.com) (AJ)

#### 3. Statement of Work

- 3.1. The first step of the conciliation activity shall be to evaluate the impact of recent changes in the proposed European regulatory framework (Riga declaration) to both JARUS and EUROCAE documents. In particular, the impact of the "bubble" concept and the related categories ("open", "specific", "regulated") recently promoted by EASA and JARUS to the envisaged scope of Type Certification (and applicability of 1309 requirement) shall be evaluated.
- 3.2. Subsequently, the conciliation team shall analyze the two approaches as respectively reflected in the two reports and identify / propose items as per the following classification :
  - 3.2.1. Those which may lead to a consensus
  - 3.2.2. Those which clearly represent diverging opinions.
- 3.3. The items shall cover fundamental issues and principles related to RPAS Safety Objectives and Assessment Criteria as identified in ER-010, including but not limited to:
  - 3.3.1. Overall guiding principle

- 3.3.2. Interrelation between Airworthiness and Operational Aspects
- 3.3.3. Failure Severity Definition and Classification
- 3.3.4. Safety objectives, including Quantitative Probability Requirements and Development Assurance Levels
- 3.3.5. UAS Categorization
- 3.3.6. Any other items found necessary during the discussion
- 3.4. A report shall then subsequently be established that should include
  - 3.4.1. The understanding of the context in which the AMC RPAS.1309 applies (result of discussion in 3.1 above)
  - 3.4.2. A description of items identified in above sections 3.2 and 3.3 and their proposed classification (consensual agreement achievable or not) and possible resolution for future EASA Rulemaking activities.

*Note: The aim is to reach a common understanding of the context in which the AMC RPAS.1309 would apply (3.4.1). However, the repercussions on items discussed on under 3.4.2 arising from possible differences in this understanding should be reviewed.*

**4. Working Arrangements and Time schedule**

- 4.1. The two reports mentioned in section 1 (JARUS and EUROCAE), as in their current state, shall be made available to the members of the conciliation team two weeks prior to the first meeting.
- 4.2. The team shall hold a maximum of three working meetings at a place and date of mutual convenience, first meeting being planned on June 25<sup>th</sup>, 2015.
- 4.3. Additional remote meetings (e.g. WebEx) might be held should the need arise.
- 4.4. Minutes of meetings (MoMs) shall be issued by one of the leaders and distributed for agreement by the conciliation team members, no later than one week after each meeting. Distribution of these MOMs (in whole or in part) outside the team shall be previously agreed by the two leaders.
- 4.5. The final report shall be approved and signed (by electronic signature) by all the team members and issued by no later than November 1<sup>st</sup>, 2015. It will be then presented and submitted to EUROCAE WG73 and JARUS before being formally distributed to EASA (and any other official bodies as required).

Date : June 9<sup>th</sup>, 2015

Name	Signature
<b>Michael ALLOUCHE</b> EUROCAE WG73 Airworthiness Leader	
<b>Lorenzo MURZILLI</b> JARUS WG6 Leader	

*(Signed copy available on request)*

**APPENDIX 2: 1309 MAJOR TOPICS CONCILIATION MATRIX**

JARUS WG6 – EUROCAE WG73 "1309" CONCILIATION TEAM REPORT – NOVEMBER 2015

<b>ITEM</b>	<b>1</b>
<b>Subject</b>	<b>Overall guiding principle</b>
<b>EUROCAE ER-010 Reference</b>	4.1
<b>EUROCAE ER-010 Statement of the issue</b>	Define an overall guiding principle that may be used as the starting point to develop more detailed quantitative UAS system probability requirements.
<b>EUROCAE ER-010 Recommendation</b>	UAS shall be designed and operated in such manner that the risk to third parties on ground or in the air is acceptable
<b>JARUS AMC1309 Is.2</b>	A - all sections S - all sections
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>The principle of designing and operating UAS in such manner that the risk to third parties on ground or in the air is acceptable is fully agreed.</p> <p>In detail, the Scoping Paper to AMC RPAS.1309 in Chapter 5(g) describes the guiding principles. Para 5.(g).2.d states "safety should therefore focus on the risks to persons in the air and on ground and, in absence of any better criteria, requiring a level of safety equivalent to manned aircraft of the same category as an objective is a defensible position". Chapter 11 (for ground risks) and Chapter 12 (for MAC risks) of the scoping paper detail the approach taken by WG6 in converting this guiding principle in safety objectives.</p> <p>It is therefore JARUS WG6's opinion that the proposed AMC RPAS.1309 and associated Scoping Paper are fully in line with ER-010 recommendation 4.1.</p>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>Whilst there may be an agreement regarding this general high level principle i.e. the risk to third parties (in the air or in the ground) should be acceptable, the interpretation and the way to cover this guiding principle into safety objectives (as further detailed in section 4.4) leads to different opinions.</p> <p>ER-010 (section 4.4.3 a) recommendation (as was also ER-004 section 4.6.4) would rather recommend to have an absolute safety target, even if the rationale to establish it may be based on comparison with the risk to third parties on the ground arising from manned aviation.</p> <p>In the light of the EASA emerging three pillars concept, agreement on this safety target is of high importance. As mentioned in the draft statement established during the meeting held on June 25, this would ensure that the overall level of safety achieved when applying the operational risk assessment method under the specific category and the one achieved when applying the process under certified category remains comparable.</p>

<b>ITEM</b>	2
<b>Subject</b>	<b>Interrelation between airworthiness and operational aspects</b>
<b>EUROCAE ER-010 Reference</b>	4.2
<b>EUROCAE ER-010 Statement of the issue</b>	Considering the specific character of UAS operations and the stronger interrelation between UAS airworthiness and operational aspects, recommendations should therefore be made as to whether the conventional manned approach of splitting requirements for TC and requirements for operational approval may or may not be applicable in the case of UAS
<b>EUROCAE ER-010 Recommendation</b>	a) maintain current aviation system - short term b) consider operational environment and operations that may have a direct impact on airworthiness and safety requirements in the TC - long term
<b>JARUS AMC1309 Issue 2</b>	This recommendation addresses aspects well beyond the AMC scope. references are: EASA Concept of Operations for Drones, A risk based approach to regulation of unmanned aircraft ( <a href="http://easa.europa.eu/newsroom-and-events/general-publications/concept-operations-drones">http://easa.europa.eu/newsroom-and-events/general-publications/concept-operations-drones</a> ) as well as the EASA A-NPA 2015-10 and similar papers currently being developed within JARUS
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>This recommendation is fully agreed by JARUS WG6. The recommendation is so relevant that it cannot be addressed by the AMC RPAS.1309 alone. The entire JARUS has recently realized the importance of this topic and tasked WG-7 to develop a concept of operations that took into account the issue. JARUS WG-7 developed an early ConOps that has been further improved by the EASA Paper: "Concept of Operations for Drones". The Riga Declaration and related material also acknowledge the issue requiring rules proportionate to the risk of the operation. The "three pillar" concept with three categories ("open", "specific" and "regulated") is the JARUS and EASA answer to the statement of the issue of WG-73.</p> <p>(a) In a short term, in line with ER-010 recommendation 4.2.3(a), the current aviation system is maintained: RPAS above 150 kg are certified by EASA when operations of UAS below 150 kg are authorised by NAAs.</p> <p>(b) In a middle-term, in line with ER-010 recommendation 4.2.3(b), it is intended to consider operation context through two different mechanisms:</p> <ul style="list-style-type: none"> <li>- the definition of 3 categories of operations (open, specific and certified)</li> <li>- the consideration of the operational conditions when assessing: <ul style="list-style-type: none"> <li>* the risk associated to operations of drones in the specific category, and</li> <li>* the assessment of failure conditions for the drones seeking for a certification.</li> </ul> </li> </ul> <p>EASA A-NPA 2015-10 goes in this direction.</p> <p>In conclusion, JARUS WG6's opinion is that this recommendation is not addressed to the AMC RPAS.1309 rather to the entire RPAS regulatory framework. It is also WG6 opinion that the latest development in the European regulatory framework are fully in line with ER-010 recommendations.</p>

<b>ITEM</b>	<b>2</b>
<b>Subject</b>	<b>Interrelation between airworthiness and operational aspects</b>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>It is agreed that this topics goes beyond the AMC 1309 itself.</p> <p>It must be stressed that, under the approach stated in 4.2.3 (b), ER-010 recommendation does not only fit with the operational risk assessment method to be used in the framework of "Specific" category but could also be used under the "Certified Category". In other words, the kind of RPAS operations could be used to introduce a classification to be taken into account when defining the Type Certification Basis (in a manner similar to manned airworthiness codes applicable to certain types of operations assumed in the framework of Type Certification such as CS-VLA - VLR operations - or CS-AWO - operational visibility conditions; this means that RPAS airworthiness code used to issue a TC may be at variance with the envisaged kind of operations).</p>



<b>ITEM</b>	<b>3</b>
<b>Subject</b>	<b>Failure severity definition and classification</b>
<b>EUROCAE ER-010 Reference</b>	4.3 & Appendix 4
<b>EUROCAE ER-010 Statement of the issue</b>	Manned failure severity provides a scheme to classify the severity of failures according to their impact on safety, notably of the aircraft and its occupants. Since UAS do not carry occupants, this classification may have to be reviewed and tailored to the specific character of UAS
<b>EUROCAE ER-010 Recommendation</b>	<p>a) On the one hand, provide a general functional failure classification considering potential end effects on third parties, UAS crew or ATC</p> <p>b) On the other hand, provide a guideline to classify the various UAS failure scenarios according to the failure classification scheme mentioned in (a)</p>
<b>JARUS AMC Issue 2</b>	<p>A - section 7</p> <p>S - section 8</p>
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>a) In line with ER-010 recommendation 4.3.3(a), the failure condition classification proposed in JARUS AMC RPAS.1309 section 7 was reviewed in comparison with the proposed classification in EASA AMC 25.1309 or FAA AC 23.1309 to take into account that UAS do not carry occupants.</p> <p>In line with ER-010 proposed approach 4.3.2(a), the JARUS WG6 has decided to stay as close as possible to the manned aircraft general severity definitions with slight adaptations to take into account the effects on:</p> <ul style="list-style-type: none"> <li>- third parties (following a ground impact)</li> <li>- ATC (loss of separation resulting in a catastrophic MAC)</li> <li>- UAS crew (increase in remote crew workload, efficiency of the remote crew impaired, ...)</li> </ul> <p>b) In line with ER-010 recommendation 4.3.3(b), the JARUS AMC RPAS.1309 at Issue 2 provide guidance with regards to the assessment of failure conditions with consideration of operational conditions (refer to section 7(d)).</p> <p>The JARUS scoping paper is as well providing some failure classification examples in section 8.</p> <p>It is therefore JARUS WG6's opinion that the proposed AMC RPAS.1309 and associated Scoping Paper are fully in line with ER-010 recommendation 4.3.</p>

<b>ITEM</b>	<b>3</b>
<b>Subject</b>	<b>Failure severity definition and classification</b>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>Please note that ER-010 4.2.3 (a) and (b) are not recommendations but a review of two outstanding potential approaches. As a matter of fact, ER-010 4.3.3 proposes a third approach specifically tailored to RPAS character and duly considering that the risk has been shifted from on-board to third parties on the ground or in the air.</p> <p>The classification of RPAS failure classification in accordance with definitions which are essentially derived from manned aircraft AMC 1309 is not considered as an easy task.</p> <p>The purpose of the functional failure classification and of the guidelines to classify typical RPAS failure scenarios as proposed in Appendix 4 is to facilitate the analysis to be performed by the manufacturer, focusing first on the potential severity of the event.</p> <p>Section 7(d) of the proposed JARUS AMC.1309 seems to mix the severity of the event and the likelihood of the event. The severity is not depending on the operational conditions, the likelihood is. For instance, imposing operational restrictions to RPAS operations (e.g. above sparsely populated areas) may not change the potential severity of an event but could reduce its likelihood to an acceptable level.</p> <p>For manned aviation this is different: operating in a different environment does not change the likelihood of injuries or fatalities on board because one always has to assume that all seats are occupied.</p> <p>Hence this is not implemented as recommended by EUROCAE.</p>

<b>ITEM</b>	<b>4</b>
<b>Subject</b>	<b>Quantitative probability requirements (part 1 – Risk on the ground)</b>
<b>EUROCAE ER-010 Reference</b>	4.3 & Appendix 4
<b>EUROCAE ER-010 Statement of the issue</b>	Although the exact wording of requirement 1309 for manned aircraft differs among the distinctive codes, in general terms it sets requirements for the design of equipment, systems, and installations based on the occurrence probability and severity of failures which could affect continued safe flight and landing. In assessing the acceptability of a design, the need to establish rational probability values for manned aircraft has been recognized (e.g. FAA AC 23.1309 or EASA AMC 25.1309) based on accident rates to establish acceptable probabilities of these failures. Likewise, UAS AMC.1309 needs explicit quantitative probability requirements; the issue is how these can be established, while reflecting in an appropriate manner the safety of third parties on the ground (see also 4.2.1).
<b>EUROCAE ER-010 Recommendation</b>	(See 4.4.3 (a) and (e) for more details) Define a specific target value for the acceptable probability for ground fatalities expressed in probability of a ground fatality per flight hour. (e.g. a target value of 10 <sup>-6</sup> /h could be proposed) and subsequently derive an acceptable UAS probability requirement for Class 1 events
<b>JARUS AMC Issue 2</b>	A - section 8 - Table 3 S - section 11.3

<b>ITEM</b>	4
<b>Subject</b>	<b>Quantitative probability requirements (part 1 – Risk on the ground)</b>
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>'In deviation with ER-010 recommendation 4.4.3(a), JARUS WG6 did not consider defining a specific target value for the acceptable probability for ground fatalities. Instead JARUS WG6 decided to setting quantitative safety objectives based on the magnitude of the accident rate per RPAS category, with a minimum target level of safety of <math>1 \times 10^{-4}</math>/fh (all causes) to prevent an unacceptable increase in the accident rate resulting from the shift in the balance of the fleet towards lower category aircraft.</p> <p>As explained in Chapter 8(h)5 of the Scoping Paper, JARUS WG6 considered that for a certificated aircraft approved to fly over populated areas there is a potential for fatalities in every accident. In such a situation the accident rate can be used in place of the number of ground fatalities to establish the safety objective to be met. In addition, lowering the acceptable accident rate to less than <math>1 \times 10^{-4}</math>/fh (e.g. <math>1 \times 10^{-3}</math>/fh) would almost imply the certainty of an accident during the life of each RPA (the life being typically between 1000 and 10000 hours) and WG6 felt this to be unacceptable for a certificated product.</p> <p>In deviation with ER-010 recommendation 4.4.3(e), JARUS WG6 did not revise the ratio 10%-90% between technical failures and operational failures. This is explained in the Scoping Paper in Note #2 related to Table 4: "Due to a RPAS's increased reliance on systems and higher levels of systems complexity and integration, it is recognise that the 10% attributed to RPAS systems may be underestimated.</p> <p>However, this value can never be 100% as other failure modes (e.g. structure, engines, HF, weather, operations) will still be present. Furthermore, if the same accident rate per category is to be maintained, then an increase in systems related failures must be compensated for by a reduction in failures from other causes. In the medium term, this is expected to be achieved through a reduction in pilot error and HF causes but as of today, there is no evidence that failures due to these causes will diminish at the expected rate.</p> <p>Therefore, the airworthiness objective to limit system related failures to 10% is maintained."</p>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>Hence the recommendations are not followed.</p> <p>JARUS WG6 "relative" approach in defining the safety target values fundamentally differs from the "absolute" approach recommended by ER-010. This well illustrates the statement made above regarding the interpretation of the overall guiding principle which was a priori commonly accepted.</p>

<b>ITEM</b>	<b>5</b>
<b>Subject</b>	<b>Quantitative probability requirements (part 2 – Risk in the air)</b>
<b>EUROCAE ER-010 Reference</b>	4.3 & Appendix 4
<b>EUROCAE ER-010 Statement of the issue</b>	<p>Although the exact wording of requirement 1309 for manned aircraft differs among the distinctive codes, in general terms it sets requirements for the design of equipment, systems, and installations based on the occurrence probability and severity of failures which could affect continued safe flight and landing. In assessing the acceptability of a design, the need to establish rational probability values for manned aircraft has been recognized (e.g. FAA AC 23.1309 or EASA AMC 25.1309) based on accident rates to establish acceptable probabilities of these failures.</p> <p>In addition, for unmanned aircraft, separation assurance and collision avoidance may rely more on equipment to perform these tasks.</p> <p>Similar to the issue of the safety of third parties on the ground, the question is how quantitative probability requirements should be established for the airworthiness approval of unmanned aircraft equipment performing these tasks in a manner consistent with the overall safety target set for mid-air collision (see also 4.2.1).</p>
<b>EUROCAE ER-010 Recommendation</b>	<p>(see 4.4.3 (b) for more details)</p> <p>For the risk in the air, the second approach which takes account of all the mid-air collision factors, is recommended i.e. setting the probability requirements for SA &amp; CA functions on board the UAS considering mitigation such as by ATC for separation assurance, where applicable, and by other aircraft SA &amp; CA (e.g. by using the Bow-tie tool see Appendix 5).</p>
<b>JARUS AMC Issue 2</b>	<p>A - section 8</p> <p>S - section 12</p>
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>'In line with ER-010 recommendation 4.4.3(b), JARUS AMC RPAS.1309 section 8 proposes that the Detect and Avoid (DAA) functions of the RPAS meet fixed safety targets.</p> <p>This is justified by the fact that the DAA functions "should provide an acceptable level of safety in maintaining safe separation with any aircraft the RPA may encounter". JARUS AMC RPAS.1309 also recognize that not all failures of DAA will result in a MAC. For this reason, WG6 proposed to consider DAA as protection functions and to treat them in accordance with ED-79A Chapter 5.2.4.</p> <p>It is therefore JARUS WG6's opinion that the proposed AMC RPAS.1309 and associated Scoping Paper are fully in line with ER-010 recommendation 4.4.3(b)</p>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>AMC.RPAS.1309 ignores that the current likelihood of a MAC is achieved by several mitigations, by both involved aircraft. The analysis shall include both aircraft, and not only the aircraft that is certified. The approach in AMC.1309 is not in line with ER-010.</p>

<b>ITEM</b>	<b>6</b>
<b>Subject</b>	<b>Fail-safe criteria</b>
<b>EUROCAE ER-010 Reference</b>	4.4.3 (c)
<b>EUROCAE ER-010 Statement of the issue</b>	Applicability and scope of the fail-safe criteria
<b>EUROCAE ER-010 Recommendation</b>	The fail-safe criteria is applied in manned aviation by either strict enforcement (regardless of probability) or with consideration of failure probability. For UAS it is recommended to combine both approaches taking into account the probability and trying to minimize single failures leading to fatal injuries
<b>JARUS AMC Issue 2</b>	A - section 8 - Table 3 - Note 3
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>In deviation with ER-010 recommendation 4.4.3(c), Note #3 related to Table 3 of JARUS AMC RPAS.1309 section 8 proposes that at "RPAS functional level, no single failure will result in a catastrophic failure condition" whatever the class or the complexity level of the RPAS. The emphasis to be considered is not whether the fail-safe concept must be applied to all features regardless of function but rather if it must be applied to all features whose failure could be catastrophic.</p> <p>It is appreciated that for smaller RPAS where the probability of causing a fatality is bordering on the improbable due to operational restrictions or size/energy of vehicle, then the mitigation of catastrophic conditions might be dealt with by operational restrictions rather than design features. In such cases, it will be evident that the need for the design features to be fail-safe is unimportant.</p> <p>However, for RPAS that could be operated and suffer failures that could lead to fatalities (on ground or in air) that would be classified as catastrophic, then the need for the development of systems that do not fail in an active fault manner must be pursued and the concept of the fail safe design embodied.</p> <p>In addition, the JARUS WG6 decision is further justified by the fact that the fail-safe concept is requested in most of manned aircraft airworthiness codes:</p> <ul style="list-style-type: none"> <li>* EASA CS-25.1309(b)(1)(ii)</li> <li>* FAA AC 29-2C 1309 Change 3</li> <li>* FAA Part 23.1309(c)(1) Amendment 62 published in December 2011</li> <li>* CS-LURS.1309 published in 2013</li> </ul>

<b>ITEM</b>	<b>6</b>
<b>Subject</b>	<b>Fail-safe criteria</b>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>The issue here is to which extent the fail safe concept or single failure criterion shall be strictly applied . It is definitely a requirement in manned CS-25.1309, it is not in CS23.1309. In STANAG 4671 for instance it is stated in the AMC, with some provisions to consider the probability of occurrence in some specific cases (e.g. mechanical jamming, accounting the risk time during take-off or landing)</p> <p>The formulation of ER-010 aimed at leaving some flexibility when establishing the Type Certification Basis.</p>

<b>ITEM</b>	7
<b>Subject</b>	<b>DAL</b>
<b>EUROCAE ER-010 Reference</b>	4.4.3 (d)
<b>EUROCAE ER-010 Statement of the issue</b>	The definition of Development Assurance Levels (DAL) as appropriate to RPAS should be established
<b>EUROCAE ER-010 Recommendation</b>	The DAL should be determined in a manner consistent with the tailored severity classification and probability levels set forth in the tailored RPAS AMC 1309 that will be established
<b>JARUS AMC Issue 2</b>	A - section 8 - Table 3 S - section 9
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	<p>'In line with ER-010 recommendation 4.4.3(d), JARUS AMC RPAS.1309 section 8 proposes DAL in line with the tailored severity classification and probability levels.</p> <p>This is further explained in the Scoping Paper section 9(e):</p> <p>"(e) When applying the ARP 4754A DAL process and activities, to remain coherent with the probability requirement associated with failure condition severity classification we can say that:</p> <ul style="list-style-type: none"> <li>▪ DAL A development gives confidence that the manifestation of a possible remaining error is compliant with an Extremely Improbable probability class defined as <math>\leq 10^{-9}/fh</math>.</li> <li>▪ DAL B development gives confidence that the manifestation of a possible remaining error is at least compliant with the Extremely Remote probability class defined as <math>10^{-7}/fh \leq P &lt; 10^{-9}/fh</math>.</li> <li>▪ DAL C development gives confidence that the manifestation of a possible remaining error is at least compliant with the Remote probability class defined as <math>10^{-5}/fh \leq P &lt; 10^{-7}/fh</math>.</li> <li>▪ DAL D development gives confidence that the manifestation of a possible remaining error is at least compliant with the Probable probability class defined as <math>10^{-3}/fh \leq P &lt; 10^{-5}/fh</math>." <p>It is therefore JARUS WG6's opinion that the proposed AMC RPAS.1309 and associated Scoping Paper are fully in line with ER-010 recommendation 4.4.3(d).</p> </li></ul>



<b>ITEM</b>	<b>7</b>
<b>Subject</b>	<b>DAL</b>
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	There is indeed a common agreement that DAL and hardware quantitative probability requirements shall remain consistent.

<b>ITEM</b>	<b>8</b>
<b>Subject</b>	<b>UAS Categorization</b>
<b>EUROCAE ER-010 Reference</b>	4.5
<b>EUROCAE ER-010 Statement of the issue</b>	The issue is whether the detailed UAS AMC.1309 failure probability requirements may apply to all types of unmanned aircraft or they may have to vary according to some UAS categorization.
<b>EUROCAE ER-010 Recommendation</b>	To establish a range of UAS probability requirements for Class I events differing from each other by an order of magnitude as a function of; <ul style="list-style-type: none"> <li>- Operations and environment parameters such as population density and class of airspace</li> <li>- The size of UA crash area, considered as the most significant parameter relating to the risk to third parties on the ground that altogether shall allow meeting the safety target value referred to in 4.4.3</li> </ul>
<b>JARUS AMC Issue 2</b>	A - section 8 - Table 3 S - section 11
<b>JARUS WG6 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	In line with ER-010 recommendation 4.5.3, JARUS proposed a risk-based approach depending on the class (thus weight), the complexity level and the operation of an RPAS. For instance, the loss of the RPAS control over a non-populated area is not classified catastrophic in according with the severity classification provided in section 7 of the AMC RPAS.1309. Nevertheless, it is recognised than in deviation with ER-010 recommendation 4.5.3, JARUS WG6 did not define for those cases where a RPAS would crash over populated areas, categories of risk depending on the probability of having a person killed or not. This is further discussed and justified in the Scoping Paper section 11(g). It is WG6 opinion that if the RPAS has sufficient energy to be lethal when the RPAS crashes, the probability of fatality(ies) would be 1 if the RPAS is certified to fly over populated areas. It is worth noting that this level of conservatism is required when the certification limitations do not exclude flying over densely populated areas.
<b>EUROCAE WG73 Initial Statement (prior to conciliation meeting 13-14/10/2015)</b>	'A classification based on weight and complexity level has no direct link with the effect on third parties: the likelihood of a fatality due to a simple but large RPA may be larger than the likelihood of a fatality due to a small RPA with complex avionics. The example of loss of control over a non-populated area mixes the severity of the outcome of the event (somebody may be killed) and the probability that this occurs (not likely because it is non-populated). It seems that there is no common understanding about EUROCAE recommendation regarding this concept. The discussion about these topics is also clearly linked to the comments made above under 4.2.