AW-Drones proposed standards – 1st iteration

D4.1

AW-Drones

Grant:	824292
Call:	H2020-MG-2-3-2018
Topic:	Airworthiness of mass-market drones
Consortium coordinator:	Deep Blue
Edition date:	19 February 2019
Edition:	00.01.00

This deliverable is part of a project that has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement no. 824292

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Rejected By - Representatives of beneficiaries involved in the project

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Document History

Edition	Date	Status	Author	Justification
00.00.01	17/01/2020	Draft	Filippo Tomasello	Initial draft
00.01.00	19/02/2020	Final	Filippo Tomasello	Final version after EASA WS

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AW-Drones

Abstract

The AW-Drones project aims to harmonize the EU drone regulatory framework by supporting the rulemaking definition process via the application of the existing standards which were deemed pertinent to the UAS domain. This document presents the results deriving from the assessment of standards considered potentially compliant to the requirements set by the Specific Operations Risk Assessment methodology (SORA), as recommended by EASA as AMC to Article 11 of EU Regulation 947/2019. For each SORA requirement, the assessment provides a list of standards offering at least a partial coverage, alongside the gaps which are missing for a complete coverage, and a list of recommendations to cover each gap and fully meet the requirement.

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Executive Summary

The AW-Drones project aims to harmonize the EU drone regulatory framework by supporting the rulemaking definition process via the identification of existing standards which are deemed pertinent to the UAS domain. This document presents the results of an assessment of standards considered potentially compliant to the requirements set by the Specific Operations Risk Assessment methodology (SORA), as recommended by EASA as AMC to Article 11 of EU Regulation 947/2019. For each SORA requirement, the assessment provides a list of standards offering at least a partial coverage, alongside the gaps which are missing for a complete coverage, and a list of recommendations to cover each gap and fully meet the requirement.

The full assessment of the standards was preceded by a data collection phase which entailed a preliminary mapping of the collected standards with SORA requirements. This led to the identification, for each requirement, of a set of standard potentially suitable to support compliance.
According to the assessment methodology defined by the project in Work Package 2, the assessment is focused on the following cases:

- CASE 1: one or more standards that are potentially suitable to comply with a given requirement have been identified;
- CASE 2: there is no standard fully covering a given requirement, thus a gap is identified.

Thus, for each SORA requirement this document presents:

- A list of standards that are in part or fully covering the requirement, ranked by a global score obtained by assessing each standard.
- A list of gaps identifying aspects that are not adequately covered by existing standards. Gaps are also given a score.
- Recommendations about the preferred standards and suggested strategies to fill the identified gaps based on their score.

The aforementioned assessment was carried out for all the requirements stemming from the SORA methodology, including:

- Ground Risk Mitigations
- Tactical Mitigations Performance Requirements (TMPR)
- Operational Safety Objectives
- Adjacent Area/Airspace requirements

With respect to the Operational Safety Objectives, the analysis was limited to the level of Robustness required for SAIL IV operations, that is where applications are mostly expected in the near future.
From the analysis carried out the following conclusions can be made:

1. For all SORA requirements that are applicable to SAIL IV there is at least a partial coverage from existing standards. The absence of full coverage derives from several reasons:
    - Standards often have a low maturity as they are still in a development phase.
    - Standards are only covering part of what SORA requires
    - Standards have a limited scope (e.g. MTOM less than 25kg, only rotorcraft, etc.)
    - Standards that were developed for the manned aviation can be too demanding for the UAS sector and hardly applicable in practice

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2. Even for the requirements for which there is full coverage, this might have been achieved on the basis of standards which are not published yet.

It is therefore recommended that:

- The maturity of the standards is continuously monitored to update the assessment. This will be done throughout the AW-Drones project and will be reflected in the next iteration of this analysis which will be developed by the end of 2020.
- The coverage identified in this document after the first iteration of project AW-Drones, is published by the project as the unique European Meta-Standard supporting the application of the SORA methodology for the specific category of operations.
- The European Commission, supported by EASA, should bring the gaps identified in paragraph 2.2 to the attention of the European UAS Standard Coordination Group (EUSCG) to possibly initiate actions to fill the gap.

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1 Introduction

1.1 Standards' assessment in the context of AW-Drones

The lack of clear standards is holding back the development of the drone-related business, both at a global level and in Europe. Several studies and surveys identify a reliable regulatory and standardization framework as one of the main potential boosters for the drone business. Therefore, to foster the growth of a safe drone usage, there is a need to implement coherent and interoperable global standards and regulations for drones in the EU. The European Union's Horizon 2020 Research and Innovation Program funded AW-Drones to tackle these issues and guide future EU drone regulation.

AW-Drones contributes to harmonize the EU drone regulation and standards, supporting the rulemaking process for the definition of rules, technical standards and procedures for civilian drones to enable safe, environmentally sound and reliable operations in the European Union. In order to achieve this, one of the sub-goals of the project, is to propose a well-reasoned set of technical standards for operations, appropriate for all relevant categories of drones.

A work plan has been formulated to collect and assess existing and planned standards. The effort is split into three main technical work packages (WP):

- WP2 - Development of a methodology for categorization and assessment
- WP3 - Collection and categorization of standards that might be applicable for UAS
- WP4 - Assessment of these standards to evaluate their feasibility to support this process in order to derive a set of standards that are validated and found applicable

While the first activity is carried out only at the beginning of the project to set the ground for all the subsequent work, both the data collection and the assessment of the standards are carried out iteratively over the course of the three years of the project. In particular during the first year (2019) the project focused on the collection and assessment of standards potentially suitable to support the demonstration of compliance to the requirements set in the Specific Operations Risk Assessment methodology (SORA). This methodology is officially recommended by EASA as AMC to Article 11 of EU Regulation 947/2019 [1] but at the moment lacks a clear guidance on which technical standards the UAS operators should use.

This deliverable will therefore provide a detailed overview of the results of the aforementioned assessment. In line with the iterative approach of the AW-Drones project, this deliverable has to be considered a living document which will be updated regularly in the next years of the project to include updates related to the standards assessed and inputs from relevant UAS industry stakeholders (e.g. EASA, Standard Making Bodies, Operators, etc.).

We acknowledge that the amount of information contained in this document might affect its readability. For this reason, the AW-Drones project plans to develop an online repository where the same information will be accessible in an easier way allowing consultation to any user. Authorized users, such as EASA and the SDOs might have also the privilege to comment the content of the repository and propose updates and changes.

1.2 Purpose and scope of this document

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As reported in the section above, the full assessment of the standards was preceded by a data collection phase which entailed a preliminary mapping of the collected standards with SORA requirements. This led to the identification, for each requirement, of a set of standard potentially suitable to support compliance.
According to the assessment methodology defined in [2], the assessment that is presented in this document is focused on the following cases:

- CASE 1: one or more standards that are potentially suitable to comply with a given requirement have been identified;
- CASE 2: there is no standard fully covering a given requirement, thus a gap is identified.

For each SORA requirement this document will therefore present:

- A list of standards that are covering in part or fully the requirement, ranked by a global score obtained by assessing each standard according to the methodology described in [2].
- A list of gaps identifying aspects that are not adequately covered by existing standards. Gaps are also given a score based on the criteria listed in [2].
- Recommendations about the preferred standards and suggested strategies to fill the identified gaps based on their score.

The aforementioned assessment was carried out for all the requirements stemming from the SORA methodology, including:

- Ground Risk Mitigations
- Tactical Mitigations Performance Requirements (TMPR)
- Operational Safety Objectives
- Adjacent Area/Airspace requirements

With respect to the Operational Safety Objectives, the analysis was limited to the level of Robustness required for SAIL IV operations, that is where applications are mostly expected in the near future. Since the overall robustness is always the combination of the integrity and assurance achieved, we always assumed the two to be the same to reach a given level of robustness (e.g. only Medium Integrity and Medium Assurance to reach Medium Robustness). Therefore, if SAIL IV requires a Medium Level of Robustness for a given mitigation, no requirement at High level is assessed at this stage. However, the scope of the assessment might be extended in the next iteration of the project, should the need arise from INEA, DG-GROW and EASA.
With respect to the standards considered in the analysis, the scope was limited considering the following aspects:

- In general, no standard in planning phase were considered, with few exceptions related to standards for which the first draft was already available.
- The maturity of the standards (i.e. their phase of development) was determined in September 2019, so there could be recent updates which are not yet included in this document

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- AW-Drones partners did not have full access to all standards at the time of the assessment. A complete assessment is provided only for the standards with full access. For the others we provide a preliminary assessment based on the publicly available information. [1]

Finally, it is worth mentioning that the assessment did not address the technical quality of the individual standards. We assumed that each standard was adequate to fulfil the scope for which it was developed, and we focused the assessment only on the evaluation of its capability to address the requirements.

1.3 Structure of the document

This document is structured in five main sections, as follows:

- Section 1 provides an introduction, defining the scope of the document and presenting its structure.
- Section 2 provides an overview of the results related to the assessment of technical standards for their effectiveness to fulfil SORA requirements. The results are presented in a synthetic way to show the coverage of SORA requirements at each level of robustness. Where the coverage is not full, gaps are identified and briefly summarised.
- Section 3 contains a detailed overview of the assessment. For each SORA requirement the following information is provided:
    - The description of the requirement as it was published in the AMC & GM to Commission Implementing Regulation (EU) 2019/947 [1];
    - A list of standards that could be used to fulfil the requirement with their overall score that take into account the effectiveness to fulfil the requirement but also other aspects such as their maturity, cost of compliance, impact on EU industry competitiveness, etc. For details about the assessment methodology, the reader should refer to AW-Drones deliverable D2.2 [2].
    - A list of gaps identified where there are no standards fully covering the whole requirement. Gaps are also evaluated in terms of different criteria to rank them and help identify the priorities and possible recommendations.
- Section 4 provides the conclusions and highlights the main recommendations that stem from the analysis presented in section 3.
- Finally, Annex 1 includes the detailed assessment of each individual standard that has been taken into account as potentially suitable to comply with a SORA requirements. In this Annex the reader will find the rationale behind the global score assigned to each standard.

[1] To cope with this issue the AW-Drones project is working to establish agreements with the main Standard Making Bodies (e.g. ASTM, EUROCAE, SAE) to obtain access to their standards for the exclusive purpose of the assessment.

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1.4 How to Read This Document

This section highlights the main features of the tables describing the assessment of each standard, as outlined in Section 3: Detailed Results. It explains how the information is presented and how to effectively read the results presented.

The figures below are taken as representative examples in portraying how each SORA requirement evaluates the extent of coverage and possible gaps arisen from the assessment of standards considered, where the following guideline applies:

- A white cell indicates that a standard is required
- A grey shading indicates that a standard is not required
- An orange shading indicates that the coverage of the requirement does not fall within a SAIL of IV, hence goes beyond the scope of this document.

1.4.1 Requirement description table

Each sub-section under Section 3 starts with a table that reports a description of the requirements as they are defined in [1]. The table below provides an example of what these tables look like.

Criteria	Robustness	Description
Criterion	Low	The automatic protection of the flight envelope has been developed in-house or out of the box (e.g. using Component Off The Shelf elements), without following specific standards.
	Medium	The automatic protection of the flight envelope has been developed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.
	High	Same as Medium. In addition, evidence is validated by EASA.

Figure 1 Requirement description example

A Requirement Description table provides a detailed description of the safety criteria to be met to cover a SORA requirement. The columns are divided as follows:

Criteria

Lists the number of criteria defined for the specific requirement; when there is more than one criterion, all of them are to be fulfilled for a specific level of robustness to be achieved.

Robustness

Lists the applicable levels of robustness with which the specific requirement can be implemented. The level of robustness is computed by combining the level of Integrity (the safety gain deriving from the application of the mitigation) and the level of Assurance (the method of proof used to demonstrate that the safety gain has been achieved).

For the Operational Safety Objectives (OSO), the requirements for which a standard is not required are highlighted in grey, while those for which a standard would be needed are white. As outlined in Section 1.2, the requirement for SAIL V and VI were out of scope of this iteration of the assessment and are highlighted in orange.

Description

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It includes the actual description of the requirements as it is extracted from the relevant SORA Annexes.

1.4.2 Summary of standards assessed for a given requirement

The table summarises the list of standards that could be used to fulfil the requirement with their related level of effectiveness. The columns are divided as follows:

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671		P		4
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO	STANAG 4703		P		4

Figure 2 Standards' effectiveness in fulfilling SORA requirements example

<u>**Title, SDO, Reference**</u>

Provides title of the standard, as well as the standard-making body and relative document reference.

<u>**Robustness**</u>

Outlines the effectiveness of each standard to fulfil the SORA requirement for each level of robustness and each criterion where applicable. In this area P means that the coverage is Partial and F that the coverage is Full. If the cell is blank it means that the standard does not cover the requirement. A grey cell means that a standard is not required, while an orange cell indicates that the assessment was out of scope because applicable for SAIL greater that IV.

<u>**Global Score**</u>

Outlines the global score of each requirement as per Annex 1 Standards' assessment. This document contains an assessment of each individual standard. The greater the score, the easier it will be for UAS operators to actually use the standard. For details on the assessment methodology refer to [2], while for details on how the global score has been computed for each standard refer to Annex 1.

1.4.3 Coverage detail

The Coverage Detail table gives additional information regarding the standard's evaluation, along with the gaps identified for each standard in fulfilling a given requirement. Gaps might be present even if a standard has a full coverage simply because their scope might not cover the full range of UAS designs (e.g. standard only for Fixed Wing UAS).

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Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671		P		The standard covers flight envelope protection in several conditions; however, it does not clearly refer to pilot error(s).

Notes:
1. Published
2. The standard defines a set of technical airworthiness requirements intended primarily for the airworthiness certification of fixed-wing military UAS with a maximum take-off weight between 150 and 20,000 kg that intend to regularly operate in non-segregated airspace

Figure 3 Coverage detail example

1.4.4 Gap summary

A gap summary table highlights the identified gaps missing to fully cover the requirement. The columns are divided as follows:

Gap	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Absence of standards covering: The remote crew ensures the UAS is in a condition for safe operation and conforms to the approved concept of operations	-7	It is recommended to develop a standard to ensure that the condition of the UAS conforms to the approved concept of operations.
2	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations	-7	It is recommended to develop a standard for documentation of what needs to be inspected prior to a flight.
3	Absence of standards covering: The remote crew's is trained to perform the product inspection, and that training is self-declared (with evidence available).	-7	It is recommended to develop a standard for training for what needs to be inspected prior to a flight.
4	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations if available. In addition, the product inspection is documented using	-7	It is recommended to develop a standard for checklists of what needs to be inspected prior to a flight.

Figure 4 Gap summary example

<u>**Gap and Gap Description**</u>

Provides a number for each gap identified, explaining the nature of the gap and its rationale. The gaps listed in this table are generally not the same identified in the assessment of the individual standards, but rather a combination of them.

<u>**Total Weighted Score**</u>

Provides the total score weighed against specific criteria, as listed in Gap Details. A negative sign indicates that the gap is somehow critical and actions might be required to cover the gap, whereas a positive sign indicates that the need to develop additional guidance/standard is not evident.

<u>**Conclusion and Recommendations**</u>

It provides conclusions on gaps which have arisen, with recommendations in relation to the severity of each respective score.

1.4.5 Gap details

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A Gap Details table evaluates each gap on the basis of the criteria defined in [2] which are: safety, cost of compliance to the requirement with a lack of standards, environmental impact, impact on EU industry competitiveness and social acceptance. The columns are divided as follows:

Criteria (Weight)

Each criterion has a weight that is related to its relevance. For example, safety, being of paramount importance, holds the highest impact on the evaluation, given in brackets.

Result

Low to high impact of the gap on the criterion (see [2] for a detailed description of the assessment methodology).

Rationale

Reasoning behind a result (see previous).

Score

This column numerically quantifies the "result" in order for it to be successively weighed against the weight of each criteria.

Weighted Score

The final weighted score is given by the multiplication of score x weight, enabling the analysis via an element of comparison between each identified gap.

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Absence of standards covering The remote crew ensures the UAS is in a condition for safe operation and conforms to the approved concept of operations	Safety (3)	High	The lack of standards to ensure that the condition of the UAS conforms to the approved concept of operations requires the remote crew to develop a method and get it approved. This could result in certain inspection items being overlooked by the remote crew or authorities. This could result in undetected technical failures which could potentially be safety critical.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	The lack of standards to ensure that the condition of the UAS conforms to the approved concept of operations requires the remote crew to develop a method and get it approved.	0	0
		Environmental Impact (1)	Bad	An undetected inadequate condition of battery systems prior to flight could cause the UAS to crash and cause fires.	-2	-2
		Impact on EU Industry competitiveness (1)	Negative	There is a cost of compliance for remote pilots, a required effort by aviation authorities, and consequently also a negative impact on commercial use of UAS in the EU market.	-1	-1
		Social Acceptance (1)	Negative	The lack of standards to ensure that the condition of the UAS conforms to the approved concept of operations may give for social acceptance of UAS flights a negative feed-back on the competence of the remote crew People are used to see the pilot checking an aircraft before flight.	-1	-1
Total Weighted Score						-7

Figure 5 Gap details example

1.4.1 Conclusions and Recommendations

The final section gives an overview of the current coverage of each requirement, providing a table with the best identified standards that cover the requirement at present, alongside any associated gaps.

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1.5 List of Acronyms

Acronym	Description
AESA	Spanish Aviation Safety and Security Agency
AMC	Acceptable Means of Compliance
ARC	Air Risk Class
ASTM	American Society for Testing and Materials International
ATC	Air Traffic Control
BVLOS	Beyond Visual Line of Sight
C2	Command and Control Link
C3	Command, Control and Communication
CAA	Civil Aviation Authority
CERTH	Centre for Research & Technology Hellas
ConOps	Concept of Operations
DAA	Detect and Avoid
DJI	DJI Europe B.V
DLR	German Aerospace Center
DoD	Department of Defence
EASA	European Union Aviation Safety Agency
ERP	Emergency Response Plan
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
EVLOS	Extended Visual Line of Sight
FAA	Federal Aviation Administration
FCU	Flight Control Unit
FSF-MED	Flight Safety Foundation – SE Europe
GM	Guidance Material
GPS	Global Positioning Unit
GRC	Ground Risk Class
HMI	Human Machine Interface
HW	Hardware
IAI	Israel Aerospace Industries Ltd.
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ISO	International Organization for Standardization
JARUS	Joint Authorities for Rulemaking of Unmanned Systems
MTOM	Maximum Take-Off Mass
NATO	North Atlantic Treaty Organization
NFPA	National Fire Protection Association
NLR	Netherlands Aerospace Centre
OSO	Operational Safety Objective
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RTCA	Radio Technical Commission for Aeronautics
RTH	Return-to-Home
SAE	Society of Automotive Engineers

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SAIL	Safety Assurance and Integrity Level
SDO	Standard Design Organization
SORA	Specific Operations Risk Assessment
STANAG	Standardization Agreement
STD	Standard
SW	Software
TMPR	Tactical Mitigations Performance Requirements
TU Delft	Delft University of Technology
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
US	United States
VLOS	Visual Line of Sight
WG	Working Group

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2 Summary of Results

This section presents a summary of the results of the assessment and gives an overview of the general coverage of all SORA requirements. For details on the individual assessment of each requirement, refer to Section 3.

2.1 Requirements' coverage overview

The tables below highlight the degree to which each SORA requirement is covered, whereas the subsequent charts provide a graphical representation of the current robustness coverage, emphasising the extent to which the current regulatory framework effectively covers the requirements expected by the SORA methodology:

- A green shading indicated that the requirement is fully covered.
- A yellow shading indicates the requirement is only partially covered.
- An orange shading indicates that the coverage of the requirement does not fall within a SAIL of IV, hence goes beyond the scope of this document.
- A grey shading indicates that a standard is not required

Table 1 Strategic Mitigations for Ground Risk: Coverage Overview

Requirement	Title	Robustness coverage		
M1 – non tethered	Strategic Mitigations for Ground Risk	L	M	H
M1 - tethered	Strategic Mitigations for Ground Risk	L	M	H
M2	Effects of UA impact dynamics are reduced	L	M	H
M3	An Emergency Response Plan is in place, operator validated and effective	L	M	H

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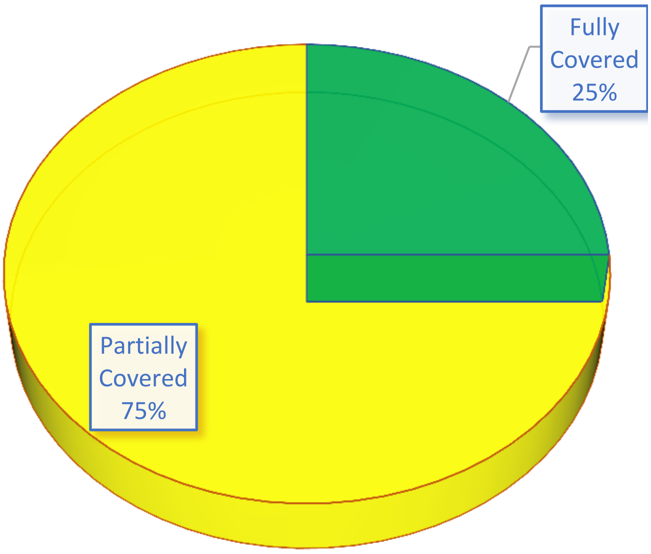

Figure 6 Strategic Mitigations for Ground Risk: Coverage Overview

Table 2 Tactical Mitigation Performance Requirements (VLOS): Coverage Overview

Requirement	Robustness Coverage
Tactical Mitigations - VLOS	P

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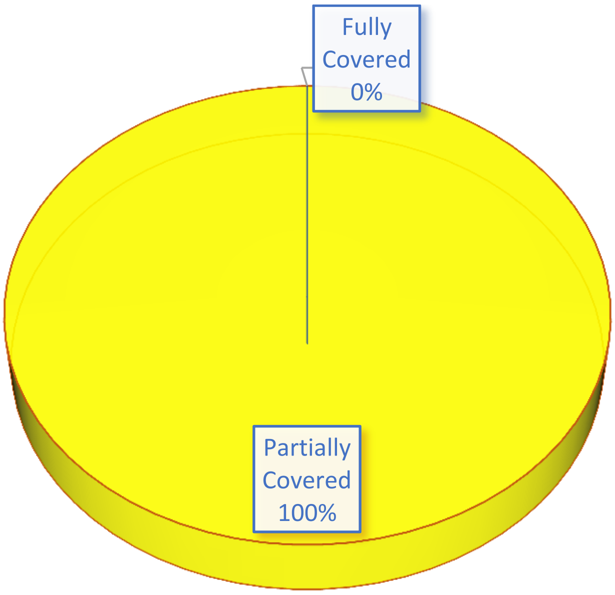

Figure 7 Tactical Mitigations Performance Requirements (VLOS): Coverage Overview

Table 3 Tactical Mitigations Performance Requirements (BVLOS): Coverage Overview

Function	Robustness Coverage			
	Arc-a	Arc-b	Arc-c	Arc-d
Detect				
Decide				
Command				
Execute				
Feedback Loop				
Integrity				

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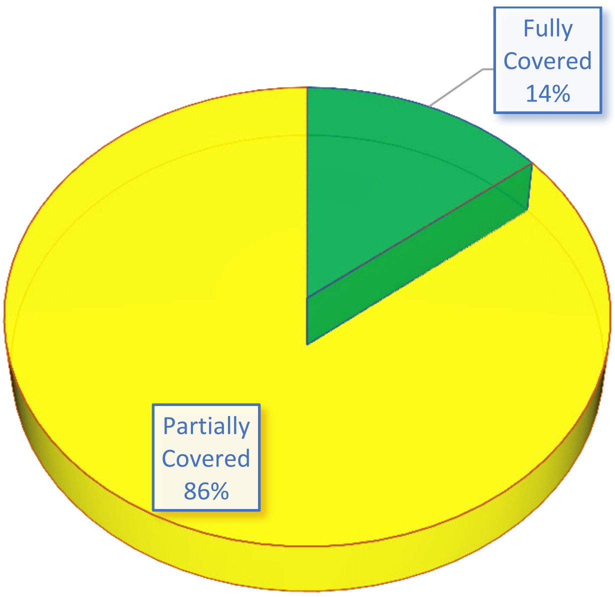

Figure 8 Tactical Mitigations Performance Requirements: Coverage Overview

Table 4 OSO Coverage Overview

Requirement	Title	Robustness coverage		
OSO 01	Ensure the operator is competent and/or proven	L	M	H
OSO 02	UAS manufactured by competent and/or proven entity	L	M	H
OSO 03	UAS maintained by competent and/or proven entity	L	M	H
OSO 04	UAS developed to authority recognized design standards	L	M	H
OSO 05	UAS is designed considering systems safety and reliability	L	M	H
OSO 06	C3 link characteristics appropriate for the operation	L	M	H
OSO 07	Inspection of the UAS (product inspection) to ensure consistency to the ConOps	L	M	H
OSO 08, 11, 14, 21	Operational procedures	L	M	H
OSO 09, 15, 22	Remote crew competencies	L	M	H
OSO 10, 12	Safe recovery from technical issues	L	M	H
OSO 13	External services supporting UAS operations are adequate to the operation	L	M	H

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OSO 16	Multi crew coordination	L	M	H
OSO 17	Remote crew is fit to operate	L	M	H
OSO 18	Automatic Protection of the flight envelope from human errors	L	M	H
OSO 19	Safe Recovery from Human Error	L	M	H
OSO 20	A Human Factors evaluation has been performed and the Human-Machine Interface (HMI) found appropriate for the mission	L	M	H
OSO 23	Environmental conditions for safe operations defined, measurable and adhered to	L	M	H
OSO 24	UAS designed and qualified for adverse environmental conditions	L	M	H

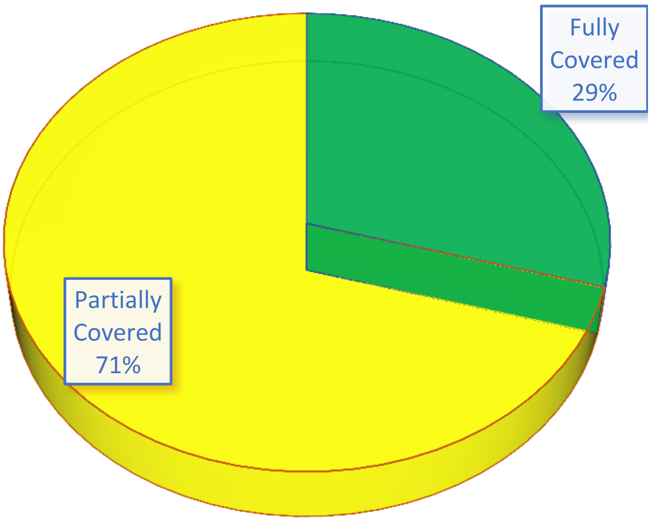

Figure 9 OSO: Coverage Overview

Table 5 Adjacent Airspace: Coverage Overview

Requirement	Title	Robustness coverage	
Adjacent Airspace	Adjacent Area/Airspace Considerations	1	2

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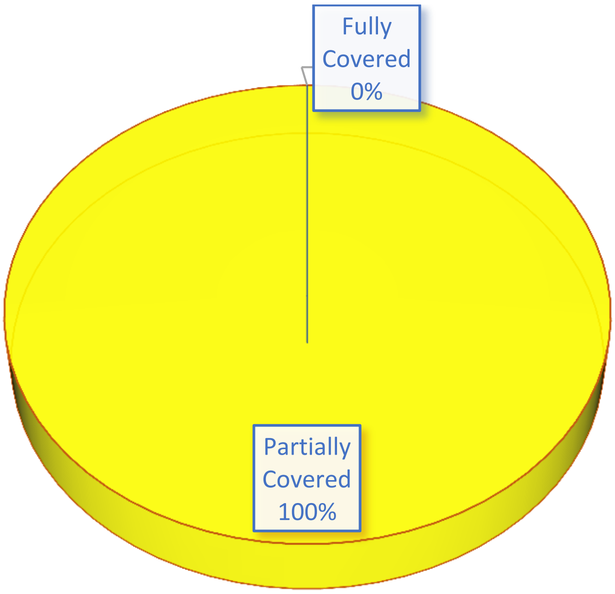

Figure 10 Adjacent Airspace: Coverage Overview

2.2 Overview of identified gaps

The following tables provide an overview of the gaps missing to fully cover each SORA requirement, alongside their weighted score. The gaps have been classified into four possible categories, to better highlight their nature:

- Guidelines: It refers to additional guidance material supporting the UAS Operator in showing compliance to the SORA requirement.
- Procedures: It refers to specific instructions and protocols associated with UAS operations.
- Technical: It refers to standards related to the design of the UAS, any of its components and/or external services..
- Training: It refers to guidelines on how to conduct training and structure training material for personnel involved in UAS operations.

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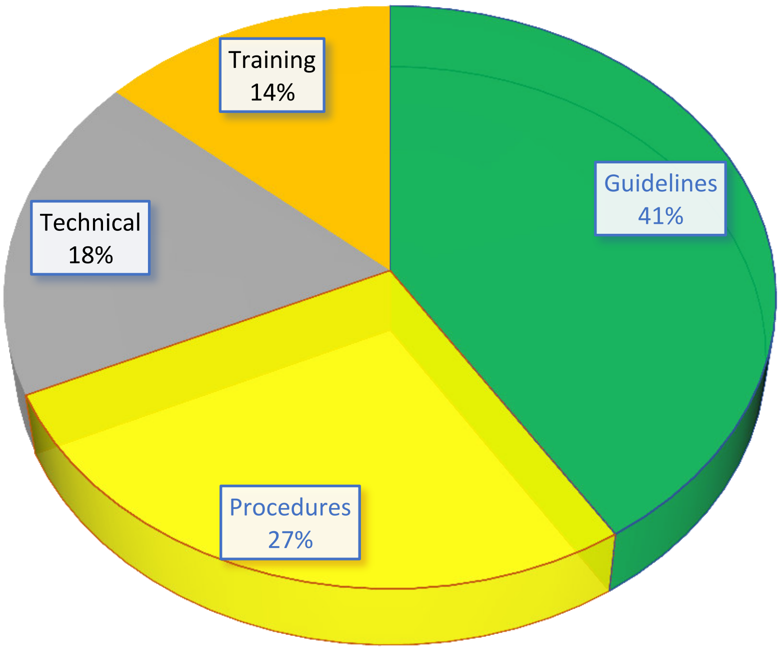

Figure 11 Overview of gaps identified

Table 6 Strategic Mitigations for Ground Risk: Gap Overview

Requirement	Gap	Classification	Score
M1	No standard/guideline available for the definition of the ground risk buffer	Guidelines	-5
	No standard defining how to evaluate number of people at risk	Guidelines	-6
	Absence of standard for the mechanical characteristics of the line	Technical	-6
	No specific standard defining how to define installation and maintenance procedures of tether	Procedures	-5
M2	No standards for automated termination system activation and documents that explicitly address techniques for the reduction of the effects of impact dynamics and post impact hazards as required.	Guidelines	-6
	No standards for contingency or emergency procedures containing means of reduction of ground impact	Procedures	-3
	No standards describing the training for ground impact measures for remote crews	Training	+2

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	No standard defining procedures for installation and maintenance	Procedures	+2
M3	Lack of standards dealing with ERP specifically developed for UAS operations	Guidelines	0
	Lack of criteria to demonstrate that the number of people at risk is reduced	Guidelines	-5
	Lack of standards covering training to cope with UAS emergencies	Training	-5

Table 7 Tactical Mitigations Performance Requirements: Gap Overview

Requirement	Gap	Classification	Score
Tactical Mitigations - VLOS	There is no existing guidance to produce a documented VLOS de-confliction scheme, explaining the methods that will be applied for detection and the criteria used to avoid incoming traffic.	Guidelines	-4
	There is no existing guidance to develop the procedures and protocols in support of a VLOS de-confliction scheme.	Guidelines	-4
Tactical Mitigations - BVLOS	Lack of standards (i.e. MOPS) on DAA for small drones (<25kg).	Technical	-11
	Lack of standards (i.e. MOPS) for small drones (<25 kg) above VLL.	Technical	-9

Table 8 OSO: Gap Overview

Requirement	Gap	Classification	Score
OSO 01	There is no guideline or standard defining the minimum requirements for organizations in terms of structure, post-holders, etc. for categories of operations.	Guidelines	-4
OSO 02	Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS.	Technical	+2
OSO 03	N/A		
OSO 04	There is no guidance to identify the applicable requirements from the selected standards that are applicable for low Robustness and SAIL IV Operations.	Guidelines	-6
OSO 05	N/A		
OSO 06	There is no standard to develop communication functionalities where needed/relevant	Technical	-4

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	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations	Procedures	10
	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations if available. In addition, the product inspection is documented using checklists.	Procedures	10
OSO 08, 11, 14, 21	No evidence of standards covering requirements for each element. In addition, some elements (i.e. contingency procedures or pre and post-flight inspection) may require specific standards for each type of UAS	Procedures	-7
	No evidence at this stage of standards covering requirements to better address the functions of crew in relation to interactions with other entities involved in UAS operations.	Guidelines	-4
	No evidence of standards covering contingency or emergency procedures.	Procedures	-5
	Absence of standards covering requirements for checklists or manual, appropriate for staff personnel in doing standardised operational procedures (e.g. flight planning procedures, operational manual, etc.)	Procedures	-9
	No evidence of standards covering operational procedures to manage human errors, either during normal operations or emergency/contingency conditions	Procedures	-9
	Absence of standards covering any requirements to train the Remote Crew with Crew Resource Management knowledge	Training	-1
OSO 09, 15, 22	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight	Training	-7
	Lack of standards covering training requirements for non-regulated professions (e.g. supporting personnel, payload operator, flight dispatcher etc.)	Training	+6
OSO 10, 12	N/A		
OSO 13	Lack of specific criteria to define GNSS performance adequacy for drone operations.	Guidelines	-11
	Lack of standardised procedures for the monitoring of external services.	Procedures	+2
	Lack of testing procedures to demonstrate that GNSS performance is adequate for UAS OPS.	Procedures	-8

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OSO 16	Absence of standards covering the assignment of tasks to the crew and the establishment of step-by-step communications	Guidelines	-6
	Absence of standards covering communication devices suitable for drone crews	Technical	-7
OSO 17	Lack of criteria to address fit conditions before or during duty times	Guidelines	-10
	Lack of standards to define a Fatigue Risk Management System (FRMS)	Guidelines	-8
OSO 18	Standards covering automatic protection of the flight envelope following remote pilot errors are not designed specifically for small UAS.	Technical	-2
OSO 19	Lack of specific standards for procedures able to provide at a minimum: a clear distribution and assignment of tasks, an internal checklist to ensure staff are adequately performing assigned tasks.	Guidelines	-6
	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight	Training	-7
OSO 20	Lack of specific standards to define platform-independent Human Machine Interface (HMI) capabilities.	Technical	-10
	Lack of standards to conduct human factors evaluation of the UAS to determine if the HMI is appropriate for the mission.	Guidelines	-10
OSO 23	There are no standards/guidelines to define how to determine adequate environmental conditions for safe operations.	Guidelines	-5
	Available standards for the development of procedures are quite generic and do not provide sufficient guidance.	Procedures	+2
OSO 24	N/A		

Table 9 Adjacent Airspace: Gap Overview

OSO	Gap	Classification	Score
Adjacent Airspace	There is a lack of guidance on how to demonstrate compliance to the requirement that "No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume"	Guidelines	-7

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	There is a lack of standards for SW and airborne electronic hardware (AEH) Development Assurance that are suitable for small UAS	Technical	-9

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3 Detailed Results

3.1 *M1* – Strategic Mitigations for Ground Risk

3.1.1 Requirement Description – Non-Tethered Operations

Table 10 Integrity Requirements' Description – Non-Tethered Operations

Criteria	Robustness	Description
Criterion #1 (Definition of the ground risk buffer)	Low	A ground risk buffer with at least a 1 to 1 rule or for rotary wing UA defined using a ballistic methodology approach acceptable to the competent authority.
	Medium	Ground risk buffer takes into consideration: • Improbable single malfunctions or failures (including the projection of high energy parts such as rotors and propellers) which would lead to an operation outside of the operational volume, • Meteorological conditions (e.g. wind), • UAS latencies (e.g. latencies that affect the timely manoeuvrability of the UA), • UA behaviour when activating a technical containment measure, • UA performance.
	High	Same as Medium
Criterion #2 (Evaluation of people	Low	The applicant evaluates the area of operations by means of on-site inspections/appraisals to justify lowering the density of people at risk (e.g. residential area during daytime when some people may not be present or an industrial area at night-time for the same reason).

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at risk)	Medium	Same as low, however the applicant makes use of authoritative density data (e.g. data from UTM data service provider) relevant for the proposed area and time of operation to substantiate a lower density of people at risk. AND/OR If the applicant claims a reduction, due to a sheltered operational environment, the applicant: uses a drone below 25 kg and not flying above 174 knots, demonstrates that although the operation is conducted in a populated environment, it is reasonable to consider that most of the non-active participants will be located within a building.
	High	Same as Medium.

Table 11 Assurance Requirements' Description – Non-Tethered Operations

Criteria	Robustness	Description
Criterion #1 (Definition of the ground risk buffer)	Low	The applicant declares that the required level of integrity is achieved.
	Medium	The applicant has supporting evidence to claim the required level of integrity has been achieved. This is typically done by means of testing, analysis, simulation, inspection, design review or through operational experience.
	High	The claimed level of integrity is validated by a competent third party.
Criterion #2 (Evaluation of people at risk)	Low	The applicant declares that the required level of integrity is achieved.
	Medium	The density data used for the claim of risk reduction is an average density map for the date/time of the operation from a static sourcing (e.g. census data for night time ops). In addition, for localised operations (e.g. intra-city delivery or infrastructure inspection) the applicant submits the proposed route/area of operation to the applicable authority (e.g. city police, office of civil protection, infrastructure owner etc.) to verify the claim of reduced number of people at risk.
	High	Same as medium, however the density data used for the claim of risk reduction is a near-real time density map from a dynamic sourcing (e.g. cellular user data) and applicable for the date/time of the operation.

3.1.2 Requirement Description – Tethered Operations

Table 12 Integrity Requirements' Description – Tethered Operations

Criteria	Robustness	Description

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Criterion #1 technical design	Low	Does not meet the “Medium” level criteria
	Medium	1) The length of the line is adequate to contain the UA in the operational volume and reduce the number of people at risk. 2) Strength of the line is compatible with the ultimate loads expected during the operation. 3) Strength of attachment points is compatible with the ultimate loads expected during the operation. 4) The tether cannot be cut by rotating propellers.
	High	Same as Medium
Criterion #2 procedures	Low	Does not meet the “Medium” level criteria
	Medium	The applicant has procedures to install and periodically inspect the condition of the tether.
	High	Same as Medium

Table 13 Assurance Requirements’ Description – Tethered Operations

Criteria	Robustness	Description
Criterion #1 technical design	Low	Does not meet the “Medium” level criteria
	Medium	The applicant has supporting evidence (including the tether material specifications) to claim the required level of integrity is achieved. • This is typically achieved through testing or operational experience. Tests can be based on simulations, however the validity of the target environment used in the simulation needs to be justified.
	High	The claimed level of integrity is validated by EASA against a standard considered adequate by EASA and/or in accordance with means of compliance acceptable to EASA (when applicable).
Criterion #2 procedures	Low	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared.

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	Medium	• Procedures are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. • Adequacy of the procedures is proven through: ○ Dedicated flight tests, or ○ Simulation, provided the simulation is proven valid for the intended purpose with positive results.
	High	Same as Medium. In addition: • Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative. • The procedures, flight tests and simulations are validated by a competent third party.

3.1.3 Summary

Table 14 M1 - Strategic Mitigations for Ground Risk - Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness												Global Score
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
Integrity															
Methodology for the UAS Operational Risk for non-geographical flight permits	ENAC	LG 2017/001-NAV	P	P	P										
General requirements for tethered unmanned aircraft system	ISO	WD 24356								P	P				
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3											F	F	3

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AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4	DGAC	N.A.	P	P	P		P								
EUROCAE Geocaging Appendix 1	EUROCAE	ED-270	P	P	P										
Unmanned Aircraft Systems — Product requirements and verification for the Open category	ASD-STAN	prEN 4709-1								P			P		
Assurance															
AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4	DGAC	N.A.					P								
General requirements for tethered unmanned aircraft system	ISO	WD 24356								P	P				
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3											F	F	3
Unmanned Aircraft Systems — Product requirements and verification for the Open category	ASD-STAN	prEN 4709-1								P			P		

3.1.4 Integrity Coverage Detail

Table 15

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	

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Methodology for the UAS Operational Risk for non-geographical flight permits	ENAC	LG 2017/001-NAV	P	P	P													This guideline includes a method to determine the ground risk buffer in relation to the characteristics of the operational area and the system under use.

Table 16

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
General requirements for tethered unmanned aircraft system	ISO	WD 24356								P	P				The standard is only in planning phase but is expected to adequately cover the requirements for tethered operations.

Table 17

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3											F	F	The standard provides only high-level guidance. It does not provide specific guidance for procedures for on-site inspections nor for installation and monitoring of tether.

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Table 18

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4	DGAC	N.A.	P	P	P		P								Criteria #1 No emphasis on improbable failures required for medium robustness and above No specific guideline on demonstration Criteria#2: Partial coverage for medium robustness: definition of populated area does not answer the other items required for medium robustness No coverage for high robustness: no real time data

Table 19

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	

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Standard Title	SDO	Doc. Reference	NT C1 L	NT C1 M	NT C1 H	NT C2 L	NT C2 M	NT C2 H	T C1 L	T C1 M	T C1 H	T C2 L	T C2 M	T C2 H	Gaps
EUROCAE Geocaging Appendix 1	EUROCAE	ED-270	P	P	P										No coverage without adapting appendix 1 or building new derived appendix to have a direct traceability to criteria #1 to have it agnostic of related systems If adapted high likelihood to have a full coverage

Table 20

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
Unmanned Aircraft Systems — Product requirements and verification for the Open category	ASD-STAN	prEN 4709-1								P			P		Standard for open category, no coverage for high robustness Criteria #2: No standards for procedures validations

3.1.1 Assurance Coverage Detail

Table 21

Standard Title	SDO	Doc. Reference	Robustness				Gaps
			Non-tethered		Tethered		
			Criterion 1	*Criterion 2*	*Criterion 1*	*Criterion 2*	

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			L	M	H	L	M	H	L	M	H	L	M	H	
AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4	DGAC	N.A.					P								Criteria #1 No emphasis on improbable failures required for medium robustness and above No specific guideline on demonstration Criteria#2: Partial coverage for medium robustness: definition of populated area does not answer the other items required for medium robustness No coverage for high robustness: no real time data

Table 22

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
General requirements for tethered unmanned aircraft system	ISO	WD 24356								P	P				The standard is only in planning phase but is expected to adequately cover the requirements for tethered operations.

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Table 23

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3											F	F	The standard provides only high-level guidance. It does not provide specific guidance for procedures for on-site inspections nor for installation and monitoring of tether.

Table 24

Standard Title	SDO	Doc. Reference	Robustness												Gaps
			Non-tethered						Tethered						
			Criterion 1			*Criterion 2*			*Criterion 1*			*Criterion 2*			
			L	M	H	L	M	H	L	M	H	L	M	H	
Unmanned Aircraft Systems — Product requirements and verification for the Open category	ASD-STAN	prEN 4709-1								P			P		Standard for open category, no coverage for high robustness Criteria #2: No standards for procedures validations

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3.1.2 Gaps

3.1.2.1 Summary

Table 25 Gap Summary – M1

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	No harmonised standard/guideline available for the definition of the ground risk buffer	-5	It is recommended to develop a harmonised approach at EU level for the definition of the ground risk buffer starting from the practices already available in some Member States.
2	No standard defining how to evaluate number of people at risk. More specifically absence of specific standard/guidance defining: • how to evaluate the area of operations by means of on-site inspections/appraisals to justify lowering the density of people at risk • what can be sheltered environment • what can be authoritative density data (e.g. data from UTM data service provider) relevant for the proposed area and time of operation to substantiate a lower density of people at risk. • what can be average density map for the date/time of the operation from a static sourcing (e.g. census data for night time ops). • how can be defined for localised operations (e.g. intra-city delivery or infrastructure inspection) the proposed route/area of operation to the applicable authority (e.g. city police, office of civil protection, infrastructure owner etc.) • what can be near-real time density map from a dynamic sourcing (e.g. cellular user data) and applicable for the date/time of the operation.	-6	It is recommended to develop dedicated guidance and standards, where relevant, to support operators in complying with the requirements of M1.
3	Absence of standards for the mechanical characteristics of the line	-6	ISO document "General Requirements for Tethered Unmanned Aircraft System" looks as the most

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			promising one to cover this item. It is recommended to monitor its development to ensure it can adequately cover the requirement.
4	No specific standard defining how to define installation and maintenance procedures of tether	-5	ISO document "General Requirements for Tethered Unmanned Aircraft System" looks as the most promising one to cover this item. It is recommended to monitor its development to ensure it can adequately cover the requirement.

3.1.2.2 Details

Table 26

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	No standard/guideline available for the definition of the ground risk buffer	Safety (3)	High	The absence of specific guidelines for the definition of the ground risk buffer may have negative impact on safety as adequate margins might not be retained in all operational conditions.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standard makes more difficult and time consuming for operators to demonstrate compliance to the requirements.	-1	-2
		Environmental Impact (1)	Neutral	-	0	0
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**-5**

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Table 27

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	No standard defining how to evaluate number of people at risk	Safety (3)	High	The absence of specific requirements, concerning the issues to be assessed, may have the consequence to miss some topics that could be relevant for the safety issues. Therefore, guidelines to defining how to evaluate number of people at risk for Operators should be developed ad hoc for operational, technical and administrative topics.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards for the evaluation of people at risk makes more difficult and even impossible for Medium and High level of robustness to meet the requirements. At the same time, it is time consuming for oversight authorities to monitor operators.	-1	-2
		Environmental Impact (1)	Neutral	-	0	0
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	The absence of uniformed way to assess the number of people at risk may give for social acceptance of UAS flights a negative feed-back on the competence of Operator.	-1	-1
Total Weighted Score						**-6**

Table 28

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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3	Absence of standard for the mechanical characteristics of the line	Safety (3)	High	The absence of specific standard for the mechanical characteristics of the line may lead to the use of inadequate equipment with a negative impact on safety.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards for tether makes more difficult and time consuming to evaluate its adequacy for the UAS. At the same time, it is time consuming for oversight authorities to monitor applications.	-1	-2
		Environmental Impact (1)	Neutral	-	0	0
		Impact on EU Industry competitiveness (1)	Negative	The absence of a specific standard does not allow EU companies to develop certified products.	-1	-1
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**-6**

Table 29

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
4	No specific standard defining how to define installation and maintenance procedures of tether	Safety (3)	High	The absence of specific standard to address procedures for installation and maintenance of the tether may lead to incidents with a negative impact on safety.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards for checklists makes more difficult and time consuming for doing procedures. At the same time, it is time consuming for oversight authorities to monitor operators.	-1	-2
		Environmental Impact (1)	Neutral	-	0	0

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		Impact on EU Industry competitiveness (1)	No impact	No impact	0	0
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**-5**

3.1.3 Conclusions and Recommendations

The M1 mitigation requirements are not adequately covered by existing standards.

For the non-tethered case, there is a lack of standards/guidelines to cover all the requirements. For the definition of the ground risk buffer, there exist only guidelines developed by national authorities but there is no common approach. For the evaluation of people at risk the only available standards cover, in a generic way, the procedures for on-site inspections. However, there is a complete lack of standards for the definition of a sheltered environment, what can be defined as authoritative density data, etc.

For the tethered case, there is no standard already published that can adequately cover the requirements. The ISO planned standard "General requirements for tethered unmanned aircraft system" appear to be the best candidate to fill this gap.

Table 30 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**

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Criterion #1 (Definition of the ground risk buffer)	Low Medium High	Partial	ENAC-LG 2017/001-NAV - Methodology for the UAS Operational Risk for non-geographical flight permits Appendix A – "RPA casualty area determination" and Appendix B – "Probabilistic criteria for the buffer determination	Some items as latencies not taken into account Lack of sample to adequately meet the requirements for applicants	No harmonized standard/guideline available for the definition of the ground risk buffer
		Partial	DGAC AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4 - §18.3.- « Protection des tiers au sol » (« uninvolved people on ground protection »)	No emphasis on improbable failures required for Med robustness and above No specific guideline on demonstration	
		Partial	EUROCAE ED-270 Geocaging Appendix 1	No full coverage without adapting appendix 1 or building new derived appendix to have a direct traceability to criteria #1 to have it agnostic of related systems	
Criterion #2 (Evaluation of people at risk)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Partial	DGAC AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4 - §18.3.-« Protection des tiers au sol » (« uninvolved people on ground protection »)	definition of populated area is some kind of "authorized data" but does not answer the other items required for Med robustness No standard/guidance defining how to evaluate number of people at risk.	No standard/guidance defining how to evaluate number of people at risk.

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	High	N.A.	NO STANDARD AVAILABLE	N/A	No standard/guidance defining the requirements for real time population data.
M1 – Tethered operation - Criterion #1 technical design	Low	N.A.	NO STANDARD REQUIRED	N/A	
	Medium	Partial	ISO/WD 24356 General requirements for tethered unmanned aircraft system	Still in planning phase, draft needs to be checked but it is expected to provide generic guidance	Lack of technical standard applicable to all classes of drones.
		Partial	ASD-STAN prEN 4709 Aerospace series — Unmanned Aircraft Systems — Product requirements and verification for the Open category	Section 7.6 possibly applicable but only for UAS manufactured according to the standard	
	High	Partial	ISO/WD 24356 General requirements for tethered unmanned aircraft system	Still in planning phase, draft needs to be checked	
M1 – Tethered operation - Criterion #2 procedures	Low	N.A.	NO STANDARD REQUIRED	N/A	
	Medium High	Partial	ASD-STAN prEN 4709 Aerospace series — Unmanned Aircraft Systems — Product requirements and verification for the Open category	Section 7.6 possibly applicable but only for UAS manufactured according to the standard	No specific standard defining how to define installation and maintenance procedures of tether
		Full	ISO/FDIS 21384-3 Unmanned aircraft systems — Part 3: Operational procedures	Not specific for installation and maintenance of a tether	

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Table 31 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Definition of the ground risk buffer)	Low	N.A.	NO STANDARD REQUIRED	N/A	
	Medium	N.A.	NO STANDARD REQUIRED	N/A	
	Medium	N.A.	NO STANDARD REQUIRED	N/A	
Criterion #2 (Evaluation of people at risk)	Low	N.A.	NO STANDARD REQUIRED	N/A	No standard/guidance defining how to evaluate number of people at risk.
	Medium	Partial	DGAC - AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4	definition of populated area is some kind of “authorized data” but does not answer the other items required for Med robustness	
	High	N.A.	NO STANDARD AVAILABLE	N/A	
M1 – Tethered operation - Criterion #1 technical design	Low	N.A.	NO STANDARD REQUIRED	N/A	
	Medium	N.A.	NO STANDARD AVAILABLE	N/A	
	High	N.A.	NO STANDARD AVAILABLE	N/A	
M1 –	Low	N.A.	NO STANDARD REQUIRED	N/A	

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Tethered operation - Criterion #2 procedures	Medium	Partial	ASD-STAN prEN 4709 Aerospace series — Unmanned Aircraft Systems — Product requirements and verification for the Open category	Section 7.6 possibly applicable but only for UAS manufactured according to the standard	
		Full	ISO/FDIS 21384-3 Unmanned aircraft systems — Part 3: Operational procedures	Not specific for installation and maintenance of a tether. This standard could provide full assurance if operators use detailed standards for the development of the procedures	
	High	Full			

3.2 *M2* – Effects of UA impact dynamics are reduced

3.2.1 Requirement Description

Table 32 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	Does not meet the "Medium" level criterion

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(Technical Design)	Medium	Ground risk buffer takes into consideration: • Effects of impact dynamics and post impact hazards are significantly reduced although it can be assumed that a fatality may still occur. • When applicable, in case of malfunctions, failures or any combinations thereof that may lead to a crash, the UAS contains all elements required for the activation of the mitigation. • When applicable, any failure or malfunction of the proposed mitigation itself (e.g. inadvertent activation) does not adversely affect the safety of the operation.
	High	Same as medium. In addition: • When applicable, the activation of the mitigation, is automated. • The effects of impact dynamics and post impact hazards are reduced to a level where it can be reasonably assumed that a fatality will not occur.
Criterion #2 (Procedures, if applicable)	Low	Any equipment used to reduce the effect of the UA impact dynamics are installed and maintained in accordance with manufacturer instructions.
	Medium	
	High	
Criterion #3 (Training, if applicable)	Low	Personnel responsible for the installation and maintenance of the measures proposed to reduce the effect of the UA impact dynamics are identified and trained by the applicant.
	Medium	
	High	

Table 33 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1 (Technical Design)	Low	The applicant declares that the required level of integrity has been achieved.
	Medium	The applicant has supporting evidence to claim the required level of integrity is achieved. This is typically2 done by means of testing, analysis, simulation3, inspection, design review or through operational experience.
	High	The claimed level of integrity is validated by a competent third party against a standard considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority (when applicable).

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Criterion #2 (Procedures, if applicable)	Low	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared
	Medium	• Procedures are validated against standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority. • The adequacy of the procedures is proved through: ○ Dedicated flight tests, or ○ Simulation, provided that the representativeness of the simulation means is proven for the intended purpose with positive results.
	High	Same as Medium. In addition: • Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative. • The procedures, flight tests and simulations are validated by a competent third party.
Criterion #3 (Training, if applicable)	Low	Training is self-declared (with evidence available).
	Medium	• Training syllabus is available. • The operator provides competency-based, theoretical and practical training.
	High	• Training syllabus is validated by a competent third party. • Remote crew competencies are verified by a competent third party

3.2.2 Summary

Table 34 M2 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Global Score
			L	M	H	L	M	H	L	M	H	
Integrity												
UAS Maintenance Technician Qualification	ASTM	WK60659							P	P	P	N.A.
Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	ASTM	F3322-18		P	P							12

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Assurance											
UAS Maintenance Technician Qualification	ASTM	WK60659							P	P	P	N.A.
Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	ASTM	F3322-18			P							

3.2.3 Integrity Coverage Detail

Table 35

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
UAS Maintenance Technician Qualification	ASTM	WK60659							P	P	P	

Notes:
No draft available, assessment was made on general data.
The document addresses training of maintenance staff and is therefore expected to cover very well the training syllabus, and possible audits by third parties.

Table 36

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Robustness *Criteria 2*			Robustness *Criteria 3*			Gaps
			L	M	H	L	M	H	L	M	H	

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Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	ASTM	F3322-18		P	P							-Does not cover criteria to assess the ground impact effects versus the likelihood of a fatality. The Civil Aviation Authority (CAA) will likely define the safe energy levels or accept proposed levels by the applicant based on the operation. -A competent third party for validation efforts is not provided. The CAA will have to define competent third parties.

Notes:

F3322-18 is a specification that defines design, manufacturing, and test requirements for the parachute system. It does not provide minimum requirements related to the ground impact effects as this will likely be dependent on the governing CAA. Requirements are included for the type of procedures which are necessary but not on the development or format. No requirements are presented related to training.

3.2.1 Assurance Coverage Detail

Table 37

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
UAS Maintenance Technician Qualification	ASTM	WK60659							P	P	P	

Notes:

No draft available, assessment was made on general data.

The document addresses training of maintenance staff and is therefore expected to cover very well the training syllabus, and possible audits by third parties.

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Table 38

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Robustness *Criteria 2*			Robustness *Criteria 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	ASTM	F3322-18			P							-Does not cover criteria to assess the ground impact effects versus the likelihood of a fatality. The Civil Aviation Authority (CAA) will likely define the safe energy levels or accept proposed levels by the applicant based on the operation. -A competent third party for validation efforts is not provided. The CAA will have to define competent third parties.
Notes: F3322-18 is a specification that defines design, manufacturing, and test requirements for the parachute system. It does not provide minimum requirements related to the ground impact effects as this will likely be dependent on the governing CAA. Requirements are included for the type of procedures which are necessary but not on the development or format. No requirements are presented related to training.												

3.2.2 Gaps

3.2.2.1 Summary

Table 39 Gap Summary – M2

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	No standards for automated termination system activation and documents that explicitly address techniques for the reduction of the effects of impact dynamics and post impact	-6	Standardization for the implementation of automated activation of termination system should be considered. Uniform techniques for the reduction of the effects of impact dynamics and post impact hazards

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	hazards as required.		should be developed.
2	No standards for contingency or emergency procedures containing means of reduction of ground impact	-3	Guidance for the definition of contingency or emergency procedures containing means of reduction of ground impact could help operators in assessing all the relevant aspects.
3	No standards describing the training for ground impact measures for remote crews	+2	It is of aid to have standards that address the training for ground impact measures.
4	No standard defining procedures for installation and maintenance	+2	It is assumed that standards covering the development of systems to reduce the effects of ground impact will also include instructions for maintenance and installation.

3.2.2.2 Details

Table 40

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	No standards for automated termination system activation and documents that explicitly address techniques for the reduction of the effects of impact dynamics and post impact hazards as required.	Safety (3)	High	Implementation standards for automated activation of recovery systems need to be developed if this technique is used to assure the integrity of the recovery system. Declaration of the effects of impact dynamics and post impact hazards have to be standardised.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	Costs are to be expected to realize system for automated activation of recovery system. Techniques for reasonable reduction of the effects of impact dynamics and post impact hazards might also lead to increasing development cost.	-1	-2
		Environmental Impact (1)	Neutral	No impact	0	0

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		Impact on EU Industry competitiveness (1)	Negative	Due to increasing development cost EU industry competitiveness could be affected negatively.	-1	-1
		Social Acceptance (1)	Neutral	No impact	0	0
Total Weighted Score						**-6**

Table 41

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	No standards for contingency or emergency procedures containing means of reduction of ground impact	Safety (3)	High	Contingency and emergency conditions need to be standardised in order to apply the "best" way to handle technical issues. Contingency/emergency procedures will support UAV pilots to manage the non-nominal situation.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	Costs are to be expected to realise the procedures and to train the personnel to apply.	0	0
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	No impact	0	0
		Social Acceptance (1)	Neutral	No impact	0	0
Total Weighted Score						**-3**

Table 42

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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3	No standards describing the training for ground impact measures for remote crews	Safety (3)	Medium	Ground impact measures are mostly quite intuitive, usually no training is required. However, systems that require training should have a standard describing the content of this training.	0	0
		Cost of compliance to the requirement with a lack standard (2)	Low	No more than a training course or short introduction to such systems is required.	+1	+2
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	No impact	0	0
		Social Acceptance (1)	Neutral	No impact	0	0
Total Weighted Score						**+2**

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
4	No standard defining procedures for installation and maintenance	Safety (3)	Medium	Procedures for installation and maintenance are likely to be provided by the manufacturer also in absence of a dedicated standards.	0	0
		Cost of compliance to the requirement with a lack standard (2)	Low	Procedures for installation and maintenance are likely to be provided by the manufacturer also in absence of a dedicated standards.	+1	+2
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	No impact	0	0
		Social Acceptance (1)	Neutral	No impact	0	0

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Total Weighted Score	+2

3.2.3 Conclusions and Recommendations

Criteria #1 and #3 of M2 seem to be adequately covered by standards that are either published or under development. However, no standard covers the definition of criteria to assess the ground impact effects versus the likelihood of a fatality. The competent authority will likely need to define the safe energy levels or the accept levels proposed by the applicant based on the operation. A harmonization of these thresholds at European level would be desirable.

The most critical gaps are related to the absence of standards covering the definition of contingency or emergency procedures containing means of reduction of ground impact, and for automated termination systems. These gaps should be addressed by either developing dedicated standards or covering these topics in existing ones. For example, procedures for contingency and emergency could be covered in general standards such as ISO 21384-3:2019 Unmanned aircraft systems — Part 3: Operational procedures.

Table 43 Recommended Standards - Integrity

Integrity					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Technical Design)	Low	N/A	NO STANDARD REQUIRED		

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	Medium	Partial	F3322-18: Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	F3322-18 is a specification that defines design, manufacturing, and test requirements for the parachute system. It does not provide minimum requirements related to the ground impact effects as this will likely be dependent on the governing CAA. Requirements are included for the type of procedures which are necessary but not on the development or format. Does not cover criteria to assess the ground impact effects versus the likelihood of a fatality. The Civil Aviation Authority (CAA) will likely define the safe energy levels or accept proposed levels by the applicant based on the operation.	No standards for automated termination system activation and documents that explicitly address techniques for the reduction of the effects of impact dynamics and post impact hazards as required. No standards for contingency or emergency procedures containing means of reduction of ground impact
	High	Partial			
Criterion #2 (Procedures, if applicable)	Low	N/A	NO STANDARDS AVAILABLE		No standard defining procedures for installation and maintenance
	Medium	N/A	NO STANDARDS AVAILABLE		
	High	N/A	NO STANDARDS AVAILABLE		
Criterion #3 (Training, if applicable)	Low	Full	ASTM WK60659	Document not yet available	No standards describing the training for ground impact measures
	Medium	Full	ASTM WK60659	Document not yet available	
	High	Full	ASTM WK60659	Document not yet available	

Table 44 Recommended Standards - Assurance

Assurance

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Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Technical Design)	Low	N/A	NO STANDARD REQUIRED		
	Medium	Partial	F3322-18: Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	F3322-18 is a specification that defines design, manufacturing, and test requirements for the parachute system. It does not provide minimum requirements related to the ground impact effects as this will likely be dependent on the governing CAA. Requirements are included for the type of procedures which are necessary but not on the development or format. Does not cover criteria to assess the ground impact effects versus the likelihood of a fatality. The Civil Aviation Authority (CAA) will likely define the safe energy levels or accept proposed levels by the applicant based on the operation.	No standards for automated termination system activation and documents that explicitly address techniques for the reduction of the effects of impact dynamics and post impact hazards as required. No standards for contingency or emergency procedures containing means of reduction of ground impact
	High	Partial			
Criterion #2 (Procedures, if applicable)	Low	N/A	NO STANDARDS AVAILABLE		No standard defining procedures for installation and maintenance
	Medium	N/A	NO STANDARDS AVAILABLE		
	High	N/A	NO STANDARDS AVAILABLE		
Criterion #3 (Training, if applicable)	Low	Partial	ASTM WK60659	Document not yet available	No standards describing the training for ground impact measures
	Medium	Partial	ASTM WK60659	Document not yet available	
	High	Partial	ASTM WK60659	Document not yet available	

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3.3 *M3* – An Emergency Response Plan is in place, operator validated and effective

3.3.1 Requirement Description

Table 45 Integrity Requirements' Description

Criteria	Robustness	Description
Integrity Criteria	Low	No ERP is available, or the ERP does not cover the elements identified to meet a "Medium" or "High" level of integrity.
	Medium	The ERP: • is suitable for the situation; • limits the escalating effects; • defines criteria to identify an emergency situation; • is practical to use; • clearly delineates Remote Crew member(s) duties
	High	Same as Medium. In addition, in case of loss of control of the operation, the ERP is shown to significantly reduce the number of people at risk although it can be assumed that a fatality may still occur.

Table 46 Assurance Requirements' Description

Criteria	Robustness	Description
Assurance Criterion #1 (Procedures)	Low	Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. The adequacy of the procedures and checklists is declared.

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	Medium	The ERP is developed to standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority. The ERP is validated through a representative tabletop exercise consistent with the ERP training syllabus.
	High	Same as Medium. In addition: • The ERP and the effectiveness of the plan with respect to limiting the number of people at risk are validated by a competent third party. • The applicant has coordinated and agreed the ERP with all third parties identified in the plan. • The representativeness of the tabletop exercise is validated by a competent third party.
Assurance Criterion #2 (Training)	Low	Does not meet the "Medium" level criterion
	Medium	• An ERP training syllabus is available. • A record of the ERP training completed by the relevant staff is established and kept up to date.
	High	Same as Medium. In addition, competencies of the relevant staff are verified by a competent third party.

3.3.2 Summary

The following requirements are disregarded in this section as they are not supposed to be mapped with any specific standard:

- Integrity (Low)
- Assurance Criterion #1 (Low, High)
- Assurance Criterion #2 (Low, High)

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Table 47 M3 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Global Score
			L	M	H	L	M	H	L	M	H	
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266								P		6
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3		P	P		P	P				3
Unmanned aircraft systems -Training for personnel involved in UAS operations	ISO	23665		P	P					P		7
RPAS Manual	ICAO	Doc. 10019		P	P							N.A.
Safety Management System	ICAO	Doc.9869		P	P							N.A.
Emergency Response Plan	IATA			P	P		P	P				9
Occupational health and safety management systems -- Requirements with guidance for use	ISO	45001		P	P					P		N.A.
Standard Practice for Handling of Unmanned Aircraft Systems at Divert Airfield	ASTM	F2849-10		P	P							8

3.3.3 Coverage Detail

Table 48

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*	Assurance Robustness *Criteria 1 (procedures)*	Assurance Robustness *Criteria 2 (training)*	Gaps

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			L	M	H	L	M	H	L	M	H	
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266								P		Does not cover criteria to assess the ground impact effects versus the likelihood of a fatality. The Civil Aviation Authority (CAA) will likely define the safe energy levels or accept proposed levels by the applicant based on the operation.

Notes:
The standard does not cover the integrity requirements for the ERP as it does not provide a template or specific guidance on ERP preparation, procedures etc. However, the standard provides a training syllabus dealing with emergency procedures, including engine failure, lost link and autorotation and therefore it could be used as AMC for the assurance criterion #2 (training).

Table 49

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3		P	P		P	P				Medium: - Criteria to define emergency situations; - Template practical to use High: - Clearly delineates remote crew duties

Notes:
The standard does not provide a template or specific guidance on how to prepare an ERP. However, the document contains high-level guidance on basic operational procedures in case of emergency, including communication with relevant entities and predisposition of emergency equipment.

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Table 50

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -Training for personnel involved in UAS operations	ISO	23665		P	P					P		Medium: Template practical to use High: - Criteria to demonstrate that the number of people at risk is reduced

Notes:
The standard is not focused on the ERP for UAS OPS as it is mostly dedicated to personnel training. However, it provides a good guidance on the ERP content, including classification of emergency actions (although not exhaustive), procedures in case of loss of control of the operation and training activities.
In conclusion, in absence of standards completely dedicated to the ERP for UAS operations, this document could be considered a good starting point.

Table 51

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	

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RPAS Manual	ICAO	Doc. 10019		P	P							Medium: - Criteria to define emergency; - Remote crew duties Template practical to use High: - Criteria to demonstrate that the number of people at risk is reduced

Notes:

The document provides guidelines on how to manage emergency situations (i.e. landing procedures, C2 Link loss), although there are no specific details on how to structure an ERP.

Table 52

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	

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Safety Management System	ICAO	Doc.9869		P	P							Medium: - Template practical to use - Remote crew duties Criteria to define emergency situations High: - Criteria to demonstrate that the number of people at risk is reduced

Notes:
The document provides guidelines on what an ERP should contain. Anyway, it is not specific for UAS operations and do not provide a template practical to be used.

Table 53

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	
Emergency Response Plan	IATA			P	P		P	P				Medium: - Duties not tailored for UAS remote crew - Criteria to define emergency situations High: - Criteria to demonstrate that the number of people at risk is reduced

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Notes:

The document provides a practical template for air carriers to handle emergency situations. The document includes roles and responsibilities for the ERT (Emergency Response Team). Although this ERP is not tailored for UAS operations, some actions, checklists, ect. could be adapted. However, the document does not provide criteria to establish the adequacy of the ERP for a certain situation as well as criteria to demonstrate that the number of people at risk is reduced. These issues are very specific for UAS operations.

Table 54

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	
Occupational health and safety management systems -- Requirements with guidance for use	ISO	45001		P	P					P		Medium: - Duties not tailored for UAS remote crew - Adequacy to UAS OPS High: - Criteria to demonstrate that the number of people at risk is reduced Medium, Criterion 2: - Training not specific for UAS OPS

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Notes:

The document provides guidance on how to compile an ERP for a generic activity. General criteria to identify an emergency are provided and are in principle applicable for UAS OPS. Training activities dedicated to emergency situations are included.

What is missing are criteria to determine the adequacy of the ERP for a give UAS operation as well as means to demonstrate that the number of people at risk is reduced.

Table 55

Standard Title	SDO	Doc. Reference	Integrity Robustness *Criteria*			Assurance Robustness *Criteria 1 (procedures)*			Assurance Robustness *Criteria 2 (training)*			Gaps
			L	M	H	L	M	H	L	M	H	
Standard Practice for Handling of Unmanned Aircraft Systems at Divert Airfield	ASTM	F2849-10		P	P							Medium: - Not applicable to rotary wing UAS - Not applicable for VLOS Does not represent a generic ERP to handle different emergency situations High: - Criteria to demonstrate that the number of people at risk is reduced

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Notes:
The document includes equipage and procedures for safely handling unmanned aircraft forced to recover at alternate or diversionary airfields where personnel trained in recovering that type of aircraft may not be present. It is intended to apply to fixed-wing unmanned aircraft conducting non-visual line-of-sight operations. It is intended to establish common locations, labelling, and functions of equipment necessary to safely power down the aircraft without damaging it and common procedures for untrained personnel to follow to contact the owner of the aircraft. It addresses mission planning procedures, automated functions, and manual functions/ handling procedures in the preflight, in-flight, and post-flight phases, respectively.

3.3.4 Gaps

3.3.4.1 Summary

Table 56 Gap Summary – M3

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of standards dealing with ERP specifically developed for UAS operations (especially crew duties)	0	The urgency to develop a standard for the ERP depends on the type of operation (e.g. SAIL). The ERP is not mandatory in SORA but it is “nice to have” since its absence determines a one point increase in the GRC. Therefore, it is recommended to develop standard for ERP to support complex operations dealing with potentially high SAILs and including the assignment of duties to crew.
2	Criteria to demonstrate that the number of people at risk is reduced	-5	It is recommended to develop such criteria as a function of the type of operation. The lack of such criteria would make more difficult to judge the effectiveness of the ERP.
3	Lack of standards covering training to cope with UAS emergencies	-5	Several good standards dedicated to remote crew training are already being developed. Therefore, it is recommended not to develop a new standard but to amend the ones under development (e.g. ISO 23665) to include also a training syllabus dedicated to the ERP.

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3.3.4.2 Details

Table 57

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Lack of standards dealing with ERP specifically developed for UAS operations (especially crew duties)	Safety (3)	Medium	Most UAS operators do not have specific emergency procedures in their operations manual and tend to confuse contingency and emergency procedures. A standard would be required to define harmonised procedures. However, the ERP is not a mandatory mitigation required by SORA. In general, the impact on safety depends on the complexity of the operation and the type of UAS. For operations in sparsely populated environment the need for an ERP is not so evident as most of abnormal situations are likely to be handled by automatic recovery procedures. For very complex operations (e.g. OPS in controlled airspace in airport environment) the impact would be higher since it is required to interact with ATC in case of emergency. Hence it is assumed that the impact on safety in average is medium.	0	0
		Cost of compliance to the requirement with a lack standard (2)	Medium	For operators, the lack of a standard means that they have to build their own ERP without specific best practices, but the cost is not expected to be high as this is what occurs for most operators today. The cost of compliance is higher for authorities when verifying the effectiveness of the ERP on a case-by-case basis.	0	0
		Environmental Impact (1)	Neutral		0	0

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		Impact on EU Industry competitiveness (1)	Positive	The lack of ERP standards would increase the business of UAS consultancy companies with expertise in risk management.	1	1
		Social Acceptance (1)	Negative	In case of incident/accident (resulting in fatalities, damages etc), the lack of recognised procedures to handle emergency situations could be seen negatively from a social perspective.	-1	-1
Total Weighted Score						**0**

Table 58

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Lack of criteria to demonstrate that the number of people at risk is reduced	Safety (3)	High	The lack of recognised criteria to evaluate that the number of people at risk is reduced leads to the difficulty to assess the effectiveness of an ERP. This is more relevant for operators with poor aeronautical culture who may not be able to develop an ERP suitable for the intended operation.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	For operators, the lack of these criteria means that they have to build a safety case on their own. Usually operators are not familiar with risk management techniques and will be probably obliged to ask for consultancy services. The cost of compliance is high for authorities as they have to verify the effectiveness of the ERP on a case-by-case basis.	-1	-2
		Environmental Impact (1)	No impact		0	0

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		Impact on EU Industry competitiveness (1)	Positive	The lack of ERP standards would increase the business of UAS consultancy companies with expertise in risk management.	1	1
		Social Acceptance (1)	Negative	In case of incident/accident (resulting in fatalities, damages etc), the lack of recognised procedures to handle emergency situations could be seen negatively from a social perspective.	-1	-1
Total Weighted Score						-5

Table 59

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
3	Lack of standards covering training to cope with UAS emergencies	Safety (3)	High	Personnel should be always adequately trained to cope with emergency situations. Experience and skills are needed to handle such situations safely and a dedicated training programme should be developed.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	The lack of standards does not help authorities to verify remote crew skills.	0	0
		Environmental Impact (1)	No impact		0	0
		Impact on EU Industry competitiveness (1)	Negative	The lack of standards does not support flight schools in developing training programmes.	-1	-1

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		Social Acceptance (1)	Negative	In case of incident/accident (resulting in fatalities, damages etc), the lack of recognised training requirements to handle emergency situations could be seen negatively from a social perspective.	-1	-1
Total Weighted Score						**-5**

3.3.5 Conclusions and Recommendations

The gap assessment contained in this section deals with the ERP, representing one of the three mitigations for Ground Risk in SORA. However, since in SORA the ERP is an optional mitigation, the priority of this standardisation is not high and mainly depends on the type of operation. Therefore, it is recommended to develop ERP strategies to handle emergency situations for critical operations (e.g. OPS in airport environment). In addition, there is no need to develop a specific standard for ERP training, but it will be enough to amend standards under development (e.g. ISO 23665) to include ERP related training activities.

Additional notes:

- Although the ERP in SORA is an optional mitigation, EASA has already included the need to have an ERP in the draft STS (ref. Opinion 05/2019) and in the first set of AMC for Pre-Defined Risk Assessment (PDRA).
- The priority of this standardisation should be high linked to the type of operation and including high SAIL, a template to compile the ERP and assignment of duties to crews.

Table 60 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Integrity	Low	N/A	NO STANDARD REQUIRED		

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Criteria	Medium	Partial	NO SPECIFIC STANDARD (see Table 62)		Absence of criteria to demonstrate that the number of people at risk is reduced Lack of standards dealing with ERP specifically developed for UAS operations (especially crew duties)
	High	Partial	NO SPECIFIC STANDARD		

Table 61 Recommended Standards - Assurance

Assurance					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Assurance Criterion #1 (Procedures)	Low	N/A	NO STANDARD REQUIRED		
	Medium	Full	ISO 21384-3: Operational Procedures	Standard provides only high level guidance	
	High	Full	ISO 21384-3: Operational Procedures	Standard provides only high level guidance	
Assurance Criterion #2 (Training)	Low	N/A	NO STANDARD REQUIRED		
	Medium	Partial	ISO 23665 Unmanned aircraft systems - Training for personnel involved in UAS operations	Not yet published	Lack of standards covering training to cope with UAS emergencies
	High	Partial			

The following matrix further highlights the applicability of each assessed standard to the criteria set by the requirement.

Table 62 Standards' Applicability

Int/Ass	Requirement	ASTM F-3266	ISO 21384-3	ISO 23665	ISO 45001	IATA ERP
Integrity	ERP Suitable for the situation (UAS OPS)	X	✔	✔	X	X

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	ERP Practical to use	X	X	X	X	✓
	Criteria to define emergency situations	X	X	✓	✓	✓
	Remote Crew duties	X	X	X	X	X
	Criteria for reduction of people at risk	X	X	X	X	X
Assurance	Procedures	X	✓	X	X	X
	Training syllabus (covered in Session 5)	✓	X	✓	✓	X

3.4 Tactical Mitigations - VLOS

3.4.1 Requirement Description

Table 63 Requirements' Description

Criteria	Description
Criterion #1 (De-confliction scheme)	The operator should produce a documented VLOS de-confliction scheme, explaining the methods that will be applied for detection and the criteria used to avoid incoming traffic.
Criterion #2 (Phraseology, procedures and protocols)	If the remote pilot relies on detection by observers, the use of communication phraseology, procedures, and protocols should be described. Since the VLOS operation may be sufficiently complex a requirement to document and approve the VLOS strategy is necessary before authorization and approval by the competent authority and/or ANSP.

3.4.2 Summary

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Table 64 Tactical Mitigations - VLOS Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	*Criterion 1*	*Criterion 2*	Global Score
Standard Practice for Communications Procedures—Phonetics	ASTM	F1583-95(2019)		P	10

3.4.3 Coverage Detail

Table 65

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*	Gaps
Standard Practice for Communications Procedures—Phonetics	ASTM	F1583-95(2019)		P	The standard potentially covers the definition of appropriate phraseology in support of VLOS de-confliction procedures
Notes: The requirement is not fully covered by any standard. A gap can be therefore identified possibly suggesting the development of a specific standard for the definition of de-confliction schemes for VLOS operations and related procedures, phraseology and protocols.					

3.4.4 Gaps

3.4.4.1 Summary

Table 66 Gap Summary – Tactical Mitigations - VLOS

Gap	Gap Description	Total	Conclusion Recommendation

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#		Weighted Score	
1	There is no existing guidance to produce a documented VLOS de-confliction scheme, explaining the methods that will be applied for detection and the criteria used to avoid incoming traffic.	-4	The gap is not particularly critical. However the development of specific guidance material for the development of VLOS de-confliction schemes would be beneficial for uniform safety and EU industry perspectives.
2	There is no existing guidance to develop the procedures and protocols in support of a VLOS de-confliction scheme.	-4	The gap is not particularly critical. However the development of specific guidance for the development of procedures and protocols for VLOS de-confliction schemes would be beneficial for uniform safety in EU.

3.4.4.2 Details

Table 67

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	There is no existing guidance to produce a documented VLOS de-confliction scheme, explaining the methods that will be applied for detection and the criteria used to avoid incoming traffic.	Safety (3)	High	The lack of a standardized way to develop a VLOS de-confliction scheme (e.g. VLL priority rules, procedures for remaining well clear in drone-to-drone) might compromise uniform safety.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	The cost of developing a VLOS de-confliction scheme in absence of a reference standard is medium on average since the UAS operator could easily develop its own, especially if he has significant experience. On the other side, the evaluation of the effectiveness of the proposed de-confliction scheme by the authority can be more difficult as each proposed scheme will need to be separately evaluated without a common reference.	0	0
		Environmental Impact (1)	Neutral	No significant environmental impact is foreseen	0	0

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		Impact on EU Industry competitiveness (1)	Negative	VLOS Operations in specific areas can be limited in absence of a reliable VLOS de-confliction scheme. According to the SESAR Drone Outlook study, VLOS operations in the EU will reach 100k/year in the Specific category leading to an overall negative impact on EU industry	-1	-1
		Social Acceptance (1)	No impact	No impact is foreseen on social acceptance	0	0
Total Weighted Score						**-4**

Table 68

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	There is no existing guidance to develop the procedures and protocols in support of a VLOS/E-VLOS de-confliction scheme.	Safety (3)	High	The lack of a standardized way to develop an E-VLOS de-confliction scheme might compromise uniform safety across all UAS operations.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	The cost of developing procedures and protocols VLOS de-confliction scheme in absence of a reference standard is medium on average since the UAS operator could easily develop its own, especially if he has significant experience. On the other side, the evaluation of the effectiveness of the proposed de-confliction scheme by the authority can be more difficult as each proposed procedures will need to be separately evaluated without a common reference.	0	0
		Environmental Impact (1)	Neutral	No significant environmental impact is foreseen	0	0
		Impact on EU Industry competitiveness (1)	Negative	VLOS Operations in specific areas can be limited in absence of a reliable VLOS procedures and protocols. According to the SESAR Drone Outlook study, VLOS operations in the EU will reach	-1	-1

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				100k/year in the Specific category leading to an overall negative impact on EU industry		
		Social Acceptance (1)	No impact	No impact is foreseen on social acceptance	0	0
Total Weighted Score						-4

3.4.5 Conclusions and Recommendations

The main gap to be addressed in relation to VLOS Tactical mitigation is the absence of guidance to develop de-confliction schemes that are suitable for the operations. It is therefore recommended to develop dedicated guidance material to help operators produce a VLOS de-confliction scheme, where the methods that will be applied for detection and the criteria used to avoid incoming traffic are explained, along with the procedures that are in place to support such scheme.

Additional notes:

- It is noted that de-confliction between drones is currently out of SORA scope. It is therefore recommended to develop dedicated guidance material to help operators produce a VLOS/E-VLOS de-confliction scheme, where the methods that will be applied for detection and the criteria used to avoid incoming traffic are explained, along with the procedures that are in place to support such scheme.

Table 69 Recommended Standards

Criteria	Coverage	Recommended standard	Limitations/Notes	Gaps

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Criterion #1 (De-confliction scheme)	N/A	NO STANDARD AVAILABLE YET		There is no existing guidance to produce a documented VLOS de-confliction scheme, explaining the methods that will be applied for detection and the criteria used to avoid incoming traffic. There is no existing guidance to develop the procedures and protocols in support of a VLOS de-confliction scheme.
Criterion #2 (Phraseology, procedures and protocols)	Partial	ASTM F1583-95 (2919): Standard practice for communications procedures - phonetics	Potentially covers the definition of appropriate phraseology in support of VLOS de-confliction procedures	Not specific for UAS operations

3.5 Tactical Mitigations Performance Requirements - BVLOS

3.5.1 Requirement Description

Table 70 Requirements' Description

Function	Arc	Requirement Description
Detect	Arc-a	No requirement
	Arc-b	The expectation is for the applicant's DAA Plan to enable the operator to detect approximately 50% of all aircraft in the detection volume. This is the performance requirement in absence of failures and defaults. It is required that the applicant has awareness of most of the traffic operating in the area in which the operator intends to fly, by relying on one or more of the following: • Use of (web-based) real time aircraft tracking services

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		• Use Low Cost ADS-B In /UAT/FLARM/Pilot Aware aircraft trackers • Use of UTM Dynamic Geofencing • Monitoring aeronautical radio communication (i.e. use of a scanner)
	Arc-c	The expectation is for the applicant's DAA Plan to enable the operator to detect approximately 90% of all aircraft in the detection volume. To accomplish this, the applicant will have to rely on one or a combination of the following systems or services: • Ground based DAA /RADAR • FLARM • Pilot Aware • ADS-B In/ UAT In Receiver • ATC Separation Services • UTM Surveillance Service • UTM Early Conflict Detection and Resolution Service • Active communication with ATC and other airspace users The operator provides an assessment of the effectiveness of the detection tools/methods chosen.
	Arc-d	A system meeting RTCA SC-228 or EUROCAE WG105 MOPS/MASPS (or similar) and installed in accordance with applicable requirements.
Decide	Arc-a	No requirement.
	Arc-b	The operator must have a documented deconfliction scheme, in which the operator explains which tools or methods will be used for detection and what the criteria are that will be applied for the decision to avoid incoming traffic. In case the remote pilot relies on detection by someone else, the use of phraseology will have to be described as well. Examples: • The operator will initiate a rapid descend if traffic is crossing an alert boundary and operating at less than 1000ft.

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		• The observer monitoring traffic uses the phrase: 'DESCEND!, DESCEND!, DESCEND!'.
	Arc-c	All requirements of ARC 2 and in addition: 1. The operator provides an assessment of the human/machine interface factors that may affect the remote pilot's ability to make a timely and appropriate decision. 2. The operator provides an assessment of the effectiveness of the tools and methods utilized for the timely detection and avoidance of traffic. In this context timely is defined as enabling the remote pilot to decide within 5 seconds after the indication of incoming traffic is provided. The operator provides an assessment of the failure rate or availability of any tool or service the operator intends to use.
	Arc-d	A system meeting RTCA SC-228 or EUROCAE WG105 MOPS/MASPS (or similar) and installed in accordance with applicable requirements.
Command	Arc-a	No requirement.
	Arc-b	The latency of the whole command (C2) link, i.e. the time between the moment that the remote pilot gives the command and the airplane executes the command must not exceed 5 seconds.
	Arc-c	The latency of the whole command (C2) link, i.e. the time between the moment that the remote pilot gives the command and the airplane executes the command must not exceed 3 seconds.
	Arc-d	A system meeting RTCA SC-228 or EUROCAE WG105 MOPS/MASPS (or similar) and installed in accordance with applicable requirements.
Execute	Arc-a	No requirement.
	Arc-b	UAS descending to an altitude not higher than the nearest trees, buildings or infrastructure or ≤ 60 feet AGL is considered sufficient. The aircraft should be able to descend from its operating altitude to the 'safe altitude' in less than a minute.
	Arc-c	Avoidance may rely on vertical and horizontal avoidance manoeuvring and is defined in standard procedures. Where horizontal manoeuvring is applied, the aircraft shall be demonstrated to have adequate performance, such as airspeed, acceleration rates, climb/descend rates and turn rates.

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		The following are suggested minimum performance criteria: • Airspeed: ≥ 50 knots • Rate of climb/descend: ≥ 500 ft/min • Turn rate: ≥ 3 degrees per second
	Arc-d	A system meeting RTCA SC-228 or EUROCAE WG105 MOPS/MASPS (or similar) and installed in accordance with applicable requirements.
Feedback Loop	Arc-a	No requirement.
	Arc-b	Where electronic means assist the remote pilot in detecting traffic, the information is provided with a latency and update rate for intruder data (e.g. position, speed, altitude, track) that support the decision criteria. For an assumed 3 NM threshold, a 5 second update rate and a latency of 10 seconds is considered adequate.
	Arc-c	The information is provided to the remote pilot with a latency and update rate that support the decision criteria. The applicant provides an assessment of the aggravated closure rates considering traffic that could reasonably be expected to operate in the area, traffic information update rate and latency, C2 Link latency, aircraft manoeuvrability and performance and sets the detection thresholds accordingly. The following are suggested minimum criteria: • Intruder and ownship vector data update rates: ≤ 3 seconds.
	Arc-d	A system meeting RTCA SC-228 or EUROCAE WG105 MOPS/MASPS (or similar) and installed in accordance with applicable requirements.

Table 71 Air Risk Class Tactical Mitigation Requirements

	Arc-a	Arc-b	Arc-c	Arc-d
Tactical Mitigation	Allowable loss of function and performance of the Tactical	Allowable loss of function and performance of the Tactical	Allowable loss of function and performance of the Tactical	Allowable loss of function and performance of the Tactical

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Integrity	Mitigation System: < 1 per 100 Flight Hours (1E-2 Loss/FH). The requirement is considered to be met by commercially available products. No quantitative analysis is required.	Mitigation System: < 1 per 100 Flight Hours (1E-2 Loss/FH). The requirement is considered to be met by commercially available products. No quantitative analysis is required.	Mitigation System: < 1 per 1,000 Flight Hours (1E-3 Loss/FH). This rate is commensurate with a probable failure condition.	Mitigation System: < 1 per 100,000 Flight Hours (1E-5 Loss/FH). A quantitative analysis is required.
Tactical Mitigation Assurance	No Assurance Required.	The operator is declaring that the Tactical Mitigation System and procedures will mitigate the risk of collisions with manned aircraft to an acceptable level.	The operator provides evidence that the tactical mitigation system will mitigate the risk of collisions with manned aircraft to an acceptable level.	The evidence that the tactical mitigation system will mitigate the risk of collisions with manned aircraft to an acceptable level is verified by a competent third party.

3.5.2 Summary

Table 72 Tactical Mitigations - BVLOS Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard title	Function	Arc	Coverage (P-Partial coverage, F-Full coverage)	Global Score
RTCA DO-365: Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems-Phase 1	All	d	P	3
RTCA DO-365A: Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems-Phase 2	Detect	d	P	N.A.
	Decide	d	P	
RTCA DO-366: Minimum Operational Performance Standards for Air To Air Radar for Detect And Avoid Systems	Detect	d	P	N.A.

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	F. Loop	d	P	
	Integrity	d	P	
RTCA DO-289: Minimum Aviation System Performance Standards for Aircraft Surveillance Applications	Detect	d	P	12
	Decide	d	P	
	F. Loop	d	P	
	Integrity	d	F	
RTCA DO-376: Minimum Operational Performance Standards for Airborne Collision Avoidance System Xu (ACAS Xu)	All	d	P	2
EUROCAE WG 105/SG 11: Minimum Aviation System Performance Standard (End-to-end Requirements at system level) for DAA of IFR Flights in class A-C airspace	All	d	P	3
EUROCAE ED 258: Operational services and environment description (OSED) for detect and avoid in class D-G airspaces under VFR/IFR	Detect	b c d	P	6
	Decide	d	P	
EUROCAE: Operational Services and Environmental Description for DAA in Very Low-Level Operations	Detect	d	P	7
	Decide	d	P	
	Command	d	P	
EUROCAE WG 105: Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Satellite)	Command	d	P	5
	Feedback Loop	d	P	

3.5.3 Coverage Detail

Table 73

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage,	Gaps (Requirements not covered)

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				F-Full coverage)	
RTCA DO-365: Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems-Phase 1	All	d		P	All the functionalities are covered. However, gaps have been identified in terms of minimum drone size and airspace applicability (See notes). The MOPS assume that all equipment that supports or sends data to the DAA system is at a design assurance level appropriate for the intended function. Other standards (e.g. RTCA DO 178C for software) can be used to ensure that the system meets such requirement.

Notes:

General and applicability:

The document provides a standard for DAA for UAS operating within the American National Airspace System (NAS).

The MOPS contain architectural requirements for different components constituting the DAA concept, in particular the UA segment, the Ground Control Station.

The MOPS apply to UAS (any configuration) with a MTOM greater than 55 lbs (i.e. 25 kg) and do not address the following conditions:

- Any visual separation clearance or flight under Visual Flight Rules (VFR);
- Operations in the VFR traffic pattern of an airport;
- Ground taxi operations;
- Flights operating in Class A, B, or C airspace;
- Detection of terrain, obstacles, adverse weather (out of scope of SORA TMPR)
- Bird encounters (out of scope of SORA TMPR)
- All types of UAS (out of scope of SORA TMPR)

In other words, the DAA system will allow a UAS pilot to conduct IFR flight operations between an airport or launch/recovery zone, where another means of traffic separation is provided.

Detect function:

Three types of detection sensors are considered including active airborne surveillance, ADS-B In and airborne radar. These sensors allow to detect most of the traffic (also non-cooperative aircraft).

MOPS for specific radar requirement are contained in DO-366. However, radar operational performance requirements at the aircraft level and associated

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recommendations are derived from the UAS DAA MOPS DO-365. ***Decide Function:*** The standard provides the conditions in which an alert must be provided to the remote pilot (i.e. when the intruder is inside the so called “hazard zone”). Specification on display of traffic information are provided. Different alert levels are available and guidance on avoidance manoeuvres and remote pilot actions are provided as well for different conditions. ***Command function:*** Minimum performance requirements in terms of (terrestrial) datalink communication are provided in terms of availability,latency,etc in a dedicated appendix that reprises DO-362 (MOPS for Terrestrial C2 Link). Satellite datalink is addressed in the phase 2 MOPS. ***Execute function:*** Flight dynamics performance specifications are provided in terms of turn rate and vertical manoeuvres. ***Feedback loop***: Requirements on minimum data rate for intruder data are provider for different conditions and sensors. In conclusion these MOPS are fully compliance with the most demanding SORA TMPR requirements (i.e. ARC-d requirements). As a consequence, the MOPS fulfil also requirements associated to lower Air Risk Classes. Consequently, also with lower Air Risk Classes. Anyway the requirements are too demanding (and hardly applicable) for small drones operating in the Specific Category. In addition, the MOPS require equipment certification according to recognised FAA TSO (this is reasonable at maximum for Arc-d where safety requirements are expected to be comparable to the Certified Category). Future revisions of this document are expected to address other operational scenarios and sensors better suited to smaller UAS needs, as well as other DAA architectures, including ground-based sensors.

Table 74

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)

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RTCA DO-365A: Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems-Phase 2	Detect	d		P	The document does not contain MOPS and there are limitations in terms of drone size and airspace applicability.
	Decide	d		P	The document does not contain MOPS and there are limitations in terms of drone size and airspace applicability.
	Command	d	X		
	Execute	d	X		
	F. Loop	d	X		
	Integrity	d	X		

Notes:

General and applicability:

This document contains the OSED for the Phase 2 MOPS for DAA systems used in aircraft transiting and performing extended operations in Class D, E, and G airspace along with transiting Class B and C airspace. It includes equipment to enable UAS operations in terminal airspace during approach and departure in Class C, D, E, and G airspace, and off-airport locations. It does not apply to small UAS operating in low-level environments (below 400') or other segmented areas. Likewise, it does not apply to operations in the visual traffic pattern of an airport or surface operations.

Detect:

Operational requirements include the detection of both cooperative and non-cooperative aircraft in the relevant airspace. MOPS will address specific detection performance requirements.

Decide:

General requirements on how information should be displayed to remote pilot on the GCS are provided.

Activity diagrams are provided for different situations, depicting the notional way that activities unfold during an encounter. Precise responsibilities for remote pilot and other stakeholders (e.g. ATC) are outlined.

Command:

No performance requirements are provided on the C2 Link. However, the OSED takes into account the possibility to have both terrestrial and satellite communication.

Execute:

No specific flight dynamics performance requirements are provided.

Feedback Loop:

No specific requirements are provided.

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In conclusion the OSED must be complemented by MASPS/MOPS to be an effective means of compliance with SORA Arc-d requirements.

Table 75

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
RTCA DO-366: Minimum Operational Performance Standards for Air To Air Radar for Detect And Avoid Systems	Detect	d		P	The document covers the Detect functionality but there are some limitations in terms of airspace applicability (i.e. VLL not covered). See notes for more details.
	Decide	d	X		
	Command	d	X		
	Execute	d	X		
	Feedback Loop	d		P	The document covers the Detect functionality but there are some limitations in terms of airspace applicability (i.e. VLL not covered). See notes for more details.
	Integrity	d		P	The MOPS assume that all equipment that supports or sends data to the DAA system is designed with a design assurance level appropriate for the intended function. Other standards (e.g. RTCA DO 178C for software) can be used to ensure that the system meets such requirement.

Notes:

General and applicability:

This document contains Phase I Minimum Operational Performance Standards (MOPS) for the air-to-air radar for Detect and Avoid (DAA) systems implemented in Unmanned Aircraft (UA) transitioning to and from Class A or special use airspace, traversing Class D, E, and G airspace in the National Airspace System (NAS). It does not apply to small Unmanned Aircraft Systems (sUAS) operating in low-level environments (below 500’) or other segmented areas. Likewise, it does not apply to operations in the Visual Flight Rules (VFR) traffic pattern of an airport. These standards specify the radar system characteristics that should be useful for

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designers, manufacturers, installers and users of the equipment. This document sets performance standards for the air-to-air radar as part of a DAA system. Separate MOPS (i.e. DO 365) were developed for the DAA systems. ***Detect:*** The radar is able to detect non-cooperative intruders with a minimum Radar cross section of a human and is not able to detect any hovering or stationary object as it depends on the radar cross section as well as the level of ground clutter. Therefore the system should be able to detect manned aircraft in the operational area but not small drones. ***Decide:*** Radar output shall be processed by a DAA system (e.g. DO 365). ***Command:*** No requirements on the link performance as the focus is on radar performance. ***Execute:*** No requirements on ownship performance are given. ***Feedback Loop***: The update rate is 1 Hz.

Table 76

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
RTCA DO-289: Minimum Aviation System Performance Standards for Aircraft Surveillance Applications	Detect	d		P	Only DAA functions to manage cooperative intruders are provided.
	Decide	d		P	
	Command	d	X		
	Execute	d	X		
	Feedback Loop	d		P	Only DAA functions to manage cooperative intruders are provided.

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	Integrity	d		F	An operational hazard analysis is provided as well as a fault tree analysis to allocate safety objectives.

Notes:
General and applicability:
This document contains MASPS for Aircraft Surveillance Applications (ASA). In particular it provides requirements for all subsystems supporting the operational application of ASA (e.g. ADS-B). This standard specifies characteristics that should be useful to designers, installers, manufacturers etc for systems intended for operational use in the US National Airspace System.
Manned aviation is the target although some requirements and functions may be applied also for UAS.
Detect:
The surveillance function is performed by ADS-B/TIS-B that is only able to detect cooperative traffic.
Decide:
Some functions aimed at improving pilot situational awareness of proximate traffic. The Cockpit Display of Traffic Information (CDTI) is the flight crew interface where alerts, graphical guidance etc. are displayed.
Command:
No reference to C2 Link as the standard is developed for manned aviation applications.
Execute:
No reference on aircraft performance dynamics.
Feedback Loop:
Requirements on latency as well as on update intervals are provided for each function.
This standard is not specific for UAS and does not cover all SORA requirements. Therefore it is better to take as reference standards on DAA systems.

Table 77

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
RTCA DO-376: Minimum Operational Performance	Detect	d		P	The MOPS cover all the functionalities but there are

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Standards for Airborne Collision Avoidance System Xu (ACAS Xu)	Decide	d		P	some limitations, mainly in terms of airspace applicability. See notes.
	Command	d		P	
	Execute	d		P	
	Feedback Loop	d		P	
	Integrity	d		P	The document requires compliance with other standards for design assurance (i.e. DO 178 C, DO 254).

<u>Notes:</u>

General and applicability:

This document contains the MOPS for ACAS Xu concept. ACAS Xu is designed for vehicles with new surveillance technologies and different performance characteristics with respect to traditional manned aviation such as UAS.

It is a complete Detect and Avoid (DAA) solution that provides RWC in compliance with the SC 228 DAA Minimum Operational Performance Standards (MOPS), and CA in compliance with the Minimum Aviation System Performance Standards (MASPS) for the Interoperability of Airborne Collision Avoidance Systems.

In addition to vertical logic, XU also supports horizontal logic, intelligently switching between the two based on a variety of factors to resolve encounters more effectively.

This ACAS Xu concept is developed for the NAS (National American Airspace), possibly overcoming the limitations of DAA Phase 1 and Phase 2 developed by RTCA.

The ACAS Xu concept has the following applicability range:

<u>Environment</u>

- Lower-risk airspace:
    - Infrequent manned traffic areas
    - Low probability of encounters with manned aircraft o Away from approach/departure paths near airports during known active times
    - Below typical transit altitudes for IFR flights

- Classes G and E airspace (below about 1,200 AGL), Class B, C, D (below about 400/500 AGL, below obstacle clearance surface, within LAANC designated areas)
    - No ATC separation services o ATC coordination/approval in Classes B, C, and D

- Mixed cooperative and non-cooperative traffic – VFR and IFR manned traffic
    - May include rotorcraft, crop dusters, ultralights, LSA/small GA fixed-wing
    - No commercial fixed wing traffic

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- Includes but is not limited to “All cooperative”, low-altitude airspace (e.g., Mode C veil in 2020)
- Day and night-time; VMC and IMC

Operations

- Applicable to avoidance of manned aircraft

o No UA-to-UA (reserved for future efforts)
o The UA will take into consideration the same right-of-way rules as manned aircraft with regards to collision avoidance and right of way
o Technical capabilities may function in manner that would also avoid some UAs but this will not drive requirements

- No requirements for terrain/obstacle/airspace avoidance function (e.g., minimum separation from obstacles)

o Requirements will address the effects of any terrain/obstacles/airspace avoidance functions on the DAA system ù

- No birds or natural hazard (e.g., weather, clouds) avoidance requirements

Aircraft

• Any smaller UA less than 254 lbs. (weight of ultralight aircraft)
• Operating at airspeeds below 100kts
• Fixed-wing, rotorcraft, hybrid transitional categories

Detect:

Surveillance inputs include ADS-B, Mode S, Mode C, and non-cooperative surveillance.

Decide:

The system is capable of issuing vertical guidance and horizontal guidance for both cooperative and non-cooperative traffic and the logic can be tuned to accommodate a wide variety of UAS vehicle performance.

Command:

The XU MOPS specify requirements (e.g. latency, vertical acceleration) for response to XU CA manoeuvres. If a platform cannot meet those requirements with manual response, then it must implement automatic response.

Execute:

Performance requirements in terms of turn rate and vertical manoeuvres are specified. The same requirements of DAA MOPS are retained.

Feedback Loop:

Requirements on surveillance update rates are provided.

In conclusion the ACAS Xu concept offer an alternative to traditional DAA concept (RWC plus TCAS CA). However, TCAS it is designed for large, manned, turbine-

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powered transport aircraft and could be applicable for large UAS once compliance with interoperability requirements is demonstrated. XU offers increased flexibility for other potential future changes (such as horizontal manoeuvres or decreased/different climb rates than those assumed by TCAS II), increased adaptability to new surveillance inputs, reduced collision risk (compared to TCAS II), and the ease of extending an interoperable concept to new user classes. In addition the Xu implementation is suitable (but not limited to) also for small drones operating at VLL.

Table 78

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
EUROCAE WG 105/SG 11: Minimum Aviation System Performance Standard (End-to-end Requirements at system level) for DAA of IFR Flights in class A-C airspace	Detect	d		P	The standard covers all the functional requirements but there are some limitations in term of drone size and airspace applicability (See notes).
	Decide	d		P	
	Command	d		P	
	Execute	d		P	
	F. Loop	d		P	
	Integrity	d		P	Safety requirements in terms of maximum allowable failure rate are provided. To comply with requirements on software design assurance, it is necessary to refer also to EUROCAE ED 12C/DO 178C.
Notes: ***General and applicability:*** The document contains the Minimum Aviation System Performance Standards (MASP) for DAA in airspace classes A, B, C under IFR. Ground based DAA is not covered. ***Detect*:** The document states that the DAA system shall detect cooperative and non-cooperative intruders in prescribed environmental conditions. ***Decide:*** The MASPS contain only high-level requirements on decide criteria, proposed manoeuvres and interface with remote pilot.					

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Command: Minimum requirements on round trip latency of the C2 Link are provided. C2 link requirements are given at RLP[2] (Required Link performance), i.e. in terms of availability, transaction time, continuity and integrity). ***Execute:*** Requirements on flight dynamics performance are provided in terms of rate of climb, descent, banking turn etc. ***Feedback Loop:*** Specifications on intruder data update are provided. In conclusions, MASPS are technology/solution agnostic as they only define system requirements and should be complemented by MOPS to define details at component level. The current version of the MASPS does not include detection of adverse weather conditions, obstacles, terrain etc. but it is announced that future revision of the document will also address these issues[3].

Table 79

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)

[2] RLP is a term proposed by JARUS and adopted by ICAO RPAS panel.

[3] It should be noted that SORA TMPR requirement only deal with manned traffic detection.

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EUROCAE ED 258: Operational services and environment description (OSED) for detect and avoid in class D-G airspaces under VFR/IFR	Detect	b,c,d		P	The document is still at OSED level. MASPS/MOPS required to comply with Arc-d. However, the standard only applies to a given portion of airspace.
	Decide	d		P	See notes.
	Command	d	X		
	Execute	d	X		
	F. Loop	d	X		
	Integrity	d	X		

Notes:

General and applicability:

The purpose of this Operational Services and Environment Definition (OSED) is to provide a basis for assessing and establishing operational, safety, performance, and interoperability requirements for the Detect And Avoid Remain Well Clear (RWC) and Collision Avoidance (CA) functions in Class D-G Airspaces. Until a new definition for RPAS Flight rules is agreed at international level, both Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) operation are in scope of the DAA functions described in this OSED.

Flight phases on ground or near ground e.g. take-off, landing, initial climb and final descent are formally excluded although the DAA system is expected to operate in these regions possibly with reduced performance.

***Detect*:**

The document states that both cooperative and non-cooperative traffic shall be detected as both traffic could be present in D-G airspace classes.

Decide:

Although general requirements on HMI are included, conditions for which an advisory alert is raised to the RP are not included in this OSED but will be part of interoperability MASPS activity of this DAA system.

Command:

No performance requirement are provided for the C2 Link (it is only recognised that C2 Link is an essential element to support DAA functions).

Execute:

No specific flight dynamics performance requirements are provided.

Feedback Loop:

No specific requirements are provided.

In conclusion this OSED is the starting point for future development of MASPS. It can be used as reference for operators flying in the relevant conditions to determine how to equip the drone to effectively detect the traffic present in the area.

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Table 80

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
EUROCAE: Operational Services and Environmental Description for DAA in Very Low-Level Operations	Detect	d		P	The document is still at OSED level. MASPS/MOPS required to comply with Arc-d. However, the standard only applies to a given portion of airspace.
	Decide	d		P	See Notes
	Command	b,c,d	X		
	Execute	b,c,d	X		
	F. Loop	b,c,d	X		
	Integrity	d	X		

Notes:

General and applicability:

This document provides the Operational Services and Environment Definition (OSED) for the Detect and Avoid (DAA) capabilities to support very low level (VLL) operations conducted by unmanned aircraft systems (UAS) in the Specific and Certified Category. All phases of flight are covered and both day and night conditions.

Adverse weather, operations in vicinity of airports, obstacles and wildlife are taken into account.

This OSED is the baseline for the development of MASPS and MOPS.

Detect:

Although not referring to specific equipment, the OSED provide guidance on the type of traffic that could be present at VLL, including manned and unmanned aircraft.

Detection of hazards can be achieved through on-board sensors, ground based sensors, databases or U-Space services.

Decide:

The document defines the DAA functionality of providing situational awareness and alerts to the remote pilot as well as guidance for avoidance manoeuvres. However specific requirements will be provided in the MASPS/MOPS. In addition, clear VLL flight rules still have to be defined.

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Command:
No performance requirements are provided on the C2 Link. However the OSED takes into account the possibility to have both RLOS and BRLOS (terrestrial or satellite) communication.
Execute:
No specific flight dynamics performance requirements are provided.
Feedback Loop:
No specific requirements are provided.

In conclusion the OSED must be complemented by MASPS/MOPS to be an effective means of compliance with SORA Arc-d requirements. Anyway, it could be used as guidance for lower Air Risk classes for the *Detect* functionality, in order to proper select the tactical mitigation that is more effective in the target environment.

Table 81

Standard title	Function	Arc	No coverage	Coverage (P-Partial coverage, F-Full coverage)	Gaps (Requirements not covered)
EUROCAE WG 105: MOPS C2 Link (SATCOM)	Detect	d	X		
	Decide	d	X		
	Command	d		P	Terrestrial link is not covered.
	Execute	d	X		
	F. Loop	d		P	MOPS only cover satellite link.
	Integrity	d	X		

Notes:
General and applicability:
This document defines MOPS for C2 Link relying on near-geosynchronous (GEO) orbit systems operating in the 5030-5091 MHz frequency band (satellite link).
Detect:
The standard does not address aircraft detection issues.
Decide:
The standard does not address criteria to take decisions with the aim to avoid collisions.

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Command:
The standard estimates performance (in terms of latency) for the execution of manoeuvres both in manual and automatic mode.
Execute:
No requirements on aircraft flight dynamics.
Feedback Loop:
Estimation on situational awareness data (rates and sizes) to support DAA function are provided.

In conclusion the standard addresses C2 Link (satellite link) performance to support DAA functions.

3.5.4 Gaps

3.5.4.1 Summary

Table 82 Gap Summary – Tactical Mitigations - BVLOS

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of standards (i.e. MOPS) on DAA for small drones.	-11	It is recommended to develop standards for DAA on small drones operating at VLL, mainly for safety and commercial reasons. It is expected that this gap will be filled by EUROCAE WG 105/SG 13 (including RWC, terrain, obstacles, etc.), as well as by ASTM RTCA with the ACAS sXu MOPS.
2	Lack of standards (i.e. MOPS) for small drones above VLL.	-9	RTCA standards cover DAA requirements for OPS above VLL but are suitable only for large drones. It is therefore recommended to develop standards for DAA above VLL for small drones. This is not a typical operational situation (as most small drones will be operated at VLL) but in principle it is allowed by SORA and tactical mitigations are needed. This gap may be filled by RTCA through the planned ACAS sXu MOPS.

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3.5.4.2 Details

Table 83

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Lack of standards (i.e. MOPS) on DAA for small drones at VLL	Safety (3)	Very High	Reliable DAA solutions are needed to avoid conflict between unmanned and manned traffic. Although small drones have a very limited size and mass, several studies indicate that effect of possible collisions may be catastrophic, resulting in serious damages [1].	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	High	The absence of recognised DAA solutions makes it impossible to carry out operations associated to Arc-d. This leads to the necessity to segregate airspace (which has a cost and is time consuming for operators).	-1	-2
		Environmental Impact (1)	Bad	DAA concept for VLL may deal with avoidance of wildlife or protected areas.	-2	-2
		Impact on EU Industry competitiveness (1)	Negative	As outlined in [4], European players are expected to play a key role in developing and commercialising drone technologies compatible with future airspace management requirements, including detect and avoid technology.	-1	-1
		Social Acceptance (1)	No impact	Until reliable DAA solutions are developed, certain types of operations will not be authorised by Authorities, but no particular societal concern is expected.	0	0
Total Weighted Score						-11

Table 84

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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2	Lack of standards (i.e. MOPS) for small drones above VLL	Safety (3)	Very High	Reliable DAA solutions are needed to avoid conflict between unmanned and manned traffic. Although small drones have a very limited size and mass, several studies indicate that effect of possible collisions may be catastrophic, resulting in serious damages	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	High	The absence of recognised DAA solutions makes impossible to carry out operations associated to Arc-d. This leads to the necessity to segregate airspace (which has a cost and is time consuming for operators).	-1	-2
		Environmental Impact (1)	No impact		0	0
		Impact on EU Industry competitiveness (1)	Negative	European players are expected to play a key role in developing and commercialising drone technologies compatible with future airspace management requirements, including detect and avoid technology. Compliance with this standard may represent one of the pillars for safe integration of drones in the civilian airspace and may enable complex operations (such as cargo), potentially expanding business of several companies.	-1	-1
		Social Acceptance (1)	No impact	Until reliable DAA solutions are developed, certain types of operations will not be authorised by Authorities, but no particular societal concern is expected.	0	0
Total Weighted Score						-9

3.5.5 Conclusions and Recommendations

Several standards dealing with DAA are being developed, especially by RTCA and EUROCAE. None of the standards fully cover SORA TMPR, due to each standard being targeted to a specific operational environment.

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RTCA MOPS for DAA Phase 1 are already published and fully cover all the SORA requirements, although the DAA concept does not support VLL operations and is not applicable for small UAS (i.e. UAS with MTOM below 25 kg). Phase 2 should extend the scope of Phase 1 to wider portions of airspace (but not VLL) and supporting also satellite C2 Link.

The new Acas Xu concept, for which RTCA has already published a draft of the MOPS, should be more flexible and applicable also for smaller UAS. In addition to vertical logic, XU also supports horizontal logic, intelligently switching between the two based on a variety of factors to resolve encounters more effectively.

As a general remark, it must be noticed that the RTCA DAA concept is developed to support operations in the US National Airspace System (NAS).

In EUROCAE some activities are ongoing to develop MOPS for DAA in different airspace classes. Currently the draft of the MASPS for DAA in A-C airspace are available as well as OSED for DAA in Class D-G and OSED for DAA at VLL. Therefore, with respect to RTCA, the VLL airspace will be covered, addressing the needs of most UAS flying BVLOS in the Specific Category.

With respect to RTCA the scope of EUROCAE DAA seems to be wider although MOPS are not available yet and fully coverage of SORA TMPR cannot be claimed. One important element is the fact that, in order to be fully complaint with SORA TMPR (i.e. “Command” and “Feedback loop” requirements), standards on DAA shall define also performance on the C2 Link (mainly latency) to support its functions. The C2 Link is an essential component of the DAA concept, which is why it was decided to include in the assessment some standards addressing C2 Link performance. This is already considered in the RTCA Phase 1 where MOPS for C2 Link are mentioned as reference and performance requirements reported in a dedicated Appendix.

It is worth noting that compliance with MASPS/MOPS is only required for Arc-d. Mandating also operators flying in Arc-b or Arc-c to comply with these MOPS would be too conservative (MOPS usually represent the basis for TSO/ETSO certification processes). To ensure compliance with lower risk classes it is suggested to monitor ASTM activities related to DAA (i.e. WK 62668 and WK 62669) which are expected to produce standards “ad hoc” for Arc-b and Arc-c, possibly prescribing less demanding requirements with respect to the traditional MOPS.

In conclusion, although some requirements are not covered at present, it is expected that the on-going and planned standardisation processes should fulfill all the TMPR requirements in SORA. Moreover, it is recognised that there is a lack of MOPS for DAA applicable for small drones. However, this gap could be filled by EUROCAE within WG 105. From this analysis it emerges that DAA requirements should be adequately covered by standards in the next years. However, aspects such as cost of compliance to DAA standards should be taken into account.

- DO-365 and ED-271 have potentially a full coverage of the BVLOS TMPR requirements for all residual Air Risk levels but:
    - Limited scope (large UAS)
    - High cost of compliance

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- Other more specific standards can be used to demonstrate compliance to the requirements for specific DAA functions (e.g. DO-366: MOPS for Air To Air Radar)
- The need to develop dedicated standards for small drones operating at VLL and above might be solved by upcoming EUROCAE MOPS on DAA at VLL and ASTM & RTCA ACAS-sXu MOPS.
- **These** activities on DAA will be monitored for the development of guidance and standards more tailored to small drones.
- It is noted that EUROCAE and RTCA intend to harmonize respective plans in this area.

Table 85 Recommended Standards

<table>
<tr><th>Functions</th><th>Arc</th><th>Coverage</th><th>Recommended standard</th><th>Limitations/Notes</th><th>Gaps</th></tr>
<tr><td rowspan="4">All functions</td><td>Arc-a</td><td>N/A</td><td>NO STANDARDS REQUIRED</td><td></td><td></td></tr>
<tr><td>Arc-b</td><td>Partial</td><td rowspan="3">DO-365: MOPS for Detect and Avoid (DAA) Systems-Phase 1
ED-271: MASPS for Detect & Avoid [Traffic] in Class A-C airspaces under IFR</td><td rowspan="3">Scope is limited in terms of operational applicability (e.g. only IFR traffic)
Not applicable to all categories of drones (SWAP)
Cost of compliance for small drones is estimated to be high</td><td rowspan="3">Lack of standards (i.e. MOPS) on DAA for small drones.
Lack of standards (i.e. MOPS) for small drones above VLL.</td></tr>
<tr><td>Arc-c</td><td>Partial</td></tr>
<tr><td>Arc-d</td><td>Partial</td></tr>
</table>

3.6 *OSO 01* - Ensure the operator is competent and/or proven

3.6.1 Requirement Description

Table 86 Integrity Requirements' Description

Criteria	Robustness	Description

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Criterion #1	Low	The applicant is knowledgeable of the UAS being used and as a minimum has the following relevant operational procedures: • checklists, • maintenance, • training, • responsibilities, and associated duties.
	Medium	Same as Low. In addition, the applicant has an organization appropriate[1] for the intended operation. Also, the applicant has a method to identify, assess, and mitigate risks associated with flight operations. These should be consistent with the nature and extent of the operations specified. *(1) For the purpose of this assessment, "appropriate" should be interpreted as commensurate/proportionate with the size of the organization and the complexity of the operation.*
	High	

Table 87Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The elements delineated in the level of integrity are addressed in the ConOps.
	Medium	Prior to the first operation, a competent third party performs an audit of the organization.
	High	The applicant holds an Organizational Operating Certificate or has a recognized flight test organization. In addition, a competent third party recurrently verifies the operator competences.

3.6.2 Summary

Table 88 OSO 1 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
New Specification for Operation over People	ASTM	WK52089		P	P	N.A.

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Standard Practice for Operational Risk Assessment of Small Unmanned Aircraft Systems (sUAS)	ASTM	F3178-16		P	P	15
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	F	P	P	2
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	F	F	F	3
Assurance						
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3		F	F	3
Standard Practice for Independent Audit Program for Unmanned Aircraft Operators	ASTM	F3364-19		F	F	6

Table 89 OSO 2 Other standards to be considered in future iterations (not yet available)

Standard Title	SDO	Doc. Reference	Notes
UAS Operator Compliance Audits	ASTM	WK62731	Ballot Item Approved as F3365-2019 and Pending Publication
Common operator qualifications	SAE	ARP XXX	Document planned
Operation of Aircraft	ICAO	Annex 6-Part IV	Part IV not yet in force or published

3.6.3 Integrity Coverage Detail

Table 90

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Specification for Operation over People	ASTM	WK52089		P	P	This standard is only applicable for operations of small UAS over people.
Notes: Full draft not available						

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Table 91

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Operational Risk Assessment of Small Unmanned Aircraft Systems (sUAS)	ASTM	F3178-16		P	P	This standard does not cover the requirement about operator competency that should be adequate for the operation.

Notes:

This practice is based on a traditional approach considering probability and severity: it focuses on preparing operational risk assessments (ORAs) to be used for supporting small unmanned aircraft systems (sUAS) (aircraft under 55 lb (25 kg)) design, airworthiness, and subsequent operational applications to the civil aviation authority (CAA). The sections about design and airworthiness are out of scope of OSO #1. Nevertheless this standard could provide useful guidance to identify, assess, and mitigate risks associated with flight operations.

Table 92

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	F	P	P	This standard defines the requirements (ie. a template) for a General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS). The standard addresses the requirements and/or best practices for documentation and organization of a professional operator (i.e., for compensation and hire).

Notes:

This standard is potentially suitable to comply with the requirements of OSO #1 at all level of robustness. The coverage is set as partial since the standard does not provide guidance on what to include in the different sections of the Manual to comply with different levels of robustness. Nevertheless, a Manual prepared according to this standard is expected to include at least all required information for a Low Level of Robustness.

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Table 93

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	F	F	F	
Notes: This document specifies the requirements for safe commercial UAS operations. With respect to the UAS Operator, this standard provides a list of the documents that an operator shall prepare to demonstrate that he is competent and/or proven (i.e. OSO #1 requirements). However, it does not contain detailed guidance on how to prepare such documents. It is expected that ISO standards will refer to other SDO's standards for guidelines on how to develop specific items. Nevertheless, an operator that is certified according to this ISO standard by an ISO notified body, can certainly claim to fulfil OSO #1 at all levels of robustness.						

3.6.1 Assurance Coverage Detail

Table 94

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3		F	F	
Notes: This document specifies the requirements for safe commercial UAS operations. With respect to the UAS Operator, this standard provides a list of the documents that an operator shall prepare to demonstrate that he is competent and/or proven (i.e. OSO #1 requirements). However, it does not contain detailed guidance on how to prepare such documents. It is expected that ISO standards will refer to other SDO's standards for guidelines on how to develop specific items. Nevertheless, an operator that is certified according to this ISO standard by an ISO notified body, can certainly claim to fulfil OSO #1 at all levels of robustness.						

Table 95

Standard Title	SDO	Doc. Reference	Criteria 1	Gaps

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			L	M	H	
Standard Practice for Independent Audit Program for Unmanned Aircraft Operators	ASTM	F3364-19		F	F	This document is addressed to auditors rather than the audited operator.
Notes: This practice establishes the minimum set of requirements for an independent audit program for unmanned aircraft system operators. The intended use is to provide minimum requirements for an initial assessment of operators bringing a new aircraft model or service to market, or for periodic review of an existing operator's operations. Compliance to this practice would ensure that the audit program and those who execute it meet the consensus set of minimum requirements and qualifications.						

3.6.2 Gaps

3.6.2.1 Summary

Table 96 Gap Summary - OSO 1

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	There is no guideline or standard defining the minimum requirements for organizations in terms of structure, post-holders, etc. for categories of operations.	-4	It is recommended to develop a standard/guideline to define minimum requirements for structure and organisation operators depending on the size of the organization and the complexity of the operations.

3.6.2.2 Details

Table 97

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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1	There is no guideline or standard defining the minimum requirements for organizations in terms of structure, post-holders, etc. for categories of operations.	Safety (3)	High	Each company should have a structure, consistent with the level of activities and business. The aviation companies should have a structure with, as minimum, specific job positions for operational, logistic and safety matters. The absence of evidence on requirements for Operators structure may create atypical roles and responsibilities with unbalanced working load. Of course, the issue is more sensitive for medium/large companies. One of the more critical aspects is the responsibility of SMS.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Low	No relevant extra costs to implement a company structure in absence of a specific standard. On the opposite, when the company is well organised and managed, financial benefit may arise.	+1	+2
		Environmental Impact (1)	Bad	The absence of requirements regarding the structure may be sensitive for environmental company policy	-2	-2
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	A structured company, with specific roles and addressed responsibilities is more appreciated	-1	-1
Total Weighted Score						**-4**

3.6.3 Conclusions and Recommendations

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In order to demonstrate compliance to OSO #1 operators might use different standards already published or under development. ISO Standard 21384-3: Unmanned aircraft systems -- Part 3: Operational procedures could be considered the foundation to define high level requirements. On top of this, other standards dealing with more detailed aspects could be used (e.g. for Risk Assessment or the development of the Operations Manual).

The gap identified is related to the absence of specific standards or guidelines to define what the minimum structure of an operator should be in relation to its size and the complexity of the operation.

Moreover, there is a need for training at operator level, the details of which are addressed in OSO #9.

Table 98 Recommended Standards - Integrity

Integrity					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	Full	ISO 21384-3: Operational Procedures	It provides high level guidance	There is no guideline or standard defining the minimum requirements for organizations in terms of structure, post-holders, etc. for categories of operations.
		Partial	ASTM WK62744: New practice for general operations manual for professional operator of light unmanned aircraft systems (UAS)	Only draft version available on 31st January 2020	
	Medium High	Full	ISO 21384-3: Operational Procedures	It provides high level guidance	
		Partial	ASTM F3178-16: Standard practice for operational risk assessment of small unmanned aircraft systems (sUAS)	It only convers the requirement related to Risk Assessment	

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Table 99 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	N/A	NO STANDARD REQUIRED		
	Medium	Full	ISO 21384-3: Operational Procedures	It could be used as the basis for audit by ISO notified bodies	
	High	Full	ASTM F3364-19*: Standard practice for independent audit program for unmanned aircraft operators	*When Article 69 of 2018/1139 will be implemented as it would require the establishment of qualified entities. The standard is addressed to auditors	

3.7 *OSO 02* – UAS manufactured by competent and/or proven entity

3.7.1 Requirement Description

Table 100 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	As a minimum, manufacturing procedures cover: • specification of materials • suitability and durability of materials used, • Processes necessary to allow for repeatability in manufacturing and conformity within acceptable tolerances.

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	Medium	Same as Low. In addition, manufacturing procedures also cover: • configuration control, • verification of incoming products, parts, materials, and equipment, • identification and traceability, • in-process and final inspections & testing, • control and calibration of tools, • handling and storage, • Non-conforming item control.
	High	Same as Medium. In addition, the manufacturing procedures cover at least: • manufacturing processes, • personnel competence and qualification, • supplier control.

Table 101 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The declared manufacturing procedures are developed to a standard considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.
	Medium	Same as low. In addition, evidence is available that the UAS has been manufactured in conformance to its design.
	High	Same as medium. In addition: • manufacturing procedures; and • the conformity of the UAS to its design and specification are recurrently verified through process or product audits by a competent third party (or competent third parties).

3.7.2 Summary

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Table 102 OSO 2 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	ASTM	F3003-14	P	P		5
New Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems	ASTM	WK62731	P	P		N.A.
Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	ASTM	F2911-14e1	P			5
Quality management systems — Requirements	ISO	9001:2015	F	F		N.A.
Quality Management Systems - Requirements for Aviation, Space and Defence Organizations	EN	9100:2018	F	F		N.A.
Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	ASTM	F2972 - 15	F	F		N.A.

3.7.3 Coverage Detail

Table 103

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	ASTM	F3003-14	F	F		It is only applicable for UAS with MTOM of less than 25 kg.

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Notes:
This specification establishes the quality assurance requirements for the design, manufacture, and production of a small unmanned aircraft system (sUAS). It is intended for all sUAS that are permitted to operate over a defined area and in airspace defined by a nation's governing aviation authority (GAA). Unless otherwise specified by a nation's GAA, this specification applies only to UA that have a maximum take-off gross weight of 55 lb/25 kg or less. This standard defines the quality assurance requirements for the design, manufacture, and production of a small unmanned aircraft system (sUAS).

Table 104

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems	ASTM	WK62731	P	P		It is understood that the standard may be useful for internal quality control in design and production, although the standard is only planned
Notes: This practice establishes the minimum set of requirements for auditing programs, methods, and systems; the responsibilities for all parties involved; and qualifications for entities conducting audits against ASTM International standards on unmanned aircraft systems (UAS). This practice provides requirements to enable consistent and structured examination of objective evidence for compliance that is beneficial for the UAS industry and its consumers. It is the intent of this practice to provide the necessary minimum requirements for organizations to develop audit programs and procedures.						

Table 105

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	ASTM	F2911-14e1	P			The standard is only applicable to UAS with MTOM less than 25 kg manufactured according to the Specifications identified in ASTM F2910.

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Notes: This standard defines the production acceptance requirements for a small unmanned aircraft system (sUAS). This standard is applicable to sUAS that comply with design, construction, and test requirements identified in Specification F2910. No sUAS may enter production until such compliance is demonstrated.

Table 106

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Quality management systems — Requirements	ISO	9001:2015	F	F		The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS.
Notes: The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS. Nevertheless, a quality system compliant with this standard is a valid starting point to demonstrate compliance to OSO #2.						

Table 107

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Quality Management Systems - Requirements for Aviation, Space and Defence Organizations	EN	9100:2018	F	F		The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS.
Notes: This standard is intended for the specific implementation of the ISO 9001 standards in the aerospace industry. Nevertheless, a quality system compliant with this standard is considered sufficient to demonstrate compliance to OSO #2 at all levels of robustness.						

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Table 108

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	ASTM	F2972 - 15	F	F		No specific requirements related to UAS manufacturing procedures.
Notes: This specification establishes the minimum requirements for a quality assurance system for manufacturers of Light Sport Aircraft or Light Sport Aircraft kits, or both. Therefore, it is not specific for UAS.						

3.7.4 Gaps

3.7.4.1 Summary

Table 109 Gap Summary - OSO 2

Gap	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS.	+2	The development of a dedicated standard might not be needed, but manufacturers should at least implement a quality management system compliant with ISO 9001 or (ASTM F3003-14 for small UAS), which is compliant with the requirements defined by OSO #2 at the required level of integrity.

3.7.4.2 Details

Table 110

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted

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						Score
1	Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS.	Safety (3)	Medium	The absence of a specific standard might not be critical if this is compensated by the implementation of an adequate generic quality management system according to one of the available standards (e.g. ISO 9001 or EN 9100)	0	0
		Cost of compliance to the requirement with a lack standard (2)	Low	The cost of compliance to the requirements of OSO #2 in absence of a specific standard is estimated as low, given that the manufacturer will likely implement in any case a quality management system for commercial reasons.	+1	+2
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	No impact	0	0
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**+2**

3.7.5 Conclusions and Recommendations

Considering the standards already available and those under development, the coverage of OSO #2 requirements seems to be adequate. However, a standard addressing specifically UAS manufacturing processes and quality assurance, that is applicable for any UAS does not exist. This could lead to a lack of uniformity in the manufacturing processes, but this is not expected to impact safety in a significant way.

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Table 111 Recommended Standards

Integrity/Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low Medium	Partial	ASTM F3003-14: Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg.	Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS.
			ASTM WK62731 New Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems	It only covers compliance audits for ASTM standards. No published version available yet.	
			ASTM F2911-14e1 Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg developed according to ASMT F2910.	
		Full	EN 9100:2018: Quality Management Systems – Requirements for Aviation, Space and Defence Organizations	No specific requirements related to UAS manufacturing procedures.	
			ASTM F2972-15: Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	No specific requirements related to UAS manufacturing procedures.	
			ISO 9001:2015 Quality management systems - Requirements	Only high level guidance. No specific requirements related to UAS manufacturing procedures.	
	High	N.A.	OUT OF SCOPE		

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3.8 *OSO 03* – UAS maintained by competent and/or proven entity

3.8.1 Requirement Description

Table 112 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion 1	Low	• The UAS maintenance instructions are defined and when applicable cover the UAS designer instructions and requirements. • The maintenance staff is competent and has received an authorisation to carry out UAS maintenance • The maintenance staff use the UAS maintenance instructions while performing maintenance.
	Medium	Same as Low. In addition: • Scheduled maintenance of each UAS is organised and in accordance with a Maintenance Programme. • Upon completion, the maintenance log system is used to record all maintenance conducted on the UAS including releases. A maintenance release can only be accomplished by a staff member who has received a maintenance release authorization for that particular UAS model/family.
	High	Same as Medium. In addition, • the maintenance staff works in accordance with a maintenance procedure manual that provides information and procedures relevant to the maintenance facility, records, maintenance instructions, release, tools, material, components, defect, deferral...

Table 113 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion 1 (procedures)	Low	• The maintenance instructions are documented. • The maintenance conducted on the UAS is recorded in a maintenance log system. • A list of maintenance staff authorised to carry out maintenance is established and kept up to date.

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	Medium	Same as Low. In addition: • The Maintenance Programme is developed in accordance with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. • A list of maintenance staff with maintenance release authority is established and kept up to date.
	High	The maintenance programme and the maintenance procedures manual are validated by a competent third party.
Criterion 2 (Training)	Low	A record of all relevant qualifications, experience and/or trainings completed by the maintenance staff is established and kept up to date.
	Medium	Same as Low. In addition: • Initial training syllabus and training standard including theoretical/practical elements duration, etc. is defined and commensurate with the authorization held by the maintenance staff. • For staff holding a maintenance release authorisation, the initial training is specific to that particular UAS model/family. All maintenance staff have undergone initial training.
	High	A programme for recurrent training of staff holding a maintenance release authorisation is established; and This programme is validated by a competent third party.

3.8.2 Summary

Table 114 OSO 3 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
Small Unmanned Aircraft Systems	FAA	AC 107-2	F			N.A.
Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft	ASTM	F2483 - 18	F	F		N.A.
Standard Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems	ASTM	F2909-19	F	F		6

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Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)	ASTM	F3366-19	P	P		10
Standard Practice for Maintenance of Aircraft Electrical Wiring Systems	ASTM	F2799-14	P	P		5

Standard Title	SDO	Doc. Reference	Robustness *Criteron 1*			Robustness *Criterion 2*			Global Score
			L	M	H	L	M	H	
Assurance									
Small unmanned aircraft systems	FAA	AC 107-2	F						N.A.
Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft	ASTM	F2483 - 18	F	F					N.A.
Standard Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems	ASTM	F2909-19	F	F					6
Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)	ASTM	F3366-19	P	P					10
Training for UAS personnel	ISO	23665					F		7

3.8.3 Integrity Coverage Detail

Table 115

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Small unmanned aircraft systems		AC 107-2	F			

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The standard provides guidelines in the area of remote pilot certification, aircraft registration, aircraft airworthiness and the operation of small UAS. Section 7 of the standard addresses small UAS maintenance and inspection guidelines\requirement and is quite similar to OSO#3. Appendix C contains maintenance and inspection best practices for small UAS and can be used to cover OSO#3 Low level integrity.

Table 116

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft	ASTM	F2483 - 18	F	F		The standard is not specific for UAS
The standard provides guidelines for the qualifications to accomplish the various levels of maintenance on US-certified experimental and special light sport aircraft. In addition, it provides the content and structure of maintenance manuals for aircraft and their components that are operated as light sport aircraft. It addresses maintenance instructions, maintenance staff and maintenance program. It can be used to cover OSO#3, although it is not specific for UAS.						

Table 117

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Continued Airworthiness of Small Unmanned Aircraft Systems (sUAS)	ASTM	F2909-19	F	F		It is only applicable for UAS with MTOM less than 25 kg.
The standard provides guidelines for the maintenance and continued airworthiness of sUAS. It provides the content and structure of maintenance manuals for sUAS It addresses maintenance instructions and maintenance staff. It can be used to cover OSO#3, adequate for the lower SAILs						

Table 118

Standard Title	SDO	Doc.	Criteria 1	Gaps

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		Reference	L	M	H	
Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)	ASTM	F3366-19	P	P		It is only applicable for UAS with MTOM less than 25 kg. It only covers the development of a Maintenance Manual.
The standard provides high level guidelines for the development of a maintenance manual. No specific maintenance practices or instructions are provided.						

Table 119

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Maintenance of Aircraft Electrical Wiring Systems	ASTM	F2799-14	P	P		No requirement for maintenance staff competency and authorization No other aspect than electrical wiring covered
The standard is intended to be used as maintenance and preventive maintenance of electrical wiring interconnection systems (EWIS). It can be used as very elaborated maintenance instructions and procedures in the aspects of wiring aloe. The standard doesn't relate to the aspects of maintenance program or maintenance staff qualification and authorization.						

3.8.4 Assurance Coverage Detail

Table 120

Standard Title	SDO	Doc. Reference	Criterion 1			Criterion 2			Gaps
			L	M	H	L	M	H	
Small unmanned aircraft systems		AC 107-2	F						
The standard provides guidelines in the area of remote pilot certification, aircraft registration, aircraft airworthiness and the operation of small UAS. Section 7 of the standard addresses small UAS maintenance and inspection guidelines\requirement and is quite similar to OSO#3. Appendix C contains maintenance and inspection best practices for small UAS and can be used to cover OSO#3 Low level integrity.									

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Table 121

Standard Title	SDO	Doc. Reference	Criteria 1			Criterion 2			Gaps
			L	M	H	L	M	H	
Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft	ASTM	F2483 - 18	F	F					The standard is not specific for UAS
The standard provides guidelines for the qualifications to accomplish the various levels of maintenance on US-certified experimental and special light sport aircraft. In addition, it provides the content and structure of maintenance manuals for aircraft and their components that are operated as light sport aircraft. It addresses maintenance instructions, maintenance staff and maintenance program. It can be used to cover OSO#3, although it is not specific for UAS.									

Table 122

Standard Title	SDO	Doc. Reference	Criteria 1			Criterion 2			Gaps
			L	M	H	L	M	H	
Standard Specification for Continued Airworthiness of Small Unmanned Aircraft Systems (sUAS)	ASTM	F2909-19	F	F					It is only applicable for UAS with MTOM less than 25 kg.
The standard provides guidelines for the maintenance and continued airworthiness of sUAS. It provides the content and structure of maintenance manuals for sUAS It addresses maintenance instructions and maintenance staff. It can be used to cover OSO#3, adequate for the lower SAILs									

Table 123

Standard Title	SDO	Doc. Reference	Criterion 1			Criterion 2			Gaps
			L	M	H	L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)	ASTM	F3366-19	P	P					It is only applicable for UAS with MTOM less than 25 kg. It only covers the development of a Maintenance Manual.
The standard provides high level guidelines for the development of a maintenance manual. No specific maintenance practices or instructions are provided.									

Table 124

Standard Title	SDO	Doc. Reference	Criterion 1			Criterion 2			Gaps
			L	M	H	L	M	H	
Training for UAS personnel	ISO	23665					F		The standard does not represent a guidance for the development of a maintenance program.
This standard deals with training of personnel involved in UAS operations. Training items include maintenance activities, but the standard does not represent a guidance for the development of a maintenance program.									

3.8.5 Gaps

The standards that are currently available are covering sufficiently the requirements of OSO #3 up to the Medium Level of Integrity which is required for operations up to SAIL IV. Therefore, no gaps are identified.

3.8.6 Conclusions and Recommendations

The standards that are currently available are covering sufficiently the requirements of OSO #3 up to the Medium Level of Integrity which is required for operations up to SAIL IV.

Table 125 Recommended Standards – Integrity

Integrity

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Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion 1	Low	Full	NO STANDARD REQUIRED	The following standards can be used as advisory material: ASTM F2909-19, ASTM 2483-18, ASTM F3366-19 and AC 107-2 Chapter 7.	
	Medium	Full	ASTM F2909-19: Standard Specification for Continued Airworthiness of Lightweight Unmanned Systems ASTM 2483-18: Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft		
		Partial	ASTM 3366-19: Standard Specification for General Maintenance Manual (GMM) for a Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM less than 25kg Covers only development of a Maintenance Manual	
	High	N/A	OUT OF SCOPE		

Table 126 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion 1 (Procedures)	Low	N/A	NO STANDARD REQUIRED	The following standards can be used as advisory material: ASTM F2909-19, ASTM 2483-18, ASTM F3366-19 and AC 107-2 Chapter 7.	

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	Medium	Full	ASTM F2909-19: Standard Specification for Continued Airworthiness of Lightweight Unmanned Systems ASTM 2483-18: Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft		
		Partial	ASTM 3366-19: Standard Specification for General Maintenance Manual (GMM) for a Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM less than 25kg Covers only development of a Maintenance Manual	
	High	N/A	OUT OF SCOPE		
Criterion 2 (Training)	Low	N/A	NO STANDARD REQUIRED		
	Medium	N/A	NO STANDARD REQUIRED	ISO 23665 could be used as guidance	
	High	N/A	OUT OF SCOPE		

3.9 *OSO 04* – UAS developed to authority recognized design standards

3.9.1 Requirement Description

Table 127 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a Low Level of Integrity and the intended operation.

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	Medium	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a Medium Level of Integrity and the intended operation.
	High	The UAS is designed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. The standards and/or the means of compliance should be applicable to a High Level of Integrity and the intended operation.

Table 128 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The applicant declares that the required level of integrity has been achieved[1]. *(1) Supporting evidence may or may not be available.*
	Medium	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[2], inspection, design review or through operational experience. *(2) When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*
	High	EASA validates the claimed level of integrity.

3.9.2 Summary

Table 129 OSO 4 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS	P			14

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Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS	P			N.A.
Unmanned Aircraft Systems - Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)	ASTM	F2910-14	P			10
New Specification for Large UAS Design and Construction	ASTM	WK62670	P			N.A.
Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)	ASTM	F3298 - 19	P			7
Design, Construction and Verification of Fixed Wing UAS	ASTM	WK57659	P			N.A.
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671	P			N.A.
Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	NATO	STANAG 4702	P			11
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO	STANAG 4703	P			4
Functional safety of electrical/electronic/programmable electronic safety-related systems	IEC	61508	P			N.A.
Standard Specification for Design and Performance of a Light Sport Aeroplane	ASTM	F2245-16c	P			8
Standard Specification for Design Loads and Conditions	ASTM	F3116/F3116M-15	P			10
Specification for Environmental Systems in Small Aircraft	ASTM	F3227	P			11
Specification for Electrical Systems in Small Aircraft	ASTM	F3231	P			5
Unmanned Aircraft Systems — Part 2: Product systems	ISO	21384-2	F			5
Aerospace series - Unmanned Aircraft Systems – Product requirements and verification for the Open category	ASD-STAN	prEN 4709-001	P			13

3.9.3 Coverage Detail

Table 130

Standard Title	SDO	Doc.	Criteria 1	Gaps

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		Reference	L	M	H	
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS	P			The standard defines minimum design requirements but only for Light Rotorcraft UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.

Notes:

1. Published
2. The standard is a Certification Specification applicable to Light Unmanned Rotorcraft Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.

Table 131

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS	P			The standard defines minimum design requirements but only for Light Aeroplane UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.

Notes:

1. Published
2. The standard is a Certification Specification applicable to Light Unmanned Aeroplane Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.

Table 132

Standard Title	SDO	Doc.	Criteria 1	Gaps

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

		Reference	L	M	H	
Unmanned Aircraft Systems - Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)	ASTM	F2910-14	P			The standard covers minimum design requirements. However it is applicable only to UAS with MTOM up to 25kg.

Notes:
1. Published
2. The standard establishes the design, construction, and test requirements for a small unmanned aircraft system (sUAS).

Table 133

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Specification for Large UAS Design and Construction	ASTM	WK62670	P			The standard is still in planning phase. It cannot be judged since it is not yet available. It is assumed it will complement standard F2910-14 for UAS with MTOM of more than 25kg.

Notes:
1. Planned
2. The standard cannot be downloaded but the subject can be identified
3. The Standard is about defining a Design and Construction Consensus Standard for Large Mass Fixed-Wing UAS up to 19.000 lbs

Table 134

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)	ASTM F38 Unmanned Aircraft Systems	F3298 - 19	P			

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Notes:

1. Published
2. The standard defines the baseline design, construction, and verification requirements for a lightweight unmanned aircraft system (UAS).

Table 135

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Design, Construction and Verification of Fixed Wing UAS	ASTM	WK57659	P			The standard is still in planning phase. It cannot be judged since it is not yet available. It is assumed to cover the requirements for Fixes Wing UAS.

Notes:

1. Planned
2. The standard cannot be downloaded but the subject can be identified
3. The standard establishes the design, construction, and test requirements for a fixed wing unmanned aircraft system (sUAS).

Table 136

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671	P			The standard covers minimum design requirements. However, the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.

Notes:

1. Published
2. The standard defines a set of technical airworthiness requirements intended primarily for the airworthiness certification of fixed-wing military UAS with a maximum take-off weight between 150 and 20,000 kg that intend to regularly operate in non-segregated airspace

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Table 137

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	NATO	STANAG 4702	P			The standard covers minimum design requirements. However, the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.

Notes:

1. Published
2. The standard defines a set of technical airworthiness requirements intended for the airworthiness certification of rotary-wing military UAV Systems with a maximum take-off weight between 150 and 3175 kg that intend to regularly operate in non-segregated airspace

Table 138

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO FINAS	STANAG 4703	P			The standard covers minimum design requirements. However, the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.

Notes:

1. Published
2. The standard defines a minimum set of technical airworthiness requirements intended for the airworthiness certification of fixed-wing Light UAS with a maximum take-off weight not greater than 150 kg and an impact energy1 greater than 66 J (49 ft-lb) that intend to regularly operate in non-segregated airspace

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Table 139

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Functional safety of electrical/electronic/programmable electronic safety-related systems	International Electronical Commission	IEC 61508	P			The standard defines minimum design requirements only for electronic safety-related systems.

Notes:

1. Published
2. The standard sets out a generic approach for all safety lifecycle activities for systems comprised of electrical and/or electronic and/or programmable electronic components that are used to perform safety functions.

Table 140

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Design and Performance of a Light Sport Aeroplane	ASTM	F2245-16c	P			This standard is related to manned sport aircraft design requirements. Some of the requirements might be applicable to UAS development.

Notes:

1. Published
2. The standard covers airworthiness requirements for the design of powered fixed wing light sport aircraft

Table 141

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Standard Specification for Design Loads and Conditions	ASTM	F3116/F3116M-15	P			The standard defines minimum design requirements specifically for design loads conditions.

Notes:
1. Published
2. The standard addresses the airworthiness requirements for the design loads and conditions of small airplanes

Table 142

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Specification for Environmental Systems in Small Aircraft	ASTM	F3227	P			The standard defines minimum design requirements specifically for environmental systems in small aircraft.

Notes:
1. Published
2. The standard n covers international standards for the environmental system aspects of airworthiness and design for "small" aircraft

Table 143

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Specification for Electrical Systems in Small Aircraft	ASTM	F3231	P			The standard defines minimum design requirements specifically for Electrical Systems in Small Aircraft.

Notes:
1. Published
2. The standard covers international standards for the electrical systems aspects of airworthiness and design for "small" aircraft

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Table 144

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned Aircraft Systems — Part 2: Product systems	ISO	21384-2	F			

Notes:

1. Ongoing (draft available)
2. The standard specifies requirements for ensuring the quality and safety of the design and manufacture of heavier than air unmanned aircraft systems (UAS) whose lifting devices are fixed or rotary wings.

Table 145

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Aerospace series - Unmanned Aircraft Systems – Product requirements and verification for the Open category	ASD-STAN	prEN 4709-001	P			This standard is intended for UAS to be operated in the Open Category. However, a UAS manufactured according to this standard might be adequate to meet Low level of robustness depending on the specific operating conditions.

Notes:

1. Ongoing (draft available)

3.9.4 Gaps

Table 146 Gap Summary - OSO 04

Gap	Gap Description	Total Weighted Score	Conclusion Recommendation

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1	There is no guidance to identify the applicable requirements from the selected standards that are applicable for low Robustness and SAIL IV Operations.	-6	It is recommended to develop guidance on the applicable requirements from available standards related to design.

3.9.4.1 Details

Table 147

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	There is no guidance to identify the applicable requirements from the selected standards that are applicable for low Robustness and SAIL IV Operations.	Safety (3)	High	A lack of guidance may create poor uniformity in the application of the requirements, hence having a high impact on safety.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	A lack of guidance to identify the applicable requirements may force operators to independently initiate and undergo complex procedures to guarantee uniformity.	-1	-2
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Negative	The EU industry competitiveness can be negatively impacted from the lack of common requirements/procedures for the identification of applicable requirements.	-1	-1
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						-6

3.9.5 Conclusions and Recommendations

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Existing standards can be used by the applicant to declare that minimum requirements have been achieved regarding equipment integrity (up to SAIL IV). However, guidance is required to identify the applicable standards and the related requirements depending on the type of UAS and the type of operation.

Table 148 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1	Low	Partial	JARUS – Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	This standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for the low level of integrity. Only applicable to Light Unmanned Rotorcraft Systems	There is a need to develop guidance to identify the applicable requirements from the selected standards that are applicable for low Robustness and SAIL IV Operations.
			JARUS – Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	This standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for the low level of integrity. Only applicable to Light Unmanned Aeroplane Systems	
			STANAG 4702 – Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	This standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for the low level of integrity. Only applicable to Rotary Wing UAS	

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			STANAG 4703 – Light Unmanned Aircraft Systems Airworthiness Requirements	This standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for the low level of integrity. Some subsets of this standard may not be applicable; the standard defines the design for the air speed indicator, however the possibility of the indicator not being necessary is not contemplated. Only applicable for small UAS	
			ASTM F2910-14 Unmanned Aircraft Systems – Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)	Only applicable for small UAS.	
	Medium	N.A.	OUT OF SCOPE		
	High	N.A.	OUT OF SCOPE		

Table 149 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	N.A.	NO STANDARD REQUIRED		
	Medium	N.A.	OUT OF SCOPE		
	High	N.A.	OUT OF SCOPE		

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3.10 *OSO 05* – UAS is designed considering systems safety and reliability

3.10.1 Requirement Description

Table 150 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The equipment, systems, and installations are designed to minimize hazards in the event of a probable malfunction or failure of the UAS.
	Medium	Same as Low. In addition, the strategy for detection, alerting and management of any malfunction, failure or combination thereof, which would lead to a hazard is available.
	High	Same as Medium. In addition: • Major Failure Conditions are not more frequent than Remote; • Hazardous Failure Conditions are not more frequent than Extremely Remote; • Catastrophic Failure Conditions are not more frequent than Extremely Improbable; • Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) may cause or contribute to hazardous or catastrophic failure conditions are developed to an industry standard or a methodology considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority.

Table 151 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion	Low	A Functional Hazard Assessment and a design and installation appraisal that shows hazards are minimized are available.

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#1	Medium	Same as Low. In addition: • Safety analyses are conducted in line with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. • A strategy for detection of single failures of concern includes pre-flight checks.
	High	Same as Medium. In addition, safety analyses and development assurance activities are validated by EASA, according to Article 40 of Regulation (EU) 2019/945.

3.10.2 Summary

Table 152 OSO 5 Integrity: Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
Applicability of Safe Design Standard for UAS in Specific Operations Category	EUROCAE	N.A.	F	F		N.A.
Assurance						
Applicability of Safe Design Standard for UAS in Specific Operations Category	EUROCAE	N.A.	F	F		N.A.
Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM	F3309		P		6
Guidelines And Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment	SAE	ARP4761A		P		N.A.

3.10.3 Integrity Coverage Detail

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Table 153

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Applicability of Safe Design Standard for UAS in Specific Operations Category	EUROCAE		F	F		

Notes:

1. Published
2. This document summarizes the proposed procedure that a UAS operator or manufacturer has to perform in order to develop the functional hazard assessment and the safety analysis required to fulfil OSO#5 requirements at Low and Medium Robustness.

3.10.4 Assurance Coverage Detail

Table 154

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Applicability of Safe Design Standard for UAS in Specific Operations Category	EUROCAE		F	F		

Notes:

3. Published
4. This document summarizes the proposed procedure that a UAS operator or manufacturer has to perform in order to develop the functional hazard assessment and the safety analysis required to fulfil OSO#5 requirements at Low and Medium Robustness.

Table 155

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

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Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM	F3309	F	F		This standard is not specific for UAS.

Notes:

1. Published
2. The standard covers methods for conducting a simplified safety assessment of aircraft systems and equipment

Table 156

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Guidelines And Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment	SAE	ARP4761A	F	F		

Notes:

1. Published
2. The standard describes Guidelines And Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment and can be used to fulfil OSO #5 at High Level of Robustness.

3.10.5 Gaps

The standards that are currently available are covering sufficiently the requirements of OSO #5 for the Medium Level of Integrity which is required for operations up to SAIL IV. Therefore, no gaps are identified.

3.10.6 Conclusions and Recommendations

The assurance criteria for OSO #5 are adequately covered at Low and Medium Level of Robustness by the dedicated EUROCAE Documents. These documents can be used to define how an applicant shall fulfil these requirements. For medium level compliance, the required safety analysis may be conducted in compliance with standard SAE-ARP 4761. This methodology is comparable to those of manned aviation procedures.

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Table 157 Recommended Standards - Integrity

Integrity					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	Full	EUROCAE Applicability of Safe Design Standard for UAS in Specific Operations Category	NOT PUBLISHED YET	
	Medium	Full	EUROCAE Applicability of Safe Design Standard for UAS in Specific Operations Category	NOT PUBLISHED YET	
	High	N.A.	OUT OF SCOPE		

Table 158 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	Full	EUROCAE Procedure to perform the functional hazard assessment for the low/medium level of robustness in OSO#5	NOT PUBLISHED YET	
	Medium	Full	EUROCAE Applicability of Safe Design Standard for UAS in Specific Operations Category	NOT PUBLISHED YET	
		Partial	EUROCAE Applicability of Safe Design Standard for UAS in Specific Operations Category	This standard covers only the requirement relate to safety analyses. It is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for medium level of robustness.	

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		Partial	ASTM F3309 Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	This standard covers only the requirement relate to safety analyses and is applicable only for Small UAS.	
	High	N.A.	OUT OF SCOPE		

3.11 *OSO 06* – C3 link characteristics appropriate for the operation

3.11.1 Requirement Description

Table 159 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	• The applicant determines that performance, RF spectrum usage and environmental conditions for C3 links are adequate to safely conduct the intended operation. • The UAS remote pilot has the means to continuously monitor the C3 performance and ensures the performance continues to meet the operational requirements.
	Medium	Same as Low.
	High	Same as Low. In addition, the use of licensed frequency bands for C2 Link is required.

Table 160 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion	Low	The applicant declares that the required level of integrity has been achieved.

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#1	Medium	Demonstration of the C3 link performance is in accordance with standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority.
	High	Same as Medium. In addition, evidence is validated by a competent third party.

3.11.2 Summary

Table 161 OSO 6 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)	ASTM	F3002 – 14	P	P		N.A.
WIFI technology (2.4 GHz + 5 GHz Band)	IEEE	802.11 + 802.11a	P	P		N.A.
Bluetooth technology	IEEE	802.15.1	P	P		N.A.
Wireless regional area network (WRAN)	IEEE	802.22	P	P		N.A.
Technical Specification Group Radio Access Network; Study on Enhanced LTE Support for Aerial Vehicles	3GPP	TR 36.777	P	P		N.A.
Guidance on Spectrum Access, Use and Management for UAS	EUROCAE	ED-266	P	P		N.A.
Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Terrestrial)	RTCA	DO-362	P	P		6
Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Satellite)	EUROCAE	ED-265	P	P		5

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Interoperable Command and Control Datalink for Unmanned Systems	NATO NNAG/JCGUAS	STANAG 4660	P	P		N.A.
Minimum Aviation Systems Performance Standard for Remote Pilot Stations supporting IFR operations into non-segregated airspace	EUROCAE	ED-272	P	P		N.A
Requirements for ensuring the safety and quality of the design and manufacture of UAS	ISO	21384-2	P	P		N.A.
Dedicated Short Range Communications (DSRC) Message Set Dictionary	SAE	J2735_201603	P	P		N.A.
Interoperable Command and Control Data Link for Unmanned Systems (IC2DL) – Operational Physical Layer / Signal in Space Description	NATO	AEP-77	P	P		-1
Standards for Aerial Communications and Networks	IEEE	P1920.1	P	P		N.A.
Standards for Vehicle to Vehicle Communications for UAS (Unmanned Aircraft Systems)	IEEE	P1920.2	P	P		N.A.
Unmanned Aircraft Systems — Product requirements for UAS in the open category	ASD-STAN	prEN 4709-001-2019	P	P		13
IP over Satellite (IPoS)	TIA	TIA-1008	P	P		N.A.
RPAS C2 link Required Communication Performance (C2 link RCP) concept	JARUS	N.A.	P	P		6
Assurance						
New Test Method for Evaluating Aerial Response Robot Sensing: Latency of Video, Audio, and Control	ASTM	WK58930		P		N.A.

3.11.3 Integrity Coverage Detail

Table 162

Standard Title	SDO	Doc. Reference	Criteria 1	Gaps

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			L	M	H	
Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)	ASTM	F3002 – 14	P	P		
Notes: 1. Applicable to low risk operations.						

Table 163

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
WIFI technology (2.4 GHz + 5 GHz Band)	IEEE	802.11 + 802.11a	P	P		
Notes: 1. Only applicable to WIFI technology.						

Table 164

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Bluetooth technology	IEEE	802.15.1	P	P		
Notes: 1. Only applicable to Bluetooth technology.						

Table 165

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Wireless regional area network (WRAN)	IEEE	802.22	P	P		

Notes:

1. Only applicable to WRAN technology.

Table 166

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Technical Specification Group Radio Access Network; Study on Enhanced LTE Support for Aerial Vehicles	3GPP	TR 36.777	P	P		

Notes:

1. Only applicable to LTE technology.

Table 167

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Guidance on Spectrum Access, Use and Management for UAS	EUROCAE	ED-266	P	P		

Notes:

2. Applicable to communication with Unmanned Airborne Vehicles (UAVs), the airborne part of Unmanned Aircraft Systems (UAS), and to Remotely Piloted Aircraft (RPA), the airborne part of Remotely Piloted Aircraft Systems (RPAS).

Table 168

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Terrestrial)	RTCA	DO-362	P	P		This standard is applicable only for terrestrial C2 Link.

Notes:

1. The use of this standard might be too demanding for the Low and Medium levels of Robustness.

Table 169

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Satellite)	EUROCAE	ED-265	P	P		

Notes:

1. Ongoing (draft available)
2. The Standard is about defining minimum operational performance standard for the satellite Line of Sight Command and Control Data Link.
3. The use of this standard might be too demanding for the Low and Medium levels of Robustness.

Table 170

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Interoperable Command and Control Datalink for Unmanned Systems	NATO NNAG/JCGUAS	STANAG 4660	P	P		The standard covers detailed performance requirements as well as continuous measurement of the circuit latency.

Notes:

1. Published
2. The Standard covers standard Line-Of-Sight command and control data link
3. The use of this standard might be too demanding for the Low and Medium levels of Robustness.

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Table 171

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Minimum Aviation Systems Performance Standard for Remote Pilot Stations supporting IFR operations into non-segregated airspace	EUROCAE	ED-272	P	P		This standard only covers the requirements for C2 link at RPS level.

Notes:

1. The Standard defines Minimum Aviation System Performance Standard at system level for the Remote Pilot Station interface to Air Traffic Control
2. The use of this standard might be too demanding for the Low and Medium levels of Robustness.

Table 172

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Requirements for ensuring the safety and quality of the design and manufacture of UAS	ISO	21384-2	P	P		This is a high level standard that would need to be complemented by other more specific ones to demonstrate compliance.

Notes:

1. Ongoing
2. The standard cannot be downloaded but the subject can be identified
3. The Standard defines requirements for ensuring the quality and safety of the design and manufacture UAS

Table 173

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Dedicated Short Range Communications (DSRC) Message Set Dictionary	SAE DSRC (Dedicated Short Range Communication) Tech Committee	J2735_201603	P	P		Must be used in connection with other standards which help define the requirements performance level for the use of the messages defined in this standard.

Notes:

1. Published
2. The standard specifies a message set, and its data frames and data elements, specifically for use by applications intended to utilize the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments (DSRC/WAVE, referenced in this document simply as "DSRC") communications systems

Table 174

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Interoperable Command and Control Data Link for Unmanned Systems (IC2DL) – Operational Physical Layer / Signal in Space Description	NATO	AEP-77	P	P		The standard refers to performance requirements and measurement of latency and processing time between nodes.

Notes:

1. Published
2. The standard defines a standard Line Of Sight (LOS) Interoperable Command and Control Data Link (IC2DL) for Unmanned Systems

Table 175

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Standards for Aerial Communications and Networks	IEEE Standards Association	P1920.1	P	P		The standard is still in planning phase. It cannot be judged since it is not yet available. Potentially partially covers some of the requirements of OSO#6 (C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation.) but it cannot be properly judged

Notes:

1. Planned
2. The standard cannot be downloaded but the subject can be identified
3. The Standard defines air-to-air communications for self-organized ad hoc aerial networks

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standards for Vehicle to Vehicle Communications for UAS (Unmanned Aircraft Systems)	IEEE Standards Association	P1920.2	P	P		The standard is still in planning phase. It cannot be judged since it is not yet available. Potentially partially covers some of the requirements of OSO#6 (C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation.) but it cannot be properly judged.

Notes:

1. Planned
2. The standard cannot be downloaded but the subject can be identified
3. The Standard defines the protocol for exchanging information between the vehicles

Table 176

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Unmanned Aircraft Systems — Product requirements for UAS in the open category	ASD-STAN	prEN 4709-001-2019	P	P		The standards refers to how to test the link performance and how to proceed in case of loss of data link. However, it is specifically intended for UAS in the Open category. Therefore its applicability must be judged depending on the type of operation.
Notes: 1. Ongoing (draft available) 2. The Standard defines means of compliance with product requirements for all UAS authorized to operate in the 'open' category (class C0, C1, C2, C3 and C4 UAS).						

Table 177

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
IP over Satellite (IPoS)	TIA	TIA-1008	P	P		The standard needs to be downloaded and studied. Potentially partially covers some of the requirements of OSO#6 (C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation.) but it cannot be properly judged.
Notes: 1. Published 2. The standard cannot be downloaded but the subject can be identified 3. The standard contains the procedures used by remote terminals and the hub for delivery of traditional Internet Protocol (IP) services in a star satellite access network						

Table 178

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

RPAS C2 link Required Communication Performance (C2 link RCP) concept	JARUS		P	P		This document defines that the RPAS C2 link must meet the performance or safety requirements of the operational airspace. Additionally, monitoring must be in place to determine if the C2 communication service provider continues to meet the C2 link RCP type. However, it only provides guidance.
Notes: 1. Published 2. The standard cover the requirements for the C2 link in RPAS						

3.11.1 Assurance Coverage Detail

Table 179

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Test Method for Evaluating Aerial Response Robot Sensing: Latency of Video, Audio, and Control	ASTM E54 Homeland Security Applications	WK58930	P	P		The standard is still ongoing. It cannot be judged since it is not yet available. The test can be used to partially show that the latency of communications is minimized.
Notes: 1. Ongoing 2. The Standard defines a new test method to specify the apparatuses, procedures, and performance metrics necessary to quantitatively evaluate the latency of video, audio, and control sub-systems as viewed through a control station						

3.11.2 Gaps

Table 180 Gap Summary - OSO 06

Gap	Gap Description	Total	Conclusion Recommendation

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

		Weighted Score	
1	All identified technical standards cover Command and Control, but there is no standard to develop communication functionalities where needed/relevant	-4	It is recommended to develop a standard to harmonize the development of the communication link.

3.11.2.1 Details

Table 181

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	All identified technical standards cover Command and Control, but there is no standard to develop communication functionalities where needed/relevant	Safety (3)	High	The lack of standards to support operators in demonstrating that the Communication Link is adequate for the scope can have a negative impact on safety due to the absence of a common reference.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	The lack of standards to standards to support operators in demonstrating that the Communication Link is adequate may lead to additional costs for the demonstration of compliance to the OSO #6 requirements.	0	0
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Negative	The EU industry competitiveness can be negatively impacted due to the lack of common requirements/procedures for UAS Communication.	-1	-1
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**-4**

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3.11.3 Conclusions and Recommendations

Most existing standards specifically aimed at Command and Control link are deemed too demanding for operations up to SAIL IV. Hence, the assessment covers lower risk operations by addressing standards covering WIFI, Bluetooth and LTE technologies for their simplicity.

Additionally, a gap was identified in the lack of standards/guidelines for the Communication section of the C3 Link, specifically with ATS. However, it is also considered that for specific operations of very low risk, the latter may not be necessary.

Table 182 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1	Low	Partial	ASTM F3002 – 14 - Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)	Only applicable to UAS with MTOM below 25Kg.	
		Partial	IEEE 802.11, IEEE 802.11a – WIFI technology (2.4 GHz + 5 GHz Band)	Only covers WIFI	
		Partial	IEEE 802.15.1 – Bluetooth technology	Only covers Bluetooth	
		Partial	IEEE 802.22 - Wireless regional area network (WRAN)	Only covers WRAN	
		Partial	3GPP - TR 36.777 Technical Specification Group Radio Access Network; Study on Enhanced LTE Support for Aerial Vehicles	Only covers LTE	
	Medium	Partial	ASTM F3002 – 14 - Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)	Only applicable to UAS with MTOM below 25Kg.	
		Partial	IEEE 802.11, IEEE 802.11a – WIFI technology (2.4 GHz + 5 GHz Band)	Only covers WIFI	
		Partial	IEEE 802.15.1 – Bluetooth technology	Only covers Bluetooth	
		Partial	IEEE 802.22 - Wireless regional area network (WRAN)	Only covers WRAN	
		Partial	3GPP - TR 36.777 Technical Specification Group Radio Access Network; Study on Enhanced LTE Support for Aerial Vehicles	Only covers LTE	

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	High	N.A.	OUT OF SCOPE		

Table 183 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Partial	ASTM WK58930: New Test Method for Evaluating Aerial Response Robot Sensing: Latency of Video, Audio, and Control	The document is a draft	
	High	N.A.	OUT OF SCOPE		

3.12 *OSO 07* – Inspection of the UAS (product inspection) to ensure consistency to the ConOps

3.12.1 Requirement Description

Table 184 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The remote crew ensures the UAS is in a condition for safe operation and conforms to the approved concept of operations.
	Medium	
	High	

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Table 185 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	Product inspection is documented and accounts for the manufacturer's recommendations if available. The remote crew's is trained to perform the product inspection, and that training is self-declared (with evidence available).
	Medium	Same as Low. In addition, the product inspection is documented using checklists. A training syllabus including a product inspection procedure is available. The operator provides competency-based, theoretical and practical training.
	High	Same as Medium. In addition, the product inspection is validated by a competent third party. A competent third party validates the training syllabus and verifies the remote crew competencies.

3.12.2 Summary

Table 186 OSO 7 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	P	P		2
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707	P	P		5
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public	NFPA	NFPA 2400	P			7
Unmanned aircraft systems – Part 3: Operational procedures	ISO	21384-3	F	F		3
Training for personnel involved in UAS operations	ISO	23665	F	F		7
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18	P	P		7

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Department of Defense Standard Practice System Safety	DoD	MIL-STD-882E	P	P		11

3.12.3 Coverage Detail

Table 187

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	P	P		The standard is still under development. It cannot be assessed since it is not yet available. Probably it partially covers some of the requirements of OSO #7
This standard defines the requirements for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS). The standard addresses the requirements and/or best practices for documentation and organization of a professional operator (i.e., for compensation and hire).						

Table 188

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707	P	P		The abstract is insufficient to assess coverage. Probably it partially covers the training requirements of OSO#7
This document provides an approach to the development of training topics for pilots of Unmanned Aircraft Systems (UAS) for use by operators, manufacturers, and regulators. The identification of training topics is based initially on Practical Test Standard (PTS) topics for manned aircraft pilots. The topics identified could be used for the construction of a PTS for UAS commercial pilot operations and a PTS for a UAS pilot instrument rating. The UAS commercial pilot rating would contain restrictions on the types of operations that could be flown that would be dependent on the type of UAS used.						

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Table 189

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public	NFPA	NFPA 2400	P			The standard is still under development. It cannot be assessed since it is not yet available. Probably it partially the requirements of OSO#7
NFPA 2400 details the minimum requirements for the safe operation, deployment, and implementation of sUAS including organization program criteria and considerations, professional qualifications for safety personnel, and elements of a maintenance program.						

Table 190

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	F	F		
This standard gives the requirements for safe commercial UA operations and applies to all types, categories, classes, sizes, and modes of operation of UA. A section is specifically dedicated to pre-flight inspections, therefore the standard covers the integrity requirements. This standard partly covers the procedure part of the assurance requirements (it contains a detailed checklist).						

Table 191

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Training for personnel involved in UAS operations	ISO	23665	F	F		
The standard provides training recommendations for UAS personnel, including practical training on pre-flight inspection skills.						

Table 192

Standard Title	SDO	Doc.	Criteria 1	Gaps

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

		Reference	L	M	H	
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18	P	P		The abstract is insufficient to assess coverage. It could partially covers the assurance requirements of OSO#7
1.1 This specification defines the requirements for training and the development of training manuals for the unmanned aircraft systems (UAS) operator. 1.2 The specification addresses the requirements or best practices, or both, for documentation and organization of a professional operator (that is, for compensation and hire) for the purposes of internal training programs and for programs offered to the general public. 1.3 This specification supports professional entities that will receive operator certification by a CAA, and provide standards of practice for self- or third-party audit of operators of UAS. 1.4 The standard case study used to develop this specification focused on operators of light UAS (below 1320 lb/600 kg as defined by EASA), but the specification may be applied to larger aircraft for using other methods of classification (that is, risk based classes and pilot privileges classes).						

Table 193

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Department of Defense Standard Practice System Safety	DoD Department of Defense	MIL-STD-882E	P	P		This standard could help identify product inspection items.
This system safety standard practice identifies the Department of Defense (DoD) Systems Engineering (SE) approach to eliminating hazards, where possible, and minimizing risks where those hazards cannot be eliminated. DoD Instruction (DoDI) 5000.02 defines the risk acceptance authorities. This Standard covers hazards as they apply to systems / products / equipment / infrastructure (including both hardware and software) throughout design, development, test, production, use, and disposal. When this Standard is required in a solicitation or contract but no specific task is identified, only Sections 3 and 4 are mandatory. The definitions in 3.2 and all of Section 4 delineate the minimum mandatory definitions and requirements for an acceptable system safety effort for any DoD system.						

3.12.4 Gaps

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3.12.4.1 Summary

Table 194 Gap Summary - OSO 7

Gap	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations	10	No need to develop a standard for this gap.
2	Absence of standards covering: Product inspection is documented and accounts for the manufacturer's recommendations if available. In addition, the product inspection is documented using checklists.	10	No need to develop a standard for this gap.

3.12.4.2 Details

Table 195

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Absence of standards covering Product inspection is documented and accounts for the manufacturer's recommendations if available.	Safety (3)	Very low	The risk that inspection items are overlooked in the manufacturer recommendations because of the lack of a standard that includes a comprehensive list of inspection items, is judged to be very low. Manufacturers know best what to include in their product inspection recommendations	2	6
		Cost of compliance to the requirement with a lack standard (2)	Low	The cost for the manufacturer to develop a set of product inspection recommendations that includes all applicable items is judged to be low. Manufacturers know best what to include in their product inspection recommendations.	1	2
		Environmental Impact (1)	No impact	No impact on the basis that manufacturers include all relevant inspection items.	0	0

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		Impact on EU Industry competitiveness (1)	Very positive	Manufacturers know best what to include in their product inspection recommendations.	2	2
		Social Acceptance (1)	No impact	No impact on the basis that manufacturers include all relevant inspection items.	0	0
Total Weighted Score						**10**

Table 196

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Absence of standards covering Product inspection is documented and accounts for the manufacturer's recommendations if available. In addition, the product inspection is documented using checklists.	Safety (3)	Very Low	The risk that inspection items are overlooked in the manufacturer recommendations because of the lack of a standard that includes a comprehensive list of inspection items, is judged to be very low. Manufacturers know best what to include in their product inspection recommendations	2	6
		Cost of compliance to the requirement with a lack standard (2)	Low	The cost for the manufacturer to develop a set of product inspection recommendations that includes all applicable items is judged to be low. Manufacturers know best what to include in their product inspection recommendations.	1	2
		Environmental Impact (1)	No impact	No impact on the basis that manufacturers include all relevant inspection items.	0	0
		Impact on EU Industry competitiveness (1)	Very positive	Manufacturers know best what to include in their product inspection recommendations.	2	2
		Social Acceptance (1)	No impact	No impact on the basis that manufacturers include all relevant inspection items.	0	0
Total Weighted Score						10

3.12.5 Conclusions and Recommendations

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The gap assessment shows that the gaps are not significant: the risk that inspection items are overlooked in the manufacturer recommendations because of the lack of a standard that includes a comprehensive list of inspection items, was judged to be very low as manufacturers know best what to include in their product inspection recommendations. Consequently, there is no recommendation to develop a standard for this.

The following ASTM standards are not yet assessed because of non-availability to the consortium or being still under development. These could potentially form an alternative to the recommended ISO standards:

- ASTM F3330 – 18 - Standard Specification for Training and the Development of Training Manuals for the UAS Operator
- ASTM WK62744 - New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)

Table 197 Recommended Standards - Integrity

Integrity					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low/None	Full	ISO 21384-3: Operational Procedures	It only provides high level guidance	
	Medium	Full			
	High	N/A	OUT OF SCOPE		

Table 198 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low/None Medium	Partial	ISO 21384-3: Operational Procedures	It only provides high level guidance	
		Partial	ISO 23665 – Training for personnel involved in UAS operations	It only provides high level guidance	
	High	N/A	OUT OF SCOPE		

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3.13 *OSO 08, 11, 14, 21* Operational Procedures

- OSO #8 - Operational procedures are defined, validated and adhered to address technical issues with the UAS
- OSO #11 - Procedures are in-place to handle the deterioration of external systems supporting UAS operation
- OSO #14 - Operational procedures are defined, validated and adhered to (to address Human Errors)
- OSO #21 - Operational procedures are defined, validated and adhered to (to address Adverse Operating Conditions)

3.13.1 Requirement Description

Table 199 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1 (Procedure definition)	Low/Medium/High	Operational procedures appropriate for the proposed operation are defined and as a minimum cover the following elements: • Flight planning, • Pre and post-flight inspections, • Procedures to evaluate environmental conditions before and during the mission (i.e. real-time evaluation), • Procedures to cope with unintended adverse operating conditions (e.g. when ice is encountered during an operation not approved for icing conditions) • Normal procedures, • Contingency procedures (to cope with abnormal situations), • Emergency procedures (to cope with emergency situations), and • Occurrence reporting procedures. Normal, Contingency and Emergency procedures are compiled in an Operation Manual. The limitations of the external systems supporting UAS operation are defined in an Operation Manual.
Criterion #2 (Procedure complexity)	Low	Operational procedures are complex and may potentially jeopardize the crew ability to respond by raising the remote crew's workload and/or the interactions with other entities (e.g. ATM…).

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	Medium	Contingency/emergency procedures require manual control by the remote pilot when the UAS is usually automatically controlled.
	High	Operational procedures are simple.
Criterion #3 (Consideration of Potential Human Error)	Low	At a minimum, operational procedures provide: • a clear distribution and assignment of tasks an internal checklist to ensure staff are adequately performing assigned tasks.
	Medium	Operational procedures take human error into consideration.
	High	Same as medium. In addition, the Remote Crew receives CRM (Crew Resource Management) training

Table 200 Assurance Requirements' Description

Criteria	Robustness	Description
Criteria	Low	• Operational procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the operational procedures is declared, except for emergency procedures, which are tested.
	Medium	• Operational procedures are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. • Adequacy of the contingency and emergency procedures is proven through: ○ dedicated flight tests; or ○ simulation, provided the simulation is proven valid for the intended purpose with positive results.
	High	Same as medium. In addition: • Flight tests performed to validate the procedures and checklists cover the complete flight envelope or are proven to be conservative. • The procedures, checklists, flight tests and simulations are validated by a competent third party.

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3.13.2 Summary

Table 201 OSO 08, 11, 14, 21 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*			Robustness *Criterion 3*			Global Score
			L/M/H	L	M	H	L	M	H	
Integrity										
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P					P	P	3
Assurance										
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P					P	P	3

Table 202 OSO 08, 11, 14, 21 Documents not available or under development

Standard Title	SDO	Doc. Reference	Notes
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	Draft under development – document not available
Minimum Aviation System Performance Standard (End-to-end Requirements at system level) for Automatic Take-Off and Landing - MASPS	EUROCAE	N.A.	Doc Planned
Minimum Aviation System Performance Standard (End-to-end Requirements at system level) for Automatic Taxiing	EUROCAE	N.A.	Doc Planned
Minimum Aviation System Performance Standard (End-to-end Requirements at system level) for automation and Emergency Recovery - MASPS	EUROCAE	N.A.	Doc Planned

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Standard Practice for Independent Audit Program for Unmanned Aircraft Operators	ASTM	F3364-19	Document not available – On-going
UAS Operator Compliance Audits	ASTM	WK62731	Document not available – On-going
Flight beyond visual line of sight	SAE	N.A.	Doc Planned
Night Operations	SAE	N.A.	Doc Planned
Aerial photography	SAE	N.A.	Doc Planned
Power line inspections	SAE	N.A.	Doc Planned
Precision agriculture	SAE	N.A.	Doc Planned
Bridge inspection	SAE	N.A.	Doc Planned
Train right-of-way's	SAE	N.A.	Doc Planned
Flare stack inspections	SAE	N.A.	Doc Planned
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA	NFPA 2400	Document not available
Guide to the Preparation of Operational Concept Documents	AIAA	AIAA G-043B-2018	Document not available
Practice for Visual Signals Between Persons on the Ground and in Aircraft During Ground Emergencies	ASTM	F1591	Document not available
Practice for Communications Procedures—Phonetics	ASTM	F1583	Document not available

3.13.3 Integrity Coverage Detail

Table 203

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L/M/H	L	M	H	L	M	H	

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Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P					P	P	Criterion 2: The document contains generic procedures that are applicable to any UAS. The level of complexity cannot be judged.
Notes: Operations – General On-going document The document contains a comprehensive list of operational procedures and best practises for operators and remote crew involved in UAS operations. Potentially all UAS operation are covered by the standard, including autonomous flights. Contingency and emergency procedures are not addressed in detail.										

3.13.1 Assurance Coverage Detail

Table 204

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L/M/H	L	M	H	L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P					P	P	Criterion 2: The document contains generic procedures that are applicable to any UAS. The level of complexity cannot be judged.
Notes: Operations – General On-going document The document contains a comprehensive list of operational procedures and best practises for operators and remote crew involved in UAS operations. Potentially all UAS operation are covered by the standard, including autonomous flights. Contingency and emergency procedures are not addressed in detail.										

3.13.2Gaps

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3.13.2.1 Summary

Table 205 Gap Summary - OSO 08, 11, 14, 21

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	No evidence of standards covering requirements for each element. In addition, some elements (i.e. contingency procedures or pre and post-flight inspection) may require specific standards for each type of UAS and related operation.	-7	It is strongly recommended to develop standards covering all the operational aspects
2	No evidence at this stage of standards covering requirements to better address the functions of crew in relation to interactions with other entities involved in UAS operations. In particular, no evidence of standard procedures with ATM or other airspace authorities (e.g. CAA, …)	0	It's strongly recommended to develop standards to clear the activities to act in case of relation with other units, in particular, with ATM
3	No evidence of standards covering contingency or emergency procedures. In particular, should be defined standards for procedures with ATM and enforcement authority units	-5	It's strongly recommended to develop standards to define emergency/contingency procedures
4	Absence of standards covering requirements for checklists or manual, appropriate for staff personnel in doing standardised operational procedures (e.g. flight planning procedures, operational manual, etc.)	-9	The operational procedures are the focus of aviation activities and shall be the same for UAS. It's very strongly recommended to develop a standard covering this issue.
5	No evidence of standards covering operational procedures to manage human errors, either during normal operations or emergency/contingency conditions	-9	Human errors are the most relevant issue in the occurrences. It's very strongly recommended to develop a standard covering this issue.
6	Absence of standards covering any requirements to train the Remote Crew through Crew Resource Management programmes, leading them to acquire the required competence.	-1	CRM is an adding value in conducting UAS operations. CRM training should be included in the curriculum for remote crews.

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3.13.2.2 Details

Table 206

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	No evidence of standards covering requirements for each element. In addition, some elements (i.e. contingency procedures or pre and post-flight inspection) may require specific standards for each type of UAS and related operation.	Safety (3)	Very High	The majority of aeronautical activities are managed following very specific procedures, as standard as possible, in order to enhance the safety aspects. Use of standard procedures for each specific issue may also support authorities to perform their supervision functions. Therefore, requirements should be developed for each single activity and applied by the UAS operators.	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	Medium	The lack of standards for standard procedures may be covered with an initial hard work. On the other side, when realised, the procedures may make easier the operations, cutting the costs.	0	0
		Environmental Impact (1)	Neutral	-	0	0
		Impact on EU Industry competitiveness (1)	Negative	The absence of requirements, may have consequences for industries in developing and producing different equipment.	-1	-1
		Social Acceptance (1)	No impact	-	0	0
Total Weighted Score						**-7**

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Table 207

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	No evidence at this stage of standards covering requirements to better address the functions of crew in relation to interactions with other entities involved in UAS operations. In particular, no evidence of standard procedures with ATM or other airspace authorities (e.g. CAA, …)	Safety (3)	High	In the aviation world, roles, functions and related responsibilities are usually structured in order to work in a more efficient and effective way. Furthermore, this issue may be sensitive in case of relation with Authorities or with ATM units. The procedures with ATM need to be very standardised in order to avoid misunderstandings and to simply the respective functions and reducing the workload. In addition, it's to be considered that Operators and crews operate in different context related to classification of airspace and/or different States.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Low	Costs are to be considered to realise the procedures and to train the personnel to apply.	+1	+2
		Environmental Impact (1)	Neutral	-	0	0
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Low	Standard operational procedures are appreciated.	+1	+1

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Total Weighted Score	0

Table 208

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
3	No evidence of standards covering contingency or emergency procedures. In particular, standards for procedures with ATM and enforcement authority units should be defined	Safety (3)	High	Contingency and emergency conditions need to be standardised in order to apply the "best" way to handle them, following same parameters for the different situations. In the ATM, this aspect is very sensitive and standard contingency/emergency procedures may support ATM personnel to manage the complete situation, even in relation to other airspace users.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	Costs are to be considered to realise the procedures and to train the personnel to apply.	0	0
		Environmental Impact (1)	Bad	The absence of requirements may have consequence in third parties, in particular, on the ground.	-2	-2
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	The absence of emergency/contingency procedures gives less trust to citizens	-1	-1
Total Weighted Score						-7

Table 209

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted

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						Score
4	Absence of standards covering requirements for checklists or manual, appropriate for staff personnel in doing standardised operational procedures (e.g. flight planning procedures, operational manual, etc.)	Safety (3)	Very high	Normal working operations in aviation context are "standard operations" and need to be known and followed by all personnel involved. The absence of standards is very sensitive for safety	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	Medium	The company could have limited extra costs to train personnel on procedures.	0	0
		Environmental Impact (1)	Bad	Operational procedures conducted in different ways may create problems for safety of third parties.	-2	-2
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	No standard operational procedures may be negatively considered and, as consequence, scarce social acceptance	-1	-1
Total Weighted Score						-9

Table 210

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
5	No evidence of standards covering operational procedures to manage human errors, either during normal operations or	Safety (3)	Very high	Human errors are, in the aviation world, the main cause of occurrences. The absence of standard procedures to check	-2	-6

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	emergency/contingency conditions			this aspect may have relevant consequences on safety for personnel involved in the operations and for third parties (on the ground and in the airspace, people and goods)		
		Cost of compliance to the requirement with a lack standard (2)	Medium	The company could have limited extra costs to train personnel on procedures.	0	0
		Environmental Impact (1)	Bad	Operational procedures conducted in different ways may create problems for safety of third parties.	-2	-2
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	No standard operational procedures may be negatively considered and, as consequence, scarce social acceptance	-1	-1
Total Weighted Score						**-9**

Table 211

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
6	Absence of standards covering any requirements to train the Remote Crew with Crew Resource Management knowledge	Safety (3)	Very High	When operations are conducted by more of one person, CRM is relevant to better merge the functions of each person.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Low	If personnel have an adequate competence, the company could have very limited extra costs to train personnel in CRM.	+1	+2
		Environmental Impact (1)	Neutral	-	0	0

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		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	No impact	-	0	0
Total Weighted Score						**-1**

3.13.3 Conclusions and Recommendations

The gap assessment highlights the necessity to develop standards to cover all the gaps, in particular gap 1, 3,4 and 5.
It is expected that future developments of "on-going" or planned documents could cover the gaps. In particular:

- ISO 21384-3 Unmanned aircraft systems -- Part 3: Operational procedures
- ISO 23665: Unmanned aircraft systems -- Training for personnel involved in UAS operations
- ASTM WK62744: New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)

The first document contains a comprehensive list of operational procedures and best practises for operators and remote crew involved in UAS operations. Potentially all UAS operations will be covered by the standard, including autonomous flights, while contingency and emergency procedures are not addressed in detail.
The second document currently only includes Annex A to cover VLOS remote pilots training course. Further annexes are expected to be released to cover BVLOS operations and other types of UAS flights.
The third document should address at least integrity criterion #1, providing requirements for the operations manual.
In addition, SAE is developing standards addressing specific operational procedures associated to specific-use cases such as night operations, power line inspections and aerial photography, possibly providing best practices ad hoc for such operations.
Ultimately, although ICAO Doc 10009 is not a "standardising paper", it should be taken into consideration.

Table 212 Recommended Standards - Integrity

Integrity

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Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Procedure definition)	Low/Medium/High	Partial	ISO 21384-3: Operational Procedures	This standard only provides high level guidance. It should be complemented by more detailed guidance for specific applications.	No standards providing detailed guidance to develop procedure covering each of the required elements.
Criterion #2 (Procedure complexity)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	N.A.	NO STANDARD REQUIRED		
	High	N.A.	NO STANDARD REQUIRED		
Criterion #3 (Consideration of Potential Human Error)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Partial	ISO 21384-3: Operational Procedures	This standard only provides high level guidance. It should be complemented by more detailed guidance for specific applications.	No standards providing detailed guidance to develop procedure covering each of the required elements.
	High	Partial			

Table 213 Recommended Standards - Assurance

Assurance

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Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criteria	Low	N/A	NO STANDARD REQUIRED		
	Medium	Partial	ISO 21384-3: Operational Procedures	This standard only provides high level guidance. It should be complemented by more detailed guidance for specific applications.	No standards providing detailed guidance to develop procedure covering each of the required elements.
	High	Full			

3.14 *OSO 09, 15, 22* – Remote Crew Competencies

- OSO #09 - Remote crew trained and current and able to control the abnormal and emergency situations (i.e. Technical issue with the UAS)
- OSO #15 - Remote crew trained and current and able to control the abnormal and emergency situations (i.e. Human Error)
- OSO #22 - The remote crew is trained to identify critical environmental conditions and to avoid them

3.14.1 Requirement Description

Table 214 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The competency-based, theoretical and practical training ensures knowledge of: a. UAS regulation b. UAS airspace operating principles c. Airmanship and aviation safety d. Human performance limitations e. Meteorology f. Navigation/Charts
	Medium	

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	High	g. UA knowledge h. Operating procedures and is adequate for the operation.

Table 215 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	Training is self-declared
	Medium	Training syllabus is available The operator provides competency-based, theoretical and practical training
	High	EASA: • Validates the training syllabus • Verifies the remote crew competencies

3.14.2 Summary

Table 216 OSO 09, *15, 22* Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707	P	P		5
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266	P	P		6
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	ISO 23665	P	P		7

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Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (OPEN) and category b (specific)	JARUS	N.A.	P	P		6
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18		P		7
Assurance						
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18		F		7

3.14.3 Integrity Coverage Detail

Table 217

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707	P	P		The doc doesn't include training requirements for rotary wings remote pilots. U-space services and related training requirements issues are not sufficiently considered. VLOS and BVLOS are not considered.

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Notes: Personnel - Remote Pilot competence
No recommendations are given for recurrent training or specific medical requirements. The scope of the document is limited to proposing an initial framework to train and certify UAS pilots for fixed wing UAS to be operated in the NAS (National American Airspace). The focus is on practical training, theoretical issues (e.g. airmanship, safety,etc.) are not included. This document divides UAS operation into two distinct categories: Certificated Pilot Operating under Visual Flight Rules (VFR) and Certificated Pilot Operating under Instrument Flight Rules (IFR). The document is developed having as model the training requirements for manned pilots. In particular, seems to address training for RPAs flying operations similar to manned traffic. U-space services and U-space environment is very poor considered. A training syllabus is provided, following the model for manned aviation (commercial and private pilots).

Table 218

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266	P	P		Training of other remote crew members is not addressed.
Notes: Personnel - Remote Pilot competence The document is well structured. It should be completed with some issues (in particular, specific training syllabus for VLOS/BVLOS conditions, emergency and contingency issues).						

Table 219

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	ISO 23665	P	P		The document is limited to remote pilots trained for VLOS operations. Remote pilots involved in BVLOS operation are not covered. Other training aspects for personnel involved in UAS operations not covered.
Notes: Personnel - Remote Pilot competence The document, even if still a draft version and not officially in force, is well structured and exhaustive. Draft version dated 2018–12-23. The document, at this stage, include only the Annex A to cover VLOS remote pilots training course. Further Annexes are expected to be realised to cover BVLOS operations and other typologies of UAS flights. The Annex A is a very good guide-line, well detailed and covering a large part of the topics referred to a "VLOS remote pilot" training course. The document reports in the chapter 3 "Terms and Definition" the definition of the *"Observer" – "remote crew member who, by visual observation of the unmanned aircraft, assists the remote pilot in the safe conduct of the flight"*.						

Table 220

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (OPEN) and category b (specific)	JARUS	N.A.	P	P		
The document is developed by JARUS ad hoc to comply with the OSOs related to training. Currently it is the unique document providing a training syllabus ad hoc for BVLOS operations. However it does not provide training requirements for personnel other than remote pilots (e.g. visual observers whose tasks could be relevant for the safe management of the flight).						

Table 221

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18		P		Only general structure. No specific and detailed matters and topics

Notes: Personnel - Remote Pilot competence
The document is a useful guideline defining the requirements for training and the development of training manuals for the unmanned aircraft systems (UAS) operator.
It reports the main chapters and sections to develop the structure of a manual.
It doesn't report the detailed matters, arguments and topics. Therefore, this standards covers the medium level of assurance.
The standard potentially cover any type of UAS (up to 600 kg) and operation.

3.14.1 Assurance Coverage Detail

Table 222

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18		F		Only general structure. No specific and detailed matters and topics

Notes: Personnel - Remote Pilot competence
The document is a useful guideline defining the requirements for training and the development of training manuals for the unmanned aircraft systems (UAS) operator.
It reports the main chapters and sections to develop the structure of a manual.
It doesn't report the detailed matters, arguments and topics. Therefore, this standards covers the medium level of assurance.
The standard potentially cover any type of UAS (up to 600 kg) and operation.

3.14.2 Gaps

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3.14.2.1 Summary

Table 223 Gap Summary - OSO 09, *15, 22*

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight	-7	It is strongly recommended to develop a standard covering training for visual observers, mainly for safety reasons.
2	Lack of standards covering training requirements for non-regulated professions (e.g. supporting personnel, payload operator, flight dispatcher etc.)	+6	No need to develop standards for remote crew not in charge of tasks related to the safe management of the flight.

3.14.2.2 Details

Table 224

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of	Safety (3)	High	In some UAS operations there might be personnel, other than remote pilot, who is responsible for the safe management of the flight. For instance, visual observers are key elements for EVLOS operations. Their role is to support the RPIC in the flight management, especially to remark	-1	-3

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	the flight			presence of other hazards (e.g. other traffic, obstacles etc) when the drone is not in the LOS of the remote pilot.[4] Therefore, a training syllabus should be developed ad hoc for these professions to ensure that they have the necessary skills and competencies.		
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards makes more difficult and time consuming for training organisations and operators to develop a training programme[5]. At the same time, it is time consuming for oversight authorities to check skills and competencies.	-1	-2
		Environmental Impact (1)	Not applicable		0	0
		Impact on EU Industry competitiveness (1)	Negative	The adoption of standards could foster the demand for training organisations to deliver ad hoc courses.	-1	-1
		Social Acceptance (1)	Negative	As the role of the observers is important in certain phases of the flight, people may be concerned about the fact that there are no specific training requirements, especially for flights in urban environment.	-1	-1
Total Weighted Score						**-7**

[4] EU regulation 947/2019 establishes that visual observers "*assist the remote pilot in safely conducting the flight. Clear and effective communication shall be established between the pilot and the observer*".

[5] EU Regulation 947/2019 establishes that "*personnel in charge of duties essential to the UAS operation, other than remote pilot itself, have completed the on-the-job training developed by the operator*".

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Table 225

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Lack of standards covering training requirements for non-regulated professions (e.g. supporting personnel, payload operator, flight dispatcher etc.)	Safety (3)	Low	The lack of standards for training of non-regulated professions has a minor impact on safety with respect of regulated professions. Usually supporting personnel (e.g. payload operator) does not have direct responsibilities in the flight management and is not even necessary in most UAS operations.	+1	+3
		Cost of compliance to the requirement with a lack standard (2)	Very low	As no formal training is prescribed by regulations for non-regulated professions, the lack of standards is not expected to generate extra costs for operators. Conversely the adoption of a standard would generate additional cost.	+2	+4
		Environmental Impact (1)	Not applicable		0	0
		Impact on EU Industry competitiveness (1)	Negative	The adoption of standards could foster the demand for training organisations to deliver ad hoc courses.	-1	-1
		Social Acceptance (1)	No Impact	No impact foreseen on social acceptance.	0	0
Total Weighted Score						+6

3.14.3 Conclusions and Recommendations

The UAS crew and operators training is still under development due to the related regulation not being fully developed and implemented yet.
Documents are often based on national regulations and standard requirements are not applied.
At this stage, some international Standards Making Bodies are working to develop standard requirements for training of personnel involved in the UAS activities.

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Taking into account the UAS regulatory framework, the functions and responsibilities of people involved in VLOS operations seem to be better defined compared to people involved in BVLOS operations.
The gap assessment highlights the necessity to develop standards to fill the first gap for safety reasons. It is expected that future amendments of ISO 23665 (Training requirements for UAS personnel) will include training for semi-regulated roles (including visual observers). While it is still a draft, the document seems to be well structured to define the requirements for VLOS remote pilots training course. Annex A is a very good guideline, well detailed and covering a large part of the topics referred to a “VLOS remote pilot” training course. It is one of the rare documents reporting the definition of “Observer”.
ASTM F3330-18 could be a valid standard for the development of an operator training program, thus it could represent an AMC for the medium level of assurance. In addition, ASTM has initiated the work item WK62741 for the development of training for UAS visual observer.
The JARUS recommendations for Recommendations for remote pilot competency (RPC) are specifically developed to cover OSO 9,15,22 and can be assumed as the best reference.
None of the analysed documents cover specific aspects related to UAS operations such as Security and Privacy aspects.

Table 226 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1	Low	Partial	JARUS Recommendations for RPC	The document is not published yet. In additional it does not include training requirements for semi and non-regulated professions	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight
	Medium	Partial			Lack of standards covering training requirements for non-regulated professions (e.g. supporting personnel, payload operator, flight dispatcher etc.)
	High	Partial			

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Table 227 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	N/A	NO STANDARD REQUIRED		
	Medium	Full	JARUS Recommendations for RPC	The document is not published yet.	
			ASTM F3330-18: Standard Specification for Training and the Development of Training Manuals for the UAS Operator		
	High	N.A.	OUT OF SCOPE		

3.15 *OSO 10, 12* – Safe recovery from technical issues

- OSO #10 - Safe recovery from technical issue
- OSO #12 - The UAS is designed to manage the deterioration of external systems supporting UAS operation

3.15.1 Requirement Description

Table 228 Integrity Requirements' Description

Criteria	Robustness	Description

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Criterion 1	Low	When operating over populous areas or gatherings of people, it can be reasonably expected that a fatality will not occur from any probable failure of the UAS or any external system supporting the operation For the purpose of this assessment, the term "probable" should be interpreted in a qualitative way as, "Anticipated to occur one or more times during the entire system/operational life of an UAS". Some structural or mechanical failures may be excluded from the criterion if it can be shown that these mechanical parts were designed to aviation industry best practices
	Medium	When operating over populous areas or gatherings 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. Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) could directly lead to a failure affecting the operation in such a way that it can be reasonably expected that a fatality will occur are developed to a standard considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority. Some structural or mechanical failures may be excluded from the no single failure criterion if it can be shown that these mechanical parts were designed to a standard considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.
	High	Same as medium.

Table 229 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion 1	Low	A design and installation appraisal is available. In particular, this appraisal shows that: • the design and installation features (independence, separation and redundancy) satisfy the low integrity criterion; • particular risks relevant to the ConOps (e.g. hail, ice, snow, electro-magnetic interference…) do not violate the independence claims, if any.
	Medium	Same as low. In addition, the level of integrity claimed is substantiated by analysis and/or test data with supporting evidence.

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	High	Same as low. In addition, the level of integrity claimed is substantiated by analysis and/or test data with supporting evidence and a competent third party validates the level of integrity claimed.

3.15.2 Summary

Table 230 OSO 10, 12 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
System Design and Analysis	FAA	AC 25.1309-1A	F	F		N.A.
System Safety Analysis and Assessment for Part 23 Airplanes	FAA	AC 25.1309-1E	F	F		N.A.
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)	JARUS	CS-LUAS	P	P		N.A.
Prognostics and Health Management Guidelines for Electro-Mechanical Actuators	SAE	AIR8012	P	P		N.A.
System Safety Assessment Objectives and Criteria Inputs to AMC 1309	EUROCAE	ER-019	F	F		N.A.
Air traffic management guidelines for Global Hawk in European airspace	EUROCONTROL		P	P		N.A.
Standard Guide for Electrical Load and Power Source Capacity Analysis	ASTM	F2490-05	P	P		11
Specification for Electrical Systems in Small Aircraft	ASTM	F3231	F	F		11
Specification for Flight Controls in Small Aircraft	ASTM	F3232	P	P		4
Standard Practice for Methods to Safely Bound Flight Behaviour of Unmanned Aircraft Systems Containing Complex Functions	ASTM	F3269	P	P		4
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)	ASTM	F3298-18	P	P		N.A.

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Standard Specification for Design, Construction, and Lightweight UAS	ASTM	F3298-19	P	P		13
Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM	F3309	F	F		11
Department of Defense Standard Practice System Safety	DoD	MIL-STD-882E	F	F		11
Avionics Integrity Program	DoD	MIL-STD-1796A	F	F		2
Unmanned Aerial Vehicles Systems Airworthiness Requirements (USAR)	NATO	STANAG 4671	F	F		N.A.
Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	NATO	STANAG 4702	F	F		11
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO	STANAG 4703	F	F		4
Permanently Installed Rechargeable Lithium Cells, Batteries and Battery Systems	FAA	TSOC179a	F	F		N.A.
Software Considerations in Airborne Systems and Equipment Certification	EUROCAE/RTCA	ED 12/DO-178		P		14
Design Assurance Guidance for Airborne Electronic Hardware	RTCA/EUROCAE	DO-254/ED-80		P		10

3.15.3 Coverage Detail

Table 231

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
System Design and Analysis		AC 25.1309-1A	F	F		

Notes:
This standard describes methods to perform system safety assessments and derive judgement for failure conditions. The standard explicitly addresses FAR §25.1309 and is meant as AMC for large aeroplanes. The methods and guidelines described within might be too stringent for UAS operations up to SAIL IV but will be appropriate to fulfil the requirements.

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Table 232

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
System Safety Analysis and Assessment for Part 23 Airplanes		AC 25.1309-1E	F	F		
Notes: This standard identifies baseline tasks in the system safety analysis and assessment applicable to part 23 airplanes. Those standard tasks are also applicable to UAS and therefore the requirements concerning system safety of OSO#10 are fully covered in all robustness levels.						

Table 233

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)	JARUS	CS-LUAS	P	P		Standard defines requirements on corresponding subsystems supporting UAS operations. Design and installation aspects such as redundancy techniques are not explicitly included. In addition software (SW) and airborne electronic hardware (AEH) considerations of systems supporting UAS operations are not explicitly included (e.g. treatment of use of complex electronic hardware (CEH) items).
Notes: The standard covers requirements for the command and control system and several off board systems related to coverage of OSO#10 SORA requirement. This includes general considerations on the corresponding systems as well as explicit requirements on: • Flight and Navigation Instruments, • Navigation Systems,						

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Table 234

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Prognostics and Health Management Guidelines for Electro-Mechanical Actuators	SAE	AIR8012	P	P		Other components then the Health Monitoring of the Vehicle Systems are not regarded

Notes:

Assessment was made on available data as this standard is still in development.

The standard aims at providing a process to verify high reliability for the health monitoring system. It does not address the aircraft on top level and does not provide analysis of faults on system and component level. It might be supportive for assurance of system monitoring and degradation processes

Table 235

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
System Safety Assessment Objectives and Criteria Inputs to AMC 1309	EUROCAE	ER-019	F	F		

Notes: Standard describes airworthiness requirements, the requirements are also valid to ensure safety as required by the OSO. However, the requirements are not specific to save recovery from technical issue.

Table 236

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Air traffic management guidelines for Global Hawk in European airspace	EUROCONTROL	N.A.	P	P		Guidelines for loss of radio comm. with ATC. Guidelines for loss of control link.
Notes: These guidelines establish a set of minimum ATM requirements for GH/EH flight in European airspace. Aspects addressing OSO#10 are: • Guidelines for loss of radio comm. with ATC • Guidelines for loss of control link						

Table 237

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Guide for Electrical Load and Power Source Capacity Analysis		F2490-05	P	P		Requirements on reliability of electrical power source are not explicitly mentioned. Fault tolerant techniques are not included.
Notes: This standard supports the development and analysis of aircraft electrical power sources. It establishes analysis procedure for electrical load analysis. Emergency and standby operation requirements and corresponding analysis tasks are in the scope of this document.						

Table 238

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Specification for Electrical Systems in Small Aircraft	ASTM	F3231	F	F		
Notes: Standard covers general requirements on electrical systems in small aircraft with combustion engine electrical generation. It therefore covers topics concerning safe design of electrical system and electrical installations of unmanned aircraft systems.						

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Table 239

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Specification for Flight Controls in Small Aircraft		F3232	P	P		Requirements on controllability in case of asymmetrical deflection angles of ailerons in movable fault condition. Actuator force fight requirements if actuator redundancies are used in system. Requirements on electrical subsystems of flight control system. Requirements on software of flight control system. Requirements on power supply of flight control system. Requirements on robustness of flight controls.

Notes:
This standard establishes baseline requirements for the design of a flight control system of small aircraft. Aspects addressing OSO#10 are:

- Requirements on the independence of movables deflection angles.
- Requirements on mechanical stops to limit maximum deflection of movables.
- Requirements addressing continued safe flight and landing under unsymmetrical load conditions concerning flap interconnection.
- Requirements to provide safety relevant information related to the flight control system to the pilot.
- Requirements related to stability augmentation system and continued controllability in case of system related fault.
- Requirements for a quick release function as a manual fall back in case of fault in an autopilot system.
- Requirements on independence of automatic pilot system from fault propagation in case of the malfunction of other systems.

Table 240

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Methods to Safely Bound Flight Behaviour of Unmanned Aircraft Systems Containing Complex Functions		F3269	P	P		Structural or mechanical failures are only considered as reflected by supervision and corresponding contingencies.

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Notes: The standard describes reference architecture for safely bounding flight behaviour. As such it can be used to monitor/supervise external as well as internal systems and prevent single points of failures and initiate potential contingencies. Applicants could benefit if the competent authorities accept this standard as an acceptable means of compliance against single point of failure. The design automatically supports independence, separation and redundancy. A suitable contingency/redundancy/mitigation must be available and executable.

Table 241

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)		F3298-18	P	P		Requirements mitigating particular risks taking external factors into account such common cause failures are not explicitly addressed. Standard defines requirements on safety relevant subsystems of UAS. Software (SW) and airborne electronic hardware (AEH) considerations of systems supporting UAS operations are not explicitly included (e.g. treatment of use of complex electronic hardware (CEH) items).
Notes: The standard contains requirements and aspects related to OSO#10: • Construction • Design Considerations • Structure • Verification methods						

Table 242

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Standard Specification for Design, Construction, and Lightweight UAS		F3298-19	P	P		Requirements mitigating particular risks taking external factors into account such common cause failures are not explicitly addressed. Standard defines requirements on safety relevant subsystems of UAS. Software (SW) and airborne electronic hardware (AEH) considerations of systems supporting UAS operations are not explicitly included (e.g. treatment of use of complex electronic hardware (CEH) items).

Notes:
The standard contains requirments and aspects related to OSO#10:

- Construction
- Design Considerations
- Structure
- Verification methods

Table 243

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft		F3309	F	F		

Notes: This standard defines a simplified safety assessment strategy which could be used for UAS. It establishes a minimum set of activities and artefacts which have to be conducted and produced. Those activities are also classified concerning the corresponding hazard class. This supports system safety in an early development phase.

Table 244

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 824292.

Department of Defense Standard Practice System Safety	US DoD	MIL-STD-882E	F	F		

Notes:
This standard gives detailed instructions on how to perform hazard and risk analysis for engineering tasks. It is not specifically tailored to aircraft / UAS use but is applicable nonetheless. Categories for acceptable risk classes are given. Focus is on risk management during the engineering development process, but analysis of subsystem failures are addressed as well. Requirements for particular risks resulting from ConOps are not given, but means to identify and mitigate risks in a systematic approach are described.

Table 245

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Avionics Integrity Program	US DoD	MIL-STD-1796A	F	F		

Notes:
The Avionics Integrity Program (AVIP) identifies the design tasks needed to achieve high reliability, long life, safe operation and supportability of aviation electronics in operational environments. It establishes a baseline of development artefacts to be produced in the development process. The process tasks concerning avionic subsystems of SORA are fully covered within this standard.

Table 246

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned Aerial Vehicles Systems Airworthiness Requirements (USAR)	STANAG	4671	F	F	P	The STANAG makes no statement about validation of the level of integrity by a third party.

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Notes: This standard contains a set of technical airworthiness requirements intended primarily for the airworthiness certification of fixed-wing military UAV Systems with a maximum take-off weight between 150 and 20,000 kg that intend to regularly operate in non-segregated airspace. It therefore covers topics concerning safe design of all UAV systems and subsystems (e.g. unsymmetrical load due to engine failure) and installations of (military) unmanned aircraft systems.

Table 247

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	STANAG	4702	F	F		
Notes: Standard merely references to NATO STANDARD AEP-80 ROTARY WING UNMANNED AERIAL SYSTEMS AIRWORTHINESS REQUIREMENTS, which was used for further assessment. Standard describes airworthiness requirements. The requirements are also valid to ensure safety as required by the OSO. However, the requirements are not specific to save recovery from technical issue.						

Table 248

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Light Unmanned Aircraft Systems Airworthiness Requirements	STANAG	4703	F	F		
Notes: Standard describes airworthiness requirements, the requirements are also valid to ensure safety as required by the OSO. However, the requirements are not specific to save recovery from technical issue.						

Table 249

Standard Title	SDO	Doc. Reference	Criteria 1	Gaps

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			L	M	H	
Permanently Installed Rechargeable Lithium Cells, Batteries and Battery Systems	FAA	TSOC179a	F	F		

Notes:
This standard references to the most relevant RTCA standards and asks to meet the requirements written in those RTCA standards. It also gives some own additional requirements.
The requirements for OSO#10 are vastly exceeded by this TSO. The TSO mainly references to RTCA standards like DO-311 (MOPS for Rechargeable Lithium Batteries and Battery Systems), DO-178B (Software Considerations in Airborne Systems and Equipment Certification) and DO-254 (Design Assurance Guidance for Airborne Electronic Hardware).

Table 250

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Software Considerations in Airborne Systems and Equipment Certification	EUROCAE/RTCA	ED 12/DO-178		P		This standard only addresses software.

Notes:
1. Published
2. The standard discusses those aspects of certification that pertain to the production of software for airborne systems and equipment used on aircraft, engines, propellers and, by region, auxiliary power units.

Table 251

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Design Assurance Guidance for Airborne Electronic Hardware	RTCA/EUROCAE	DO-254/ED-80		P		This standard is a set of considerations for hardware design which should be used together with other standards in order to fulfil safety requirements.

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Notes:
1. Published 2. The standard provides guidance for design assurance of airborne electronic hardware. It use might be too demanding for Medium Robustness.

3.15.4 Gaps

No gaps were identified in OSO 10 and 12.

3.15.5 Conclusions and Recommendations

Table 252 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion	Low	Full	ASTM F3309: Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	This standard defines a simplified safety assessment strategy which could be applied to UAS. It establishes a minimum set of activities and documents which must be conducted and produced. The activities are also classified in relation to the corresponding hazard class. This supports system safety in an early development phase.	
	Medium	Full	AC 23.1309-1E: System Safety Analysis and Assessment for Part 23 Airplanes JARUS AMC RPAS.1309: Safety Assessment of Remotely Piloted Aircraft Systems **to be considered for future versions**	AC 23.1309-1E identifies baseline tasks in the system safety analysis and assessment applicable to part 23 airplanes. The standard tasks are also applicable to UAS and therefore the requirements concerning system safety of OSO#10 are fully covered in all robustness levels.	
	High	Full			

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Table 253 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Technical Design)	Low	Full	ASTM F3309: Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	This standard defines a simplified safety assessment strategy which could be applied to UAS. It establishes a minimum set of activities and documents which must be conducted and produced. The activities are also classified in relation to the corresponding hazard class. This supports system safety in an early development phase.	
	Medium	Full	AC 23.1309-1E: System Safety Analysis and Assessment for Part 23 Airplanes JARUS AMC RPAS.1309: Safety Assessment of Remotely Piloted Aircraft Systems **to be considered for future versions**	AC 23.1309-1E identifies baseline tasks in the system safety analysis and assessment applicable to part 23 airplanes. The standard tasks are also applicable to UAS and therefore the requirements concerning system safety of OSO#10 are fully covered in all robustness levels.	
	High	Full			

3.16 *OSO 13* – External services supporting UAS operations are adequate to the operation

3.16.1 Requirement Description

Table 254 Integrity Requirements' Description

Criteria	Robustness	Description

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Criteria	Low	The applicant ensures that the level of performance for any externally provided service necessary for the safety of the flight is adequate for the intended operation. If the externally provided service requires communication between the operator and service provider, the applicant ensures there is effective communication to support the service provisions. Roles and responsibilities between the applicant and the external service provider are defined.
	Medium	
	High	

Table 255 Assurance Requirements' Description

Criteria	Robustness	Description
Criteria	Low	The applicant declares that the requested level of performance for any externally provided service necessary for the safety of the flight is achieved (without evidence being necessarily available).
	Medium	The applicant has supporting evidence that the required level of performance for any externally provided service required for safety of the flight can be achieved for the full duration of the mission. This may take the form of a service-level agreement (SLA) or any official commitment that prevails between a service provider and the applicant on the relevant aspects of the service (including quality, availability, responsibilities). The applicant has a means to monitor externally provided services which affect flight critical systems and take appropriate actions if real-time performance could lead to the loss of control of the operation.
	High	Same as medium. In addition: • the evidence of the performance of an externally provided service is achieved through demonstrations; and • a competent third party validates the claimed level of integrity.

3.16.2 Summary

Table 256 OSO 13 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*	Global Score

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			L/M/H	
Integrity/Assurance				
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P	3
Unmanned aircraft systems -- Part 2: Product systems	ISO	21384-2	P	5
Space - Use of GNSS-based positioning for road Intelligent Transport Systems- Part1- Definitions and system engineering procedures for the establishment and assessment of performance	EN	16803-1:2016	P	3
Space - Use of GNSS-based positioning for road Intelligent Transport Systems- Part2- Assessment of basic performances of GNSS-based positioning terminals	EN	16803-2:2016	P	3
Space systems — Space-based service for a positioning system with high accuracy and safety support applications in low visibility due to weather conditions	ISO	CD 22591.2	P	N.A.
Resolución de 8 de marzo de 2019, de la Dirección de la Agencia Estatal de Seguridad Aérea, por la que se publican los medios aceptables de cumplimiento y material guía, aprobados para las operaciones con aeronaves pilotadas por control remoto, en virtud del Real Decreto 1036/2017, de 15 de diciembre.	AESA	N.A.	P	7
Guidelines for the use of multi-GNSS solutions for UAS	EUROCAE	N.A.	P	3
Requirements for UTM services and service providers	ISO	23629-12	P	N.A.

3.16.3 Coverage Detail

Table 257

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3		P		-Adequacy for the intended operation. -Specific roles and requirements are not defined.

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Notes: The standard provides general operational procedures to ensure safety of UAS operations. Among these procedures it is advised to check the accuracy of GNSS as a function of the location and the environmental conditions. Service level agreements are included in the list of suggested documentation to be held by UAS operator. Oversight of contracted service providers is needed to ensure quality and performance of safety-critical information The standard covers at high level general operational requirement but it is unclear how to determine adequacy of navigation performance for the intended operation.

Table 258

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 2: Product systems	ISO	21384-2		P		-Adequacy for the intended operation. -Specific roles and requirements are not defined.
Notes: The standard provides requirements for ensuring the quality and safety of the design and manufacture of UAS. However, no technical requirements are provided so it remains unclear how to determine adequacy of navigation performance for the intended operation. Conservatively, the standard could be compliant with low level of integrity (where adequacy of performance does not have to be demonstrated with tests, compliance with technical standards, etc.).						

Table 259

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Space - Use of GNSS-based positioning for road Intelligent Transport Systems- Part1- Definitions and system engineering procedures for the establishment and assessment of performance	EN	16803-1:2016		P		-Criteria to define performance adequacy for a given drone operation -Roles and responsibilities

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Notes: The document contains a framework for GNSS applications. The standard is mainly addressed to the Road ITS domain, but definitions and metrics are applicable also to the UAS context. Performance metrics are defined. It is proposed an approach to define performance levels. The standard could be used as informative guidance to better understand the general architecture of a GNSS system. In addition, the document provides a classification of “reference GNSS environment” in which GNSS performance may vary. This definition is applicable to the context of drone operations as the “GNSS environment” is very similar to the Road domain.

Table 260

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Space - Use of GNSS-based positioning for road Intelligent Transport Systems-Part2- Assessment of basic performances of GNSS-based positioning terminals	EN	16803-2:2016		P		-Criteria to define performance adequacy for a given drone operation -Roles and responsibilities

Notes:
The document contains procedures to assess the basic performances (i.e. availability, continuity, accuracy and integrity) of any GBPT (GNSS based positioning terminal) for a given use case.
However, the document does not define minimum performance requirements (i.e. it does not include MOPS) as these may vary depending on the type of application.
The proposed tests are specific for the road domain and not directly repeatable for drones. Some operational environment and dynamics are comparable (so that it could be possible to “adapt” the procedures), others are not (e.g. traffic congestion).
More similarities can be found between ground vehicles dynamics and multicopters (i.e. the possibility to have multiple stops along the route, etc.).
The metrics and the mathematical approach to derive performance requirement can be applied to the drone context.
In conclusion the standard offers an approach that can be adopted to derive performance of GNSS equipment but does not provide criteria to determine the adequacy of a given performance. Therefore, it can only partially fulfil OSO #13.

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Table 261

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Space systems — Space-based service for a positioning system with high accuracy and safety support applications in low visibility due to weather conditions	ISO	CD 22591.2		P		-Adequacy for UAS operations -Roles and responsibilities

Notes:
The document contains safety, performance and HMI requirements for space-based positioning systems as support to applications in low visibility conditions. The targets of this standard are ground vehicles (e.g. employed in snowplow, docking,etc.) for which a high level of accuracy is needed to ensure safety of personnel. Four different accuracy levels are proposed, up to centimeter level. Although drones are not supposed to fly in bad weather conditions, these performance levels could be relevant also for small UAS operating at VLL, possibly in proximity of obstacles/infrastructures (e.g. performing inspection missions, or delivery in urban environment).

Table 262

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Resolución de 8 de marzo de 2019, de la Dirección de la Agencia Estatal de Seguridad Aérea, por la que se publican los medios aceptables de cumplimiento y material guía, aprobados para las operaciones con aeronaves pilotadas por control remoto, en virtud del Real Decreto 1036/2017, de 15 de diciembre.	AESA	N.A.		P		Roles and responsibilities

Notes:
The document represents an AMC officially recognised by AESA (CAA of Spain) to comply with OSO #13 requirements. Different navigation performance levels are defined, distinguishing between VLOS/BVLOS conditions and flight above or below VLL.
Roles and responsibilities are not defined.

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Table 263

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Guidelines for the use of multi-GNSS solutions for UAS	EUROCAE	N.A.	P			

Notes:
The document contains guidelines related to the use of GNSS in UAS operations and propose approaches to fulfil OSO #13 requirements related to GNSS. Three different levels (Low, Medium, High) of navigation performance are proposed, possibly matching the SORA integrity requirements: values for accuracy, integrity, availability, continuity, etc. are provided.
In addition, possible causes for degradation of GNSS performance are provided, included their dependency with environmental conditions.
The document is just a preliminary guidance. It is expected that SG-62 will develop adequate standards (e.g. MOPS) for UAS GNSS equipment, taking into account the SORA approach and thus perfectly matching with the OSO #13 requirements.

Table 264

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Requirements for UTM services and service providers	ISO	23629-12	P			

Notes:
The document is a NWIP with the aim to cover safety, security, privacy and quality requirements for UTM service providers, C2 Link service providers and communication (C2CSP) service providers. The standard is still in the form of a proposal, but it has a high potential since no other standards are covering these aspects.
Navigation service providers are not in the scope.

3.16.4 Gaps

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3.16.4.1 Summary

Table 265 Gap Summary - OSO 13

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of specific taxonomy (e.g. RNP 0.02 or 0.0) to define GNSS performance adequacy for drone operations.	-11	Several indicators (including ANSI Roadmap and the establishment of EUROCAE WG 105/SG 62) show that there is the urgency to develop standards to cover this gap. Work is on-going at EUROCAE level as WG 105/ SG 62 should publish in the future standards related to use of GNSS for drone applications. Some metrics have already been published by EUROCAE, CEN, ISO and AESA but only at level of guidelines.
2	Lack of standardised procedures for the monitoring of external services.	2	There is no particular need to have standards covering this gap. For operations dealing with low SAILs (i.e. with a low level of robustness) it will be sufficient for operators to refer to the GNSS open services document definition. For high risk operations, standard procedures to monitor GNSS performance should be defined.
3	Lack of testing procedures to demonstrate that GNSS performance is adequate for UAS OPS.	-8	It is recommended to develop a standard dedicated to testing procedures for drone GNSS related applications. CEN prEN 16803-2 can be used as model to produce a similar standard for drones.

3.16.4.2 Details

Table 266

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
	Lack of specific taxonomy (e.g. RNP 0.02 or 0.0) to define GNSS performance adequacy for drone	Safety (3)	Very High	GNSS performance is a crucial element to support UAS operations. Accurate tracking solutions enabled by GNSS are critical for reducing operational risks and complying with SORA. GNSS performance depends on several factors, including environment,	-2	-6

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1	operations.			altitude, location, weather etc. In addition, depending on the type of operation, different GNSS performance levels would be needed. For instance, performance levels to be ensured for BVLOS mission in urban areas and/or in proximity of obstacles would are different from those that might be needed for BVLOS missions over a sparsely populated environment. High reliability, robustness and accuracy are essential in ensuring that accurate position information on the drone is available and that beyond line of sight operations can be conducted safely. In addition, GNSS supports geofencing functions that are essential to remain inside the predefined volume. In absence of precise metrics, it is hard for operators to understand to what extent the available GNSS performance is able to safely support their missions.		
		Cost of compliance to the requirement with a lack standard (2)	High	In absence of standards, it takes longer for operators to understand whether the GNSS performance is adequate for the operations. On the other hand, it will be more time consuming for Authorities to verify adequacy of GNSS performance.	-1	-2
		Environmental Impact (1)	Bad	The use of GNSS contributes to reduce traffic congestion and improve the efficiency of transportation through navigation, fleet management, opportunities and satellite traffic monitoring. The enhanced positioning capabilities of EGNSS could be a key element in the safe and sustainable development of autonomous drones, helping to further reduce congestion and pollution.	-2	-2
		Impact on EU Industry competitiveness (1)	Very Negative	The 2019 GNSS market report shows that the GNSS is the key to unlock the drone market. GNSS positioning information will enable safe and harmonious drone market growth. The number of GNSS devices shipped on these drones has greatly increased in recent years, especially starting in 2015 when prices had decreased sufficiently for consumer drones to become more	-2	-2

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				widely available. The Shipments of GNSS devices by drone category have reached the 11 million units in 2018 and are expected to grow more. In addition, GNSS is one of the main enablers for BVLOS missions and several European companies have been developing drones with beyond visual line of sight capabilities (e.g. Airbus, Delar-Tech etc.) In general, it is estimated that the global GNSS downstream market revenues from both devices and services are forecast to grow from €150 billion in 2019 to €325 billion in 2029. This growth is mainly due to revenues from mass market and mid-end devices (<€150) and from augmentation services.		
		Social Acceptance (1)	Positive	As GNSS is an important element to manage and increase efficiency of drone traffic, reduce emissions and power consumption. This aspect is socially relevant. However, enabling a large number of drone missions in populated areas may be seen in a negative way from part of the public opinion as these intrinsically represent a significant element of risk.	1	1
Total Weighted Score						**-11**

Table 267

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
	Lack of standardised procedures for the monitoring of external	Safety (3)	Low	During flight operations, the GNSS level is monitored through the GCS. In case of poor signal, failsafe procedures can be activated (either manually or automatically). These procedures are widely	1	3

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2	services			adopted by most commercial drones to allow a safe recovery of the UAS.		
		Cost of compliance to the requirement with a lack standard (2)	Medium	The lack of standard procedures to monitor GNSS signal will cause each pilot to become confident and trained with monitoring systems used on a case by case basis. In addition, specific HMI evaluation might be required.	0	0
		Environmental Impact (1)	No impact		0	0
		Impact on EU Industry competitiveness (1)	Negative	The lack of standards to monitor GNSS signal makes difficult for industries to produce harmonised solutions (e.g. design of RPS interfaces and functions).	-1	-1
		Social Acceptance (1)	No impact		0	0
Total Weighted Score						**+2**

Table 268

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
3	Lack of testing procedures to demonstrate that GNSS performance is adequate for UAS OPS.	Safety (3)	High	For high assurance it is required to demsontrate somehow that the desired performance level is achieved. The absence of standard procedures might lead operators to perform inaccurate or incomplete tests.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	Validation by competent third parties would take much time to check compliance. I addition operators may dedicate some effort in defining from scratch the test campaign.	-1	-2
		Environmental Impact (1)	Bad	Standards may improve tests efficiency (e.g. by optimising the number of tests to be done) and consequently reduce	-2	-2

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				the energy consumption and emissions.		
		Impact on EU Industry competitiveness (1)	No impact		0	0
		Social Acceptance (1)	Negative	In case of accident/incident due to GNSS issues, the lack of standard testing procedures may have a negative impact on public opinion.	-1	-1
Total Weighted Score						**-8**

3.16.5 Conclusions and Recommendations

This section contains an assessment of the standards to support compliance with the requirements defined in OSO #13. As the requirements for the U-Space services will be addressed in the second iteration of the project, the current focus is on the adequacy of navigation services.

Performance level:

Navigation performance is essential to ensure safety of UAS operations. The reliability of navigation data affects the capacity of correctly following a predefined flight trajectory (automatic flight modes) but also the robustness of the geofencing functionality.

The assessment for OSO #13 shows that there is a lack of standards tailored for UAS applications, confirming the analysis carried out by ANSI in December 2018. In fact, existing standards mainly deal with traditional manned aviation applications (e.g. RTCA DO-316). Although the definition of performance metrics (i.e. accuracy, availability, integrity etc.) is similar, performance requirements and test procedures are not directly applicable to most UAS given the different flight dynamics and operational context (low altitudes, lower ground speed, etc...). For large drones with flight dynamics comparable to those of manned aircraft (and likely to operate in the Certified Category) these requirements could instead be applicable. However, the priority of this assessment is focused on the Specific Category.

Some standards imported from domains other than aviation (e.g. road) define accuracy requirements that could be suitable especially for UAS operations at VLL. Although the operational target is different, the environmental conditions are similar (urban canyons, dynamics, etc.) However, OSO #13 requires demonstrating that navigation performance is adequate for the “intended UAS operation”. This means that an operator, depending on the envisaged UAS mission, shall demonstrate that navigation the performance is adequate to ensure safety. It is therefore necessary to have standards that can map performance requirements to typical-use cases and environment.

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The performance level for a give operation may be:

- Derived from regulations/standards (AESA has developed specific AMC to comply with OSO#13 requirements (at least at navigation performance level)
- Determined by the operator on a case-by case basis (a recognised methodology should be defined in this case)

The prEN 16803-x series provides some definitions and test methods to measure the performance of GNSS in the Road ITS domain. While intended for vehicle use, most dynamic parameters of the former are comparable to those of drones, as well as environmental conditions (i.e. operations in urban canyons at low altitudes). Therefore, some of the procedures and scenarios defined in such documents could be considered as a baseline to develop tests for drones.
As a further remark, there is general lack of criteria to evaluate the adequacy of a given performance for a specific mission. There is the ned for a standard or a guideline to define reference values in terms of GNSS performance for low, medium and high integrity. For each of these levels, distinction should be made depending on the type of operation.

Roles and responsibilities:
The definition of roles and responsibilities between operators and service providers in "contracting" navigation services is not regulated (this could be relevant when the operator will require access to non-open services such as GALILEO PRS and HAS). SORA Annex E states that "*requirements for contracting services with Service Providers may be derived from ICAO Standards and Recommended Practices - SARPS (currently under development)".* In general ICAO SARPs for GNSS are not applicable for UAS (given the different phases of flight, dynamics, environment, etc) and, moreover, no GNSS-specific SARPS for UAS are currently under development. Rather than having specific standards, this aspect should be regulated at ICAO/EU level.

Assurance:
For medium assurance the operator shall provide evidence that the claimed level of integrity is achieved.
In this case evidence of performance relies on two elements:

- Performance that can be delivered by the GNSS receiver (this can be inferred by the technical data sheet)
- Performance delivered by the GNSS constellation and service provider (this can be inferred by the respective Service Definition Documents)

It is further required to have means to monitor GNSS performance during the flight. Currently such procedure is not yet standardised.
For high integrity, there is the need to implement standards defining procedures to demonstrate that the service performance is achieved.
This requirement can be partially covered by the CEN prEN 16803-2 as it provides some testing procedures for GNSS receivers for the road domain.

Other
Cyber security is also a relevant issue for GNSS. On-going standardisation activities are working on GNSS attacks (not necessarily for drone applications). Anyway, since security issues are not part of the current version of the SORA, such standards are not considered in this analysis.

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EUROCAE has recently established the SG 62 in WG 105 with the purpose to develop standards on GNSS for UAS. The group published in June 2019 the "Guidelines for the use of multi-GNSS solutions for UAS". The document proposes approaches to fulfil requirements for OAS #13 (related to navigation) and seems to pave the way for the development of adequate standards tailored for drone applications, while keeping in consideration the SORA methodology. Therefore, it is strongly recommended to monitor the activities of this WG as it is expected that the emerging standards will match OSO requirements at least at equipment level (i.e. Performance of GNSS receiver). In addition, the guidelines propose three different performance layers for GNSS (low/medium/high) tailored to UAS operations.

Beside navigation, external services may include C2 Link providers and C2CSP providers (e.g. cellular networks). Requirements for such providers shall be established to ensure an adequate level of safety. ISO TC207SC 16 has planned the development of a standard to cover safety, privacy, quality and security requirements for these providers, including U-Space providers that could represent an AMC for OSO #13 in the future (except for navigation performance that is out of scope).

Finally, the analysis carried out shows that there is a general lack of GNSS related standards tailored for UAS operations. It is strongly recommended to produce a standard (e.g. by EUROCAE WG 105/ SG 62) to define performance levels for different types drone operations. This gap has a very negative impact, especially on safety and market related aspects. In addition, a standard is needed to define specific performance tests on GNSS. This standard could be developed similarly to CEN 16803, which is tailored for the drone domain, although some environmental conditions and flight dynamics are comparable with those of small drones. U-Space issues related to OSO #13 will be addressed in future iterations of the project.

Table 269 Recommended Standards - Integrity

Integrity					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criteria	Low	N.A.	NO SPECIFIC STANDARD RECCOMENDED		See gaps above
	Medium				
	High				

Table 270 Recommended Standards - Assurance

Assurance

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Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criteria	Low	N.A.	NO SPECIFIC STANDARD RECCOMENDED		See gaps above
	Medium				
	High				

3.17 *OSO 16* – Multi crew coordination

3.17.1 Requirement Description

Table 271 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1 (Procedures)	Low	Procedure(s) to ensure coordination between the crew members and robust and effective communication channels is (are) available and at a minimum cover: • assignment of tasks to the crew, • establishment of step-by-step communications.
	Medium	
	High	
Criterion #2 (Training)	Low	Remote Crew training covers multi crew coordination
	Medium	Same as Low. In addition, the Remote Crew receives Crew Resource Management (CRM) training.
	High	
Criterion #3 (Communication devices)	Low	N/A
	Medium	Communication devices comply with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority
	High	Communication devices are redundant and comply with standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.

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Table 272 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1 (Procedures)	Low	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. • The adequacy of the procedures and checklists is declared.
	Medium	Procedures are validated against standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority. Adequacy of the procedures is proven through: • Dedicated flight tests, or • Simulation, provided the simulation is proven valid for the intended purpose with positive results.
	High	Same as Medium. In addition: Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative. The procedures, flight tests and simulations are validated by a competent third party.
Criterion #2 (Training)	Low	Training is self-declared (with evidence available)
	Medium	• Training syllabus is available. • The operator provides competency-based, theoretical and practical training.
	High	A competent third party: • Validates the training syllabus. • Verifies the remote crew competencies.
Criterion #3 (Communication devices)	Low	The applicant declares that the required level of integrity has been achieved
	Medium	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation, inspection, design review or through operational experience.
	High	EASA validates the claimed level of integrity.

3.17.2 Summary

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Table 273 OSO 16 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*			Robustness *Criterion 3*			Global Score
			L/M/H	L	M	H	L	M	H	
Integrity/Assurance										
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	P	P	P					2
Architecture Framework for Unmanned Systems	SAE	AIR5665B	P	P	P			P		N.A.
UAS Operator Compliance Audits	ASTM	WK62731	P	P	P			P		N.A.
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707		P	P					5
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA	2400		P	P					9
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	23665		P	P					7
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18	P		P					7
New Guide for Training UAS Visual Observers	ASTM	WK62741		P	P					N.A.
Practice for Communications Procedures—Phonetics	ASTM	F1583		P	P					7

3.17.3 Coverage Detail

Table 274

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*	Robustness *Criterion 2*	Robustness *Criterion 3*	Gaps

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			L	M	H	L	M	H	L	M	H	
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744	P			P	P					Criterion 1: Partial for medium as it is assumed that the standard will address multi crew procedures but could not be determined as standard is under development. Criterion 2: Partial as, based on draft title and scope, it is assumed that the standard will address multi crew training but not a complete training syllabus
Notes: Standard is under development, only draft title and scope available. Based on this it is assessed that the standard addresses items to be covered in a manual only (therefore coverage is limited to criterion 1 and 2)												

Table 275

Standard Title	SDO	Doc. Reference	*Robustness Criterion 1*			*Robustness Criterion 2*			*Robustness Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Architecture Framework for Unmanned Systems	SAE	AIR5665B	P			P	P			P		Gaps could not be identified through publicly available scope description.
Notes: Published standard. Based on the title and publicly available scope description it provides a common set of principles, terms, concepts, patterns, structures, and guidance for creating system architectures for which it is expected that it covers crew concepts at a generic level if addressed at all. Therefore assessed as Partial.												

Table 276

Standard Title	SDO	Doc. Reference	*Robustness Criterion 1*	*Robustness Criterion 2*	*Robustness Criterion 3*	Gaps

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			L	M	H	L	M	H	L	M	H	
UAS Operator Compliance Audits	ASTM	WK62731		P		P	P			P		Gaps could not be identified through available draft title and scope description

Notes:
Standard is under development. Only title and scope in draft available. Based on this and as it is being drafted by ASTM F38.03, Unmanned Aircraft Systems (UAS) - Personnel Training, Qualification & Certification committee it is expected to fully cover the requirements yet from an audit perspective only. Therefore assessed as Partial.

Table 277

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707				P	P					Gaps could not be identified through publicly available scope description

Notes:
Standard provides an approach to the development of training topics for pilots of Unmanned Aircraft Systems (UAS) for use by operators, manufacturers, and regulators
The topics identified could be used for the construction of a Practical Test Standard for UAS commercial pilot operations and a PTS for a UAS pilot instrument rating.
Through the publicly available abstract it could not be assessed whether or not this provides a full coverage on criterion 2, hence it is assessed as partial.

Table 278

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	

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Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA	2400				P	P					Not covered are UAS other than sUAS and operators other than public safety entities

Notes:
Published standard, specifying minimum criteria necessary to support safe, effective, and efficient sUAS operations when utilized by public safety entities. As this is limited to sUAS and public safety entities its coverage is assessed as partial.

Table 279

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	23665				P	P					CRM training is included

Notes:
The standard provides a very good reference for training of remote pilots in VLOS conditions. Although Crew resource management is included in the training syllabus, the standard does not provide an exhaustive reference for multi-coordination procedures.

Table 280

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	

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Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18	P				P					Criterion 1: Standard addresses manual aspects, not the content of procedures Criterion 2: Standard addresses more generic training manual aspects, including the need to (optionally) include syllabi information, but does not include standards for a training syllabus.

Notes:
Published standard, defining requirements for training and the development of training manuals for the unmanned aircraft systems (UAS) operator. It defines a structure and content (topics) of a training manual

Table 281

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
New Guide for Training UAS Visual Observers	ASTM	WK62741				P	P					Syllabus items for roles other than visual observers and those for advanced visual observer roles.

Notes:
Standard under development, only draft title and scope available. Based on this it is assessed that the standard addresses syllabus items for basic observer tasks only.

Table 282

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	

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Practice for Communications Procedures—Phonetics		F1583		P	P					All aspects other than the use of phonetics in communication procedures
Notes: Published standard, addressing the use of phonetics in communication procedures only.										

3.17.4Gaps

3.17.4.1 Summary

Table 283 Gap Summary - OSO 16

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Absence of standards covering the assignment of tasks to the crew and the establishment of step-by-step communications	-6	It is recommended to develop a standard covering the assignment of tasks to the crew and the establishment of step-by-step communications, mainly for safety reasons. As an intermediate step, the sharing of good practices for various different operational characteristics (EVLOS/BVLOS/urban environment, etc) may also be considered.
2	Absence of standards covering communication devices suitable for drone crews	-7	It is recommended to develop a standard covering communication devices suitable for drone crews. As an intermediate step, standards for communication devices applied in manned aviation may be considered and adapted to accommodate specificities for drone crews stemming from different operational concepts (physical separation of crew members, ability of crew member to use/activate a communication device, need for full duplex communication, etc).

3.17.4.2 Details

Table 284

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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1	Absence of standards covering the assignment of tasks to the crew and the establishment of step-by-step communications	Safety (3)	Very High	Aspects which are critical to the establishment of step-by-step communications and other associated aspects may be overlooked. In an unfortunate situation this may lead to a serious incident/accident with crew miscommunication as root cause as a critical aspect was overlooked in establishing a multi crew coordination procedure. Therefore standards, or as an intermediate step, shared best practices are needed.	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	Medium	With missing standards, operators need to start from scratch by thinking through their operation and how that is affected by multi crew coordination aspects. This would not be an extra burden when a standard would already be available which, possibly, may only need some minor adaptations to suit the specific operation	0	0
		Environmental Impact (1)	Neutral	No difference expected from a standard on crew communication	0	0
		Impact on EU Industry competitiveness (1)	No Impact	No difference expected from a standard on crew communication	0	0
		Social Acceptance (1)	No Impact	No difference expected from a standard on crew communication	0	0
Total Weighted Score						**-6**

Table 285

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
	Absence of standards covering communication devices appropriate for	Safety (3)	High	Aspects which are critical for communication devices and their appropriate use may be overlooked. Therefore standards, or as an intermediate step, shared best practices are needed.	-1	-3

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2	drone crews	Cost of compliance to the requirement with a lack standard (2)	High	With missing standards, operators need to start from scratch by thinking through the required capabilities and performances of communication devices. Furthermore, the operator needs to liaise with communication devices manufacturers in order to find an appropriately matching device. This would not be an extra burden when a standard would already be available to which manufacturers have already devices available	-1	-2
		Environmental Impact (1)	Neutral	No difference expected from a standard on crew communication	0	0
		Impact on EU Industry competitiveness (1)	Negative	A lack of standards for communication devices may fragment the devices manufacturers have to produce	-1	-1
		Social Acceptance (1)	No Impact	No difference expected from a standard on crew communication	0	0
Total Weighted Score						**-7**

3.17.5 Conclusions and Recommendations

This OSO consists of 3 criteria of which only criterion 1 (procedures) refers to standards, nonetheless the listed standards are assessed on all 3 criteria. Identified standards addressing (non-drone) specific type of operations (such as how to handle hazardous material or guides on how to handle in (non-drone) specific situations and environments) have typically no coverage on the OSO criteria as these do not include standards on procedures, training or devices that can reasonably be linked to air and/or ground risks. Some standards are currently being drafted and, although full compliance may be expected, it could not be determined whether they fully cover all OSO aspects and are therefore rated as partial coverage. Based on publicly available scope descriptions the coverages of such standards (typically SAE) has been assessed leading in all cases to a partial coverage assessment as it is expected that it addresses the requirements from a specific and partial perspective only.

It is therefore recommended to develop a standard covering the assignment of tasks to the crew and the establishment of step-by-step communications (for safety reasons) and a standard covering communication devices suitable for drone crews (for safety, cost and EU competitiveness reasons). Although some existing standards include the notion of duty assignment and training aspects to be covered in an operations manual (F3330 – 18), this may not reflect today's

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possible concepts of operation and does not include the notion of step-by-step communications. As an intermediate step, the sharing of good practices for different operational characteristics, as well as the adaptation of standards for communication devices applied in manned aviation may be considered.

Table 286 Recommended Standards

<table>
<tr><th colspan="6">Integrity/Assurance</th></tr>
<tr><th>Criteria</th><th>Robustness</th><th>Coverage</th><th>Recommended standard</th><th>Limitations/Notes</th><th>Gaps</th></tr>
<tr><td rowspan="3">Criterion #1 Procedures</td><td>Low</td><td>N.A.</td><td>NO STANDARD REQUIRED</td><td></td><td rowspan="9">Absence of standards covering the assignment of tasks to the crew and the establishment of step-by-step communications</td></tr>
<tr><td>Medium</td><td>Partial</td><td>ASTM WK62744</td><td>Based on draft title and scope, it is assumed that the standard will address multi crew training but not a complete training syllabus</td></tr>
<tr><td>High</td><td>N.A.</td><td>OUT OF SCOPE</td><td></td></tr>
<tr><td rowspan="6">Criterion #2 Training</td><td>Low</td><td>N.A.</td><td>NO STANDARD REQUIRED</td><td></td></tr>
<tr><td rowspan="4">Medium</td><td rowspan="4">Partial</td><td>ISO 23665</td><td>No exhaustive coverage on multi crew coordination procedures</td></tr>
<tr><td>ASTM F3330-18</td><td>Only defines structure of a training manual</td></tr>
<tr><td>ASTM F1583</td><td>Only addresses communication procedures</td></tr>
<tr><td>SAE ARP 5707</td><td>Provides an approach to the development of training topics for pilots of Unmanned Aircraft Systems (UAS) for use by operators, manufacturers, and regulators</td></tr>
<tr><td>High</td><td>N.A.</td><td>OUT OF SCOPE</td><td></td></tr>
<tr><td>Criterion #3</td><td>Low</td><td>N.A.</td><td>NO STANDARD REQUIRED</td><td></td><td></td></tr>
</table>

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Communication devices	Medium	Partial	SAE AIR5665B Architecture Framework for Unmanned Systems	It is expected to cover crew concepts (including communication devices) only generically.	Absence of standards covering communication devices appropriate for drone crews
	High	N.A.	OUT OF SCOPE		

3.18 *OSO 17* – Remote crew is fit to operate

3.18.1 Requirement Description

Table 287 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1 Effectiveness to fulfil the requirement	Low	The applicant has a policy defining how the remote crew can declare themselves fit to operate before conducting any operation.
	Medium	Same as Low. In addition: • Duty, flight duty and resting times for the remote crew are defined by the applicant and adequate for the operation. • The operator defines requirements appropriate for the remote crew to operate the UAS.
	High	Same as Medium. In addition: • The remote crew is medically fit, • A Fatigue Risk Management. System (FRMS) is in place to manage any escalation in duty/flight duty times.

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Table 288 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1 Effectiveness to fulfil the requirement	Low	The policy to define how the remote crew declares themselves fit to operate (before an operation) is documented. The remote crew declaration of fit to operate (before an operation) is based on policy defined by the applicant.
	Medium	Same as Low. In addition: • Remote crew duty, flight duty and the resting times policy are documented. • Remote crew duty cycles are logged and cover at a minimum: ○ when the remote crew member's duty day commences, ○ when the remote crew members are free from duties, and ○ resting times within the duty cycle. • There is evidence that the remote crew is fit to operate the UAS.
	High	Same as Medium. In addition: Medical standards considered adequate by the competent authority and/or means of compliance acceptable to that authority are established and a competent third party verifies that the remote crew is medically fit. • A competent third party validates the duty/flight duty times. • If an FRMS is used, it is validated and monitored by a competent third party.

3.18.2 Summary

Table 289 OSO 17 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744		P		2

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Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P	P		3
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA	NFPA 2400		P		8
Regulation for Training centers and certification of UAS operators	Official Greek Government Gazette	4527 /30 Dec 2016		P		9
Assurance						
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P	P		3

3.18.3 Integrity Coverage Detail

Table 290

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM	WK62744		P		Does not seem to address resting times during duty/ flight duty times.

Table 291

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P	P		This standard provides only high level guidance with no specific definition of what medical fitness means.

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Table 292

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA	NFPA 2400		P		Does not define a Fatigue Risk Management System (FRMS).

Table 293

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Regulation for Training centers and certification of UAS operators	Official Greek Government Gazette	4527 /30 Dec 2016		P		Defines operational and medical fit requirements for operators but does not define any Fatigue Risk Management System (FRMS).

Notes:

- Available only in Greek language.

3.18.1 Assurance Coverage Detail

Table 294

Standard Title	SDO	Doc. Reference	Criterion 1	Gaps

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			L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3	P	P		This standard provides only high-level guidance with no specific definition of what medical fitness means.

3.18.2 Gaps

3.18.2.1 Summary

Table 295 Gap Summary - OSO 17

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of criteria to address fit conditions before or during duty times	-10	It is strongly recommended to develop a standard covering not only general fit conditions for operational licenses, but also to determine the particular fit conditions before and during duty times.
2	Lack of standards to define a Fatigue Risk Management System (FRMS)	-8	There is not even a single standard to define a Fatigue Risk Management System. Without any, there is a serious gap in the regulatory framework for safety.

3.18.2.2 Details

Table 296

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
	Lack of criteria to address fit conditions before or during duty times	Safety (3)	Very High	Physical and mental condition can greatly affect basic drone operations. Stress and fatigue are highly contributing factors to maintain a satisfactory level in	-2	-6

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1				safety.		
		Cost of compliance to the requirement with a lack standard (2)	High	Without standards providing criteria to address fit conditions, both the integrity of the equipment and the performance of the operation can be jeopardised.	-1	-2
		Environmental Impact (1)	N/A		0	0
		Impact on EU Industry competitiveness (1)	N/A		0	0
		Social Acceptance (1)	Very negative	Working conditions seem to be a sensitive issue for the general public.	-2	-2
Total Weighted Score						**-10**

Table 297

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Lack of standards to define a Fatigue Risk Management System (FRMS)	Safety (3)	Very High	Depending on the operation, resting might represent and important safety factor.	-2	-6
		Cost of compliance to the requirement with a lack standard (2)	Medium	There is a direct correlation of the cost of compliance to this requirement but the magnitude cannot be assessed.	0	0
		Environmental Impact (1)	N/A		0	0
		Impact on EU Industry competitiveness (1)	N/A		0	0
		Social Acceptance (1)	Very Negative	Enabling drone missions in populated areas can trigger social awareness due to the significant imposed risk.	-2	-2

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Total Weighted Score	-8

3.18.3 Conclusions and Recommendations

None of the existent standards were found to fully cover the criterion on its highest robustness level, whereas they can be used separately to identify the individual segments that make up the total requirement. The "official Greek government gazette 4527/30" may be used as a general reference template that covers and regulates most operational requirements, as well as "NFPA 2400 - Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations" which is the most complete on the definition of requirements and physical integrity of the staff. None of these standards was found to define or specify a Fatigue Risk Management System (FRMS).

Crew physical and mental condition is directly related to the safety and performance efficiency of any drone operation. While the general need to address fit requirements for the licencing of the drone operation has been identified within some standards, the gap assessment presents the need to identify and evaluate the same conditions before and during duty times as well as provisions about required intermediate breaks for resting. The effects of fatigue have not been recorded adequately and no remedial instructions are provided through a FRMS.

Table 298 Recommended Standards

Integrity/Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion	Low	Partial	NO STANDARD REQUIRED	ISO 21384-3 UAS – Part 3: Operational Procedures could be used as guidance. However, this standard provides only high-level guidance with no specific definition of what medical fitness means.	
	Medium	Full	NO STANDARD REQUIRED	ISO 21384-3 UAS – Part 3: Operational Procedures could be used as guidance. However, this standard provides only high-level guidance with no specific definition of what medical fitness means.	
	High	N/A	OUT OF SCOPE		

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3.19 *OSO 18* – Automatic Protection of the flight envelope from human errors

3.19.1 Requirement Description

Table 299 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion	Low	The UAS flight control system incorporates automatic protection of the flight envelope to prevent the remote pilot from making any single input under normal operating conditions that would cause the UA to exceed its flight envelope or prevent it from recovering in a timely fashion.
	Medium	The UAS flight control system incorporates automatic protection of the flight envelope to ensure the UA remains within the flight envelope or ensures a timely recovery to the designed operational flight envelope following remote pilot error(s).
	High	(The distinction between a medium and a high level of robustness for this criterion is achieved through the level of assurance.)

Table 300 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion	Low	The automatic protection of the flight envelope has been developed in-house or out of the box (e.g. using Component Off The Shelf elements), without following specific standards.
	Medium	The automatic protection of the flight envelope has been developed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.
	High	Same as Medium. In addition, evidence is validated by EASA.

3.19.2 Summary

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Table 301 OSO 18 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671	F	P		4
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO	STANAG 4703	F	P		4
General Requirements of Flight Control System for Civil Small and Light Multirotor UAS	ISO	WD 24355	P	P		N.A.
Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS	P	P		N.A.
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS	P	P		14

3.19.3 Coverage Detail

Table 302

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671	F	P		The standard covers flight envelope protection in several conditions; however, it does not clearly refer to pilot error(s).

Notes:

1. Published
2. The standard defines a set of technical airworthiness requirements intended primarily for the airworthiness certification of fixed-wing military UAS with a maximum take-off weight between 150 and 20,000 kg that intend to regularly operate in non-segregated airspace

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Table 303

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Light Unmanned Aircraft Systems Airworthiness Requirements	NATO	STANAG 4703	F	P		The standard covers flight envelope protection in several conditions; however, it does not clearly refer to pilot error(s).

Notes:
1. Published
2. The standard defines a minimum set of technical airworthiness requirements intended for the airworthiness certification of fixed-wing Light UAS with a maximum take-off weight not greater than 150 kg and an impact energy1 greater than 66 J (49 ft-lb) that intend to regularly operate in non-segregated airspace

Table 304

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
General Requirements of Flight Control System for Civil Small and Light Multirotor UAS	ISO	WD 24355	P	P		The standard is still in planning phase. It cannot be judged since it is not yet available. However, it defends that a standardisation process regarding FCS for UAS should be activated and is, therefore, believed to cover some of the requirements of OSO#18 (Automatic protection of the flight envelope from human errors).

Notes:
1. Planned
2. The standard cannot be downloaded but the subject can be identified
3. The standard specifies the composition, functional requirements and performance of flight control and navigation system for civil multi-axis UAV piloted aircraft

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Table 305

Standard Title	SDO	Doc. Reference	Criteria 1 L	Criteria 1 M	Criteria 1 H	Gaps
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS	P	P		The standard defines minimum design requirements but only for Light Rotorcraft UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness.

Notes:

1. The applicable requirement for this OSO could be: CS-LURS.1329 Flight control system
2. The standard is a Certification Specification applicable to Light Unmanned Rotorcraft Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.

Table 306

Standard Title	SDO	Doc. Reference	Criteria 1 L	Criteria 1 M	Criteria 1 H	Gaps
Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS	P	P		The standard defines minimum design requirements but only for Light Aeroplane UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness.

Notes:

1. The applicable requirement for this OSO could be: CS-LUAS.1329 Flight control system and operational flight envelope protection
2. The standard is a Certification Specification applicable to Light Unmanned Aeroplane Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.

3.19.4 Gaps

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3.19.4.1 Summary

Table 307 Gap Summary - OSO 18

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Standards covering automatic protection of the flight envelope following remote pilot errors are not designed specifically for small UAS.	-2	It is recommended to develop standards covering automatic protection of the flight envelope following remote pilot errors specifically designed for small civil UAS.

3.19.4.2 Details

Table 308

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Standards covering automatic protection of the flight envelope following remote pilot errors are not designed specifically for small UAS.	Safety (3)	Low	The absence of standards is very sensitive for safety as these protections might not be correctly implemented resulting in vulnerability in case of remote pilot errors.	+1	+3
		Cost of compliance to the requirement with a lack standard (2)	Very High	Operational costs may increase as limitations on the remote pilot actions are set in order to comply with this requirement without a reference standard or following very demanding requirements.	-2	-4
		Environmental Impact (1)	No Impact	-	0	0
		Impact on EU Industry competitiveness (1)	No impact	-	0	0
		Social Acceptance (1)	Negative	People may be concerned about the safety around UAS if they feel that UAVs are unpredictable in terms	-1	-1

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				of flight stability.		
Total Weighted Score						-2

3.19.5 Conclusions and Recommendations

There are existing standards potentially covering the OSO 17 requirements. However, these standards are not specifically tailored for small civil UAS, with a potential negative impact on the actual capacity of the manufacturers to comply with the at a reasonable cost.

Table 309 Recommended Standards

Integrity/Assurance					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Partial	STANAG 4701 – UAV System Airworthiness Requirements (USA)	• The standard does not clearly refer to pilot error(s). • Only applicable to fixed-wing military UAV Systems with a maximum take-off weight between 150 and 20,000 kg	Standards covering automatic protection of the flight envelope following remote pilot errors are not designed specifically for small UAS.
		Partial	STANAG 4703 – Light Unmanned Aircraft Systems Airworthiness Requirements	• The standard does not clearly refer to pilot error(s). • Only applicable to minimum risk operations.	

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		Partial	JARUS – Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	• The standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for medium level of robustness. • Only applicable to Light Unmanned Rotorcraft Systems. Possible applicable requirements: • CS-LURS.1329 Flight control system	
		Partial	JARUS – Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	• The standard is too demanding for operations until SAIL IV. A guidance is needed to determine which subset of the proposed requirements should be used for medium level of robustness. • Only applicable to Light Unmanned Aeroplane Systems. Possible applicable requirements: • CS-LUAS.1329 Flight control system and operational flight envelope protection	
	High	N.A.	OUT OF SCOPE		

3.20 OSO 19 – Safe Recovery from Human Error

3.20.1 Requirement Description

Table 310 Integrity Requirement Descriptions'

Criteria	Robustness	Description

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Criterion #1 (Procedures and checklists)	Low Medium High	Procedures and checklists that mitigate the risk of potential human errors from any person involved with the mission are defined and used. Procedures provide at a minimum: • a clear distribution and assignment of tasks, • an internal checklist to ensure staff are adequately performing assigned tasks.
Criterion #2 (Training)	Low Medium High	The Remote Crew is trained to procedures and checklists. The Remote Crew receives Crew Resource Management (CRM) training.
Criterion #3 (UAS design)	Low Medium High	Low: Systems detecting and/or recovering from human errors are developed to industry best practices Medium/High: Systems detecting and/or recovering from human errors are developed to standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.

Table 311 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1 (Procedures and checklists)	Low	Procedures and checklists do not require validation against either a standard or a means of compliance considered adequate by the competent authority. The adequacy of the procedures and checklists is declared.
	Medium	Procedures and checklists are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. Adequacy of the procedures and checklists is proven through: • Dedicated flight tests, or • Simulation provided the simulation is proven valid for the intended purpose with positive results.

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	High	Same as Medium. In addition: • Flight tests performed to validate the procedures and checklists cover the complete flight envelope or are proven to be conservative. • The procedures, checklists, flight tests and simulations are validated by a competent third party.
Criterion #2 (Training)	Low	Consider the criteria defined for level of assurance of the generic remote crew training OSO (i.e. OSO #09, OSO #15 and OSO #22) corresponding to the SAIL of the operation.
	Medium	
	High	
Criterion #3 (UAS design)	Low	The applicant declares that the required level of integrity has been achieved.
	Medium	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation, inspection, design review or through operational experience.
	High	EASA validates the claimed level of integrity.

3.20.2 Summary

Table 312 OSO 19 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Global Score
			L	M	H	L	M	H	L	M	H	
Integrity												
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	23665				P	P	P				7
Unmanned aircraft systems — Part 3: Operational procedures	ISO	21383-3		P								3
Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (OPEN) and category b (specific)	JARUS	N.A.				P	P	P				8
Assurance												

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Training for UAS personnel	ISO	23665					F					7
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18					F					7
JARUS guidance material (GM) to JARUS RECOMMENDATION UAS RPC CAT A AND CAT B Regarding Recognised Assessment Entity (RAE)	JARUS	N.A.					F					8

3.20.3 Integrity Coverage Detail

Table 313

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO TC20 / SC16	23665				P	P	P				The document is limited to remote pilots trained for VLOS operations. Remote pilots involved in BVLOS operation are not covered. Other training aspects for personnel involved in UAS operations not covered.

Notes: Personnel - Remote Pilot competence
The document, even if still a draft version and not officially in force, is well structured and exhaustive. Draft version dated 2018–12-23.
The document, at this stage, include only the Annex A to cover VLOS remote pilots training course. Further Annexes are expected to be realised to cover BVLOS operations and other typologies of UAS flights.
The Annex A is a very good guide-line, well detailed and covering a large part of the topics referred to a “VLOS remote pilot” training course.
The document reports in the chapter 3 “Terms and Definition” the definition of the *“Observer” – “remote crew member who, by visual observation of the unmanned aircraft, assists the remote pilot in the safe conduct of the flight”*.

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Table 314

Standard Title	SDO	Doc. Reference	Robustness Criterion 1			Robustness Criterion 2			Robustness Criterion 3			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems — Part 3: Operational procedures	ISO TC20 / SC16	21383-3		P								Section 10 of the standards provides an extensive list of elements to be covered by appropriate procedures and checklists during preparation, execution and termination of operations. Nevertheless, no standards nor best practice about the definition of such procedures and checklist are defined. A clear distribution and assignment of tasks is not provided

Table 315

Standard Title	SDO	Doc. Reference	Robustness Criterion 1			Robustness Criterion 2			Robustness Criterion 3			Gaps
			L	M	H	L	M	H	L	M	H	
Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (OPEN) and category b (specific)	JARUS	N.A.				P	P	P				
The document is developed by JARUS ad hoc to comply with the OSOs related to training. Currently it is the unique document providing a training syllabus ad hoc for BVLOS operations. However it does not provide training requirements for personnel other than remote pilots (e.g. visual observers whose tasks could be relevant for the safe management of the flight).												

3.20.4 Assurance Coverage Detail

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Table 316

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Training for UAS personnel	ISO	23665					F					

Notes: Personnel - Remote Pilot competence
The document defines requirements for the training organisation, thus representing a good reference for operators to develop competency-based training.

Table 317

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 - 18					F					

Notes: Personnel - Remote Pilot competence
The document is a useful guideline defining the requirements for training and the development of training manuals for the unmanned aircraft systems (UAS) operator.
It reports the main chapters and sections to develop the structure of a manual.
It doesn’t report the detailed matters, arguments and topics. Therefore, this standard covers the medium level of assurance.
The standard potentially covers any type of UAS (up to 600 kg) and operation.

Table 318

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	

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JARUS guidance material (GM) to JARUS RECOMMENDATION UAS RPC CAT A AND CAT B Regarding Recognised Assessment Entity (RAE)	JARUS						F						
The document is developed by JARUS to complemente JARUS guodelines on RPC. It represent an AMC to comply with high level of assurance as it defines requirements for RAE.													

3.20.5 Gaps

3.20.5.1 Summary

Table 319 Gap Summary - OSO 19

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of specific standards for procedures able to provide at a minimum: • a clear distribution and assignment of tasks, • an internal checklist to ensure staff are adequately performing assigned tasks.	-6	It is recommended to develop a standard covering procedures and checklist for error recovery including a clear allocation of tasks among the remote crew.
2	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight	-7	It is strongly recommended to develop a standard covering training for visual observers, mainly for safety reasons.

3.20.5.2 Details

Table 320

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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1	Lack of specific standards for procedures able to provide at a minimum: • a clear distribution and assignment of tasks, • an internal checklist to ensure staff are adequately performing assigned tasks.	Safety (3)	High	Adequate procedures and related checklist for tasks allocation within the remote crew are crucial elements to support UAS operations safety by reducing the likelihood and effects of human errors.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards makes more difficult and time consuming for operators to develop procedures and associated checklists. At the same time, it is time consuming for oversight authorities to check the adequacy of procedures and checklists.	-1	-2
		Environmental Impact (1)	Not applicable		0	0
		Impact on EU Industry competitiveness (1)	No impact	The lack of standards for this OSO does not have immediate impact on industry competitiveness.	0	0
		Social Acceptance (1)	Negative	Having clear standardised procedures and checklists would have a positive impact on public perception of drone operations safety.	-1	-1
Total Weighted Score						**-6**

Table 321

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of	Safety (3)	High	In some UAS operations there might be personnel, other than remote pilot, who is responsible for the safe management of the flight and error recovery. For instance, visual observers are key elements for EVLOS operations. Their role is to support the RPIC in the flight management,	-1	-3

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	the flight			especially to remark presence of other hazards (e.g. other traffic, obstacles etc) when the drone is not in the LOS of the remote pilot.[6] Therefore, a training syllabus should be developed ad hoc for these professions to ensure that they have the necessary skills and competencies.		
		Cost of compliance to the requirement with a lack standard (2)	High	The lack of standards makes more difficult and time consuming for training organisations and operators to develop a training programme[7]. At the same time, it is time consuming for oversight authorities to check skills and competencies.	-1	-2
		Environmental Impact (1)	Not applicable		0	0
		Impact on EU Industry competitiveness (1)	Negative	The adoption of standards could foster the demand for training organisations to deliver ad hoc courses.	-1	-1
		Social Acceptance (1)	Negative	As the role of the observers is important in certain phases of the flight, people may be concerned about the fact that there are no specific training requirements, especially for flights in urban environment.	-1	-1

[6] EU regulation 947/2019 establishes that visual observers "*assist the remote pilot in safely conducting the flight. Clear and effective communication shall be established between the pilot and the observer*".

[7] EU Regulation 947/2019 establishes that "*personnel in charge of duties essential to the UAS operation, other than remote pilot itself, have completed the on-the-job training developed by the operator*".

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Total Weighted Score	-7

3.20.6 Conclusions and Recommendations

Table 322 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1 (Procedures and checklists)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Partial	ISO 21384-3 UAS – Part 3: Operational Procedures	It only provides high level guidance with no specification on how to practically develop the required procedures to fulfil this OSO.	Lack of specific standards for procedures able to provide at a minimum: - a clear distribution and assignment of tasks, - an internal checklist to ensure staff are adequately performing assigned tasks.
	High	N.A.	OUT OF SCOPE		
Criterion #2 (Training)	Low	Partial	JARUS Recommendations for RPC	It only includes training requirements for the Remote Pilot. No mention of other crew members or CRM training.	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight
	Medium	Partial	JARUS Recommendations for RPC		
	High	N.A.	OUT OF SCOPE		
Criterion #3 (UAS design)	Low	N.A.	NO STANDARD AVAILABLE		
	Medium	N.A.	NO STANDARD AVAILABLE		

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	High	N.A.	OUT OF SCOPE		

Table 323 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1 (Procedures and checklists)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Full	ISO 21384-3 UAS – Part 3: Operational Procedures	It only provides high level guidance with no specification on how to practically develop the required procedures to fulfil this OSO.	Lack of specific standards for procedures able to provide at a minimum: - a clear distribution and assignment of tasks, - internal checklist to ensure staff are adequately performing assigned tasks.
	High	N.A.	OUT OF SCOPE		
Criterion #2 (Training)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Full	ASTM F3330-18: Standard Specification for Training and the Development of Training Manuals for the UAS Operator	It provides generic guidance for the development of training manuals and syllabi.	Does not report detailed matters, arguments and topics to be included in the training manuals and syllabi.
		Partial	JARUS Recommendations for RPC	It only includes training requirements for the Remote Pilot. No mention of other crew members or CRM training.	Lack of standards covering training requirements for personnel, other than remote pilot, in charge of duties essential to the management of the flight

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	High	N.A.	OUT OF SCOPE		
Criterion #3 (UAS design)	Low	N.A.	NO STANDARD REQUIRED		
	Medium	N.A.	NO STANDARD AVAILABLE		
	High	N.A.	OUT OF SCOPE		

3.21 OSO 20 – A Human Factors evaluation has been performed and the Human-Machine Interface (HMI) found appropriate for the mission

3.21.1 Requirement Description

Table 324 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The UAS information and control interfaces are clearly and succinctly presented and do not confuse, cause unreasonable fatigue, or contribute to remote crew error that could adversely affect the safety of the operation
	Medium	
	High	

Table 325 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	The applicant conducts a human factors evaluation of the UAS to determine if the HMI is appropriate for the mission. The HMI evaluation is based on inspection or Analyses

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	Medium	Same as Low but the HMI evaluation is based on demonstrations or simulations
	High	Same as Medium. In addition, EASA witnesses the HMI evaluation of the UAS and a competent third party witnesses the HMI evaluation of the possible electronic means used by the VO.

3.21.2 Summary

Table 326 OSO 20 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity						
Assurance						
JAUS HMI Service Set	SAE	AS6040	P	P		N.A.

3.21.3 Assurance Coverage Detail

Table 327

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	

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JAUS HMI Service Set	SAE	AS6040	P	P		The standard needs to be downloaded and studied. Expected to provide basis for platform-independent Human Machine Interface (HMI) capabilities commonly found across all domains and types of unmanned systems.

Notes:

1. Published
2. The standard cannot be downloaded but the subject can be identified
3. This specification describes the standard application layer interfaces called JAUS HMI Services. JAUS Services provide the means for software entities in an unmanned system or system of unmanned systems to communicate and coordinate their activities.

3.21.4 Gaps

3.21.4.1 Summary

Table 328 Gap Summary - OSO 20

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	Lack of specific standards to define platform-independent Human Machine Interface (HMI) capabilities.	-10	The assessment shows that there is the urgency to develop standards to cover this gap. Work is on-going at EUROCAE level as WG 105/ SG 61 should publish in the future standards related to Applicability of Safe Design Standard for UAS in Specific Operations Category that will address, among the others, HMI design standards.
2	Lack of standards to conduct human factors evaluation of the UAS to determine if the HMI is appropriate for the mission.	-10	The assessment shows that there is the urgency to develop standards to cover this gap. The Human Performance Assessment (HPA) methodology developed in SESAR might be a good basis for the definition of such standards. Nevertheless, being HPA thought to cover manned aviation concepts, it may be difficult to deeply analyse some issues specific to drones using such methodology. Specific considerations on human factors for UAS are collected in the “Human Factors Guidelines for Unmanned Aircraft System Ground Control Stations” published by the NASA within the *UAS in the NAS* Project and might be considered when developing UAS-specific

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			versions of human factors evaluation methodologies to cover the identified gap.

3.21.4.2 Details

Table 329

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	Lack of specific standards to define platform-independent Human Machine Interface (HMI) capabilities.	Safety (3)	High	An adequate HMI is a crucial element to support UAS operations safety by reducing the likelihood and effects of human errors. In absence of a defined standard for UAS HMI design and development, it is hard for operators to understand to what extent the available HMI is able to safely support their missions in terms of information presentation, human error, fatigue.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	In absence of standards, human factors considerations in the design and development of the HMI (e.g. information presentation, human error, crew fatigue) may vary from a manufacturer to another, with consequent costs for the operators to adapt their operation manuals to the different interfaces. On the other hand, it will be more time consuming for Authorities to verify adequacy of HMI design and development. The absence of a standard HMI development philosophies may also lead to increased training costs for pilots and crews.	-1	-2
		Environmental Impact (1)	Bad	A standard to define adequate design and development guidelines for the HMI of drones would enable more efficient and safer operation, thus leading to environmental benefits.	-2	-2
		Impact on EU Industry competitiveness (1)	Very Negative	The 2016 European Drones outlook study and other documents published in the EU identify Human Factors and Training as both key enablers for the drone market in Europe and sector where high investments in R&D are needed (~additional 70 millions in 5-10	-2	-2

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				years). The lack of clear standards in the field may lead to a slow down in the investments and to negative effects on EU industry competitiveness.		
		Social Acceptance (1)	Negative	Having a clear framework for the design and development of drones HMI (including automated safety features) would have a positive impact on public perception of drone operations safety.	-1	-1
Total Weighted Score						**-10**

Table 330

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
2	Lack of standards to conduct human factors evaluation of the UAS to determine if the HMI is appropriate for the mission.	Safety (3)	Low	An adequate HMI is a crucial element to support UAS operations safety by reducing the likelihood and effects of human errors. In absence of a defined standard for UAS HMI human factors evaluation, it is hard for operators to understand to what extent the available HMI is able to safely support their missions.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Medium	In absence of standards, it takes longer for operators to understand whether the HMI performance is adequate for the operations. On the other hand, it will be more time consuming for Authorities to verify adequacy of HMI human factors evaluation. The absence of a standard human factors evaluation of HMI may also lead to increased training costs for pilots and crews.	-1	-2
		Environmental Impact (1)	No impact	A standard to define adequate means of human factors evaluation for the HMI of drones would enable more efficient and safer operation, thus leading to environmental benefits.	-2	-2
		Impact on EU Industry competitiveness (1)	Negative	The 2016 European Drones outlook study and other documents published in the EU identify Human Factors and Training as both key enablers for the drone market in Europe and sector where	-2	-2

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				high investments in R&D are needed (~additional 70 millions in 5-10 years). The lack of clear standards in the field may lead to a slow down in the investments and to negative effects on EU industry competitiveness.		
		Social Acceptance (1)	No impact	Having a clear framework for the evaluation and assessment of Human Factors issues of drones HMI (including automated safety features) would have a positive impact on public perception of drone operations safety.	-1	-1
Total Weighted Score						**-10**

3.21.5 Conclusions and Recommendations

Regarding the *“OSO #20 – A Human Factors evaluation has been performed and the Human-Machine Interface (HMI) found appropriate for the mission”*, none of the standards herein evaluated fully cover the OSO #20 requirements up to SAIL IV, as they fail to address human factors evaluation of the UAS to determine if the HMI is appropriate for the mission.

Table 331 Recommended Standards - Integrity

Integrity					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1	Low	N.A.	NO STNDARDS IDENTIFIED		
	Medium				
	High	N.A.	OUT OF SCOPE		

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Table 332 Recommended Standards - Assurance

Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	Partial	SESAR Human Performance Assessment (HPA)	The Human Performance Assessment (HPA) methodology developed in SESAR might be a good basis for the definition of such standards. Nevertheless, being HPA thought to cover manned aviation concepts, it may be difficult to deeply analyse some issues specific to drones using such methodology.	
	Medium	Partial			
	High	N/A	OUT OF SCOPE		

3.22 *OSO 23* – Environmental conditions for safe operations defined, measurable and adhered to

3.22.1 Requirement Description

Table 333 Requirements' Description

Integrity Criteria	Robustness	Assurance description
Criterion #1 Environmental conditions for safe operations are defined and reflected in the flight manual or equivalent document	Low	The applicant declares that the required level of integrity has been achieved
	Medium	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation, inspection, design review or through operational experience.
	High	A competent third party validates the claimed level of integrity.

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Criterion #2 Procedures to evaluate environmental conditions before and during the mission (i.e. real-time evaluation) are available and include assessment of meteorological conditions (METAR, TAFOR, etc.) with a simple recording system	Low	• Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority. The adequacy of the procedures and checklists is declared.
	Medium	• Procedures are validated against standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. • The adequacy of the procedures is proved through: ○ Dedicated flight tests, or ○ Simulation provided the simulation is proven valid for the intended purpose with positive results.
	High	Same as Medium. In addition: • Flight tests performed to validate the procedures cover the complete flight envelope or are proven to be conservative. The procedures, flight tests and simulations are validated by a competent third party.
Criterion #3 Training covers assessment of meteorological conditions	Low	Training is self-declared (with evidence available).
	Medium	• Training syllabus is available. The operator provides competency-based, theoretical and practical training.
	High	EASA: • Validates the training syllabus. Verifies the remote crew competencies.

3.22.2 Summary

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Table 334 OSO 23 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Global Score
			L	M	H	L	M	H	L	M	H	
Integrity/Assurance												
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18								F		7
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707								P		5
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266								P		6
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	23665								P		7
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3				P	P					3

Table 335 OSO 23 Documents not available or under development

Standard Title	SDO	Doc. Reference	Notes
Cockpit Display of Data Linked Weather Information	SAE	ARP5740	ARP5740 is not currently available. Based on scope, the standard covers the information content for the electronic presentation of data linked weather Meteorological (MET) information

3.22.3 Integrity Coverage Detail

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Table 336

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM	F3330 – 18								F		
Notes: The standard should cover criterion 3 since it states that it "supports professional entities that will receive operator certification by a CAA, and provide standards of practice for self- or third-party audit of operators of UAS". Further scoring could not be provided based on assumptions.												

Table 337

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE	ARP5707								P		The doc doesn't include training requirements for rotary wings remote pilots. U-space services and related training requirements issues are not sufficiently considered. VLOS and BVLOS are not considered.
Notes: The scope of the document is limited to proposing an initial framework to train and certify UAS pilots for fixed wing UAS to be operated in the NAS (National American Airspace). The focus is on practical training, theoretical issues (e.g. airmanship, safety,etc.) are not included.												

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Table 338

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM	F3266								P		Training of other remote crew members (e.g. observer) is not addressed.
Notes: The document is well structured. It should be completed with some issues (in particular, specific training syllabus for VLOS/BVLOS conditions, emergency and contingency issues).												

Table 339

Standard Title	SDO	Doc. Reference	Robustness *Criterion 1*			Robustness *Criterion 2*			Robustness *Criterion 3*			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO	23665								P		The document is limited to remote pilots trained for VLOS operations. Remote pilots involved in BVLOS operation are not covered. Other training aspects for personnel involved in UAS operations not covered.
Notes:												

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Table 340

Standard Title	SDO	Doc. Reference	Robustness Criterion 1			Robustness Criterion 2			Robustness Criterion 3			Gaps
			L	M	H	L	M	H	L	M	H	
Unmanned aircraft systems -- Part 3: Operational procedures	ISO	21384-3					P					The document contains generic procedures that are applicable to any UAS for any specific purpose.
Notes:												

3.22.4 Gaps

3.22.4.1 Summary

Table 341 Gap Summary - OSO 23

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	There are no standards/guidelines to define how to determine adequate environmental conditions for safe operations.	-5	Safe environmental operating conditions should be clearly defined in manuals or any other relevant document to avoid accidents
2	Available standards for the development of procedures are quite generic and do not provide sufficient guidance.	+2	The development of a specific standard does not seem to be necessary at this stage.

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3.22.4.2 Details

Table 342

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	There are no standards/guidelines to define how to determine adequate environmental conditions for safe operations.	Safety (3)	High	In case that drone safe environmental operating conditions are not properly defined there is a high risk of misuse of the equipment in non-safe conditions.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Low	The cost of compliance with defining safe conditions for operations should not be high since it is part of the testing and operators with a licence are already aware under what conditions they should fly a drone	+1	+2
		Environmental Impact (1)	Bad	Not properly defined safe operating conditions of drones could have adverse effect to the environment only in extreme cases in case of accidents that can cause environmental pollution	-2	-2
		Impact on EU Industry competitiveness (1)	Negative	The lack of clearly defined operating safe conditions by manufacturers could affect number of accidents and thus the reputation of EU made drones	-1	-1
		Social Acceptance (1)	Negative	Clearly defined operating safe conditions by manufacturers could affect the general social acceptance due to lack of misuse of drones	-1	-1
Total Weighted Score						-5

Table 343

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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2	Available standards for the development of procedures are quite generic and do not provide sufficient guidance.	Safety (3)	Medium	A competent operator should be able to define adequate procedure also in absence of a specific guideline.	0	0
		Cost of compliance to the requirement with a lack standard (2)	Low	The cost of developing specific procedures should not be high, as this is expected to be standard practice anyways.	+1	+2
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	No impact	No impact	0	0
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**+2**

3.22.5 Conclusions and Recommendations

The assessment of OSO #23- "Environmental conditions for safe operations defined, measurable and adhered to" at this stage can only provide preliminary conclusions. Given the context of OSO #23 the standards that are applicable and tend to have a wider coverage are more related to training and competence of pilots rather than other technical standards. Although they do indicate from their preliminary assessment that they have a coverage of OSO 23, further analysis is required.

Table 344 Recommended Standards – Integrity/Assurance

Integrity/Assurance					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Gaps**
Criterion #1 –	Low	N.A.	NO STANDARD REQUIRED		There are no standards/guidelines to

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[Definition]	Medium	No coverage	NO STANDARD AVAILABLE		define how to determine adequate environmental conditions for safe operations.
	High	N.A.	OUT OF SCOPE		
Criterion #2 [Procedures]	Low	Partial	NO STANDARD REQUIRED		
	Medium	Partial	ISO 21384-3 Unmanned aircraft systems -- Part 3: Operational procedures	Generic standard which implies that the operator must operate under manufacturer-imposed weather limitations	Available standards for the development of procedures are quite generic and do not provide sufficient guidance.
	High	N.A.	OUT OF SCOPE		
Criterion #3 [Training]	Low	N.A.	NO STANDARD REQUIRED		
	Medium	Full	F3330 – 18: Standard Specification for Training and the Development of Training Manuals for the UAS Operator	Generic standard which implies that the operator must operate under manufacturer-imposed weather limitations	
	High	N.A.	OUT OF SCOPE		

3.23 *OSO 24* – UAS designed and qualified for adverse environmental conditions

3.23.1 Requirement Description

Table 345 Integrity Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	N/A
	Medium	The UAS is designed to limit the effect of environmental conditions.

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	High	The UAS is designed using environmental standards considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority. *National Aviation Authorities (NAAs) may define the standards and/or the means of compliance they consider adequate. The SORA Annex E will be updated at a later point in time with a list of adequate standards based on the feedback provided by the NAAs.*

Table 346 Assurance Requirements' Description

Criteria	Robustness	Description
Criterion #1	Low	N/A
	Medium	The applicant has supporting evidence that the required level of integrity is achieved. This is typically done by testing, analysis, simulation[2], inspection, design review or through operational experience. *2 When simulation is used, the validity of the targeted environment used in the simulation needs to be justified.*
	High	EASA validates the claimed level of integrity.

3.23.2 Summary

Table 347 OSO 24 Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Robustness *Criteria 1*			Global Score
			L	M	H	
Integrity/Assurance						
Unmanned Aircraft Systems (UAS) - Product requirements	ASD-STAN	prEN4709-01		P	P	N.A.
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671		P	P	4

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Rotary Wing Unmanned Aerial Systems Airworthiness Requirements (AEP-80)	NATO	STANAG 4702		P	P	11
Light Unmanned Aircraft Systems Airworthiness Requirements (AEP-83)	NATO	STANAG 4703		P	P	4
Standard for Unmanned Aircraft Systems	UL	UL 3030		P	P	10
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)	ASTM	F3298-19		P	P	N.A.
Environmental Conditions and Test Procedures for Airborne Equipment	RTCA	DO-160		P	P	11
Avionics Integrity Program	DoD	MIL-STD-1796A		P	P	2
Department of Defense Standard Practice System Safety	DoD	MIL-STD-882E		P	P	11
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS		P	P	14
Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS		P	P	N.A.

3.23.3 Coverage Detail

Table 348

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Unmanned Aircraft Systems (UAS) - Product requirements	ASD-STAN	prEN4709-01		P	P	The standard deals mainly with UAS in the category “open” but it could be used as well for other UAS in the specific category to demonstrate that they are safely controllable and manoeuvrable under all anticipated operating conditions. The lowest integrity level should be considered for those cases where a UAS equipment has only a partial environmental qualification and/or a partial demonstration by similarity and/or parts with no qualification at all.

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Notes:
1. Ongoing
2. This harmonised standard covers all the requirements defined in the Annex of Commission delegated Regulation (EU) 2019/945 for each of the five classes of UAS (C0 -C4) defined in Chapter II of this regulation, with the exception of direct remote identification, geo-awareness and lighting. It shall describe appropriate technical solutions and verification methods to ensure and demonstrate the conformity of the UAS with these requirements

Table 349

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
UAV System Airworthiness Requirements (USAR)	NATO	STANAG 4671		P	P	Only for fixed wing military UAS with MTOM >150 kg < 20.000kg

Notes:
1. Ongoing
2. Only an outdated version of this standard was publicly available under: https://www.defense.gouv.fr/content/download/552731/9407958/file/4671eed01.pdf
3. This document contains a set of technical airworthiness requirements intended primarily for the airworthiness certification of fixed-wing military UAV Systems with a maximum take-off weight between 150 and 20,000 kg that intend to regularly operate in non-segregated airspace. Certifying Authorities may apply these certification requirements outside these limits where appropriate.

Table 350

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Rotary Wing Unmanned Aerial Systems Airworthiness Requirements (AEP-80)	NATO	STANAG 4702		P	P	Only for military rotary wing UAS

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Notes:

1. Published
2. Publicly available: https://www.uvsr.org/Documentatie%20UVS/Reglementari%20internationale/STANAG-uri/Standarde%20pt%20analiza%20UAV/STANAG/4702/AEP-80(A).pdftps://www.uvsr.org/Documentatie%20UVS/Reglementari%20internationale/STANAG-uri/Standarde%20pt%20analiza%20UAV/STANAG/4702/4702Ed01.pdf
3. This document contains a set of technical airworthiness requirements intended for the airworthiness certification of rotary-wing military UAV Systems with a maximum take-off weight between 150 and 3175 kg that intend to regularly operate in non-segregated airspace. Certifying Authorities may apply these certification requirements outside these limits where appropriate. These requirements represent the minimum acceptable airworthiness requirements for design and construction of military rotorcraft UAVs intended to operate in non-segregated airspace. It may be augmented by additional Special Conditions (i.e. additional airworthiness requirements) required by Certifying Authorities. The USAR-RW is intended for application by Certifying Authorities within each country's relevant national regulatory framework.

Table 351

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Light Unmanned Aircraft Systems Airworthiness Requirements (AEP-83)	NATO	STANAG 4703		P	P	Only for military fixed wing UAS.

Notes:

1. Published
2. Publicly available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/391827/2010916-STANAG-4703_AEP-83_A___1_.pdf
3. This document contains the minimum set of technical airworthiness requirements intended for the airworthiness certification of fixed-wing Light UAS with a maximum take-off weight not greater than 150 kg and an impact energy1 greater than 66 J (49 ft-lb) that intend to regularly operate in non-segregated airspace.

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Table 352

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Standard for Unmanned Aircraft Systems	UL	UL 3030		P	P	The lowest integrity level should be considered for those cases where a UAS equipment has only a partial environmental qualification and/or a partial demonstration by similarity and/or parts with no qualification at all.

Notes:

1. Status: published
2. Recognized by Transport Canada (CAA)
3. The standard deals with Design of UAS <25kg and their intended operational spectrum (focused on electrical systems) and test methods for different conditions including adverse weather conditions. UASs covered by these requirements are intended to be operated by certified UAS pilots as identified in the Federal Regulations, where the unmanned aircraft is less than 25 kg (55 lbs). The UAS is intended to be provided with an internal lithium ion battery that is charged from an external source. UASs are intended to have an operating voltage of not greater than 100 V dc, and are intended for outdoor operation. These requirements also cover the electrical shock, fire and explosion hazards associated with the inherent features of these UASs, as well as the battery and charger system combinations provided for recharging the UAS.

Table 353

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Standard Specification for Design, Construction, and Verification of Fixed-Wing Unmanned Aircraft Systems (UAS)	ASTM	F3298-19		P	P	The lowest integrity level should be considered for those cases where a UAS equipment has only a partial environmental qualification and/or a partial demonstration by similarity and/or parts with no qualification at all.

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Notes:
1. Status: Published 2. The standard deals with Design of UAS <25kg and test methods for different conditions including adverse weather conditions like icing. This specification covers the airworthiness requirements for the design of light unmanned aircraft systems. This specification defines the baseline design, construction, and verification requirements for an unmanned aircraft system (UAS).

Table 354

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Environmental Conditions and Test Procedures for Airborne Equipment	RTCA	DO-160		P	P	

Notes:
1. Published
2. The standard cannot be downloaded but the subject can be identified by information provided from RTCA under: https://do160.org/rtca-do-160g/
3. RTCA DO-160G provides standard procedures and environmental test criteria for testing airborne equipment for the entire spectrum of aircraft from light general aviation aircraft and helicopters through the "jumbo jets" and SST categories of aircraft. Coordinated with EUROCAE, RTCA DO-160G and EUROCAE ED-14G are identically worded. RTCA DO-160G is recognized by the International Organization for Standardization (ISO) as de facto international standard ISO-7137. These standards are developed to cover airborne equipment of manned aviation and could be potentially suitable for UAS airborne component. Conversely, the UAS ground component (e.g. ground control station) may be subject to different environmental conditions (e.g. pressure, temperature, etc..) so a dedicated standard should be developed.

Table 355

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Avionics Integrity Program	DoD	MIL-STD-1796A		P	P	The standard only deals with the "integrity" performance requirements and not with how to show compliance.

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Notes: 1. Published 2. Publicly Available: http://everyspec.com/MIL-STD/MIL-STD-1700-1799/MIL-STD-1796A_38674/ 3. The Avionics Integrity Program (AVIP) identifies the design tasks needed to achieve high reliability, long life, safe operation and supportability of aviation electronics in operational environments. AVIP is focused on the “integrity” performance requirements (tolerate the environment, perform reliably, etc.), as opposed to “mission” performance requirements (e.g., radar range, navigation accuracy, communication capability, etc.). The document focuses on tasks to be performed to define and achieve avionics integrity rather than focusing on specification requirements.

Table 356

Standard Title	SDO	Doc. Reference	Criterion 1			Gaps
			L	M	H	
Department of Defense Standard Practice System Safety	DoD	MIL-STD-882E		P	P	Not directly mentioned how to design a UAS related to #OSO24 but systematic approach for manufacturer who could not show compliance to other standards doing their own Hazard Management including environmental Hazard Analysis related to #OSO24. Not approved for civil usage.
Notes: 1. Published 2. Publicly available: https://www.system-safety.org/Documents/MIL-STD-882E.pdf 3. This Standard is approved for use by all Military Departments and Defense Agencies within the Department of Defense (DoD). 4. This system safety standard practice is a key element of Systems Engineering (SE) that provides a standard, generic method for the identification, classification, and mitigation of hazards.						

Table 357

Standard Title	SDO	Doc.	Criteria 1	Gaps

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		Reference	L	M	H	
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	CS-LURS		P	P	The standard defines minimum design requirements but only for Light Rotorcraft UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.
Notes: 1. The standard is a Certification Specification applicable to Light Unmanned Rotorcraft Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.						

Table 358

Standard Title	SDO	Doc. Reference	Criteria 1			Gaps
			L	M	H	
Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)	JARUS	CS-LUAS		P	P	The standard defines minimum design requirements but only for Light Aeroplane UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.
Notes: 1. The standard is a Certification Specification applicable to Light Unmanned Aeroplane Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 750 kg.						

3.23.4 Gaps

No gaps were identified in OSO 24 as the identified standards seem to cover adequately all the requirements.

3.23.5 Conclusions and Recommendations

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Table 359 Recommended Standards

Integrity/Assurance					
Criteria	Robustness	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	Low	N/A	NO STANDARD REQUIRED		
	Medium	NO STANDARD REQUIRED. THE FOLLOWING CAN BE USED AS GUIDANCE	JARUS CS-LURS – "Certification Specification for Light Unmanned Rotorcraft Systems"	• Applicable to Light Unmanned Rotorcraft Systems with MTOM not exceeding 750 kg	Guidance needed to determine which subset of the proposed requirements should be used for each level of robustness
			JARUS CS LUAS – "Certification Specification for Light Unmanned Aeroplane Systems"	• Applicable to Light Unmanned Rotorcraft Systems with MTOM not exceeding 750 kg	Guidance needed to determine which subset of the proposed requirements should be used for each level of robustness
			ASTM F3298-19 – "Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems"	Document deals with Design of UAS <25kg and test methods for different conditions including adverse weather conditions (ie. Icing)	

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			UL 3030 – "Standard for Unmanned Aircraft Systems"	• Recognized by Transport Canada (CAA) • Document deals with Design of UAS <25kg and their intended operational spectrum (focused on electrical systems) and test methods for different conditions including adverse weather conditions • Also covers the electrical shock, fire and explosion hazards associated with the inherent features of UASs, as well as the battery and charger system combinations provided for recharging the UAS	
			IEC 60529 – "Degrees of protection provided by enclosures (IP Code)"	• Standard applies to the classification of degrees of protection provided by enclosures for electrical equipment in general (not specific to UAS) with a rated voltage not exceeding 72,5 kV. • Provides definitions for degrees of protection provided by enclosures of electrical equipment • Provides designations for these degrees of protection including requirements for each designation • Provides tests to be performed to verify that the enclosure meets the requirements of this standard	
		Partial	NATO STANAG 4701 – "UAV System Airworthiness Requirements (USAR)"	• Only for fixed wing military UAS with MTOM >150 kg < 20.000kg	Remote control station not covered

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			NATO STANAG 4702 – "Rotary Wing Unmanned Aerial Systems Airworthiness Requirements (AEP-80)"	• Only for military rotary wing UAS	Remote Control station not covered
			NATO STANAG 4703 – "Light Unmanned Aircraft Systems Airworthiness Requirements (AEP-83)"	• Only for military fixed wing UAS	Remote Control station not covered
			EUROCAE ED-14G / RTCA DO-160 – Environmental Conditions and Test Procedures for Airborne Equipment"	• Provides standard procedures and environmental test criteria for testing airborne equipment for the entire spectrum of aircraft from light general aviation aircraft and helicopters through the "jumbo jets" and SST categories of aircraft	Multi-rotor UA and remote-control station not covered
			DoD MIL-STD-882E – "Department of Defence Standard Practice System Safety"	• Systematic approach for manufacturers who could not show compliance to other standards doing their own Hazard Management including environmental Hazard Analysis related to #OSO24. Not approved for civil usage.	Not directly mentioned how to design a UAS related to #OSO24
			DoD MIL-STD-1796A – "Avionics Integrity Program"	• The standard only deals with the "integrity" performance requirements and not with how to show compliance	
	High	Partial	As above	As above	As above

3.24 Adjacent Area/Airspace Considerations

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3.24.1 Requirement Description

Table 360 Requirements' Description

Criteria	Applicability	Description
1	Always	No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume. Compliance with the requirement above shall be substantiated by a design and installation appraisal and shall minimally include: • design and installation features (independence, separation and redundancy); • any relevant particular risk (e.g. hail, ice, snow, electro-magnetic interference…) associated with the ConOps.
2	If adjacent areas are: 1. Gatherings of people unless already approved for operations over gathering of people OR 2. ARC-d unless the residual ARC is ARC-d In populated environments where: 1. M1 mitigation has been applied to lower the GRC 2. Operating in a controlled ground area	1. The probability of leaving the operational volume shall be less than 10-4/FH. 2. No single failure of the UAS or any external system supporting the operation shall lead to operation outside of the ground risk buffer. *Compliance with the requirements above shall be substantiated by analysis and/or test data with supporting evidence.* 3. Software (SW) and Airborne Electronic Hardware (AEH) whose development error(s) could directly lead to operations outside of the ground risk buffer shall be developed to an industry standard or methodology recognized as adequate by the competent authority.

3.24.2 Summary

Table 361 Adjacent Area Standards' effectiveness in fulfilling the requirement (in order of ranking)

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Global Score
				1	2	3	

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Integrity							
Operational services and environment definitions (OSED) for remotely piloted aircraft systems (RPAS) automation and emergency recovery functions	EUROCAE	ED-253	P	P			1
Minimum Operational Performance Specification Geocaging	EUROCAE	ED-270		F			6
Minimum Operational Performance Specification Geofencing	EUROCAE	ED-269		F			6
Design Assurance Guidance for Airborne Electronic Hardware	RTCA/EUROCAE	DO-254/ED-80				P	10
International Standard - Systems and software engineering -- Software life cycle processes	IEEE	IEEE12207				P	N.A.
Software Considerations in Airborne Systems and Equipment Certification	EUROCAE/RTCA	ED 12/DO-178				P	14
Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM	F3309			P		11
Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment	SAE	ARP4761A			P		N.A.

3.24.3 Coverage Detail

Table 362

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
Operational services and environment definitions (OSED) for remotely piloted aircraft systems (RPAS) automation and emergency recovery functions	EUROCAE	ED-253	P	P			This document is only an OSED and does not cover explicitly the requirements but can be useful for the analysis of the failure modes.

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Table 363

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
Minimum Operational Performance Specification Geocaging	EUROCAE	ED-270		F			
Notes: A system developed according to this standard is expected to limit the probability of leaving the operational volume to less than 10-4/FH							

Table 364

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
Minimum Operational Performance Specification Geofencing	EUROCAE	ED-269		F			
Notes: A system developed according to this standard is expected to limit the probability of leaving the operational volume to less than 10-4/FH							

Table 365

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
Design Assurance Guidance for Airborne Electronic Hardware	RTCA/EUROCAE	DO-254/ED-80				P	The standard only addresses Hardware

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Table 366

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
International Standard - Systems and software engineering -- Software life cycle processes	IEEE	IEEE12207				P	The standard only addresses Software

Table 367

Standard Title	SDO	Doc. Reference	Criterion 1	Criterion 2			Gaps
				1	2	3	
Software Considerations in Airborne Systems and Equipment Certification	EUROCAE/RTCA	ED 12/DO-178				P	The standard only addresses Software

Table 368

Standard Title	SDO	Doc. Reference	*Criterion 1*	*Criterion 2*			Gaps
				1	2	3	
Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM	F3309			P		This standard is not specific for UAS.

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Table 369

Standard Title	SDO	Doc. Reference	*Criterion 1*	*Criterion 2*			Gaps
				1	2	3	
Guidelines And Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment	SAE	ARP4761A			P		This standard is not specific for UAS.

3.24.4 Gaps

3.24.4.1 Summary

Table 370 Gap Summary – Adjacent Area

Gap #	Gap Description	Total Weighted Score	Conclusion Recommendation
1	There is a lack of guidance on how to demonstrate compliance to the requirement that “No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume”	-7	It is recommended to develop some guidelines to support operators in demonstrating that “No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume”. Guidelines similar to those developed by EUROCAE to support compliance to OSO #5 should work.
2	There is a lack of standards for SW and airborne electronic hardware (AEH) Development Assurance that are suitable for small UAS	-9	It is recommended to develop a standard for SW and AEH development assurance that is suitable for small UAS. EUROCAE activity on this topic is expected to cover this gap

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3.24.4.2 Details

Table 371

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1	There is a lack of guidance on how to demonstrate compliance to the requirement that "No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume"	Safety (3)	High	The lack of guidelines can lead to very subjective approaches in the demonstration of compliance to the requirement, with a negative impact on safety.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	High	The work needed to develop and document redundant systems to reduce malfunctions and failures is expected to be large and thus a high result.	-1	-2
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Negative	As the cost of compliance is high it will have a negative impact on EU Industry competitiveness.	-1	-1
		Social Acceptance (1)	Negative	Social acceptance for drones is directly linked to the safety aspect of drones and therefore the lack of standards has an impact.	-1	-1
Total Weighted Score						**-7**

Table 372

Gap	Gap Description	Criteria (Weight)	Result	Rationale	Score	Weighted Score

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2	There is a lack of standards for SW and airborne electronic hardware (AEH) Development Assurance that are suitable for small UAS	Safety (3)	High	A lack of standards does not guarantee a way to assess whether the current means adopted by drone manufacturers to comply with the requirement is reliable.	-1	-3
		Cost of compliance to the requirement with a lack standard (2)	Very High	Complying to requirements born to suit only larger aircrafts is time consuming and expensive.	-2	-4
		Environmental Impact (1)	Neutral	No impact	0	0
		Impact on EU Industry competitiveness (1)	Very Negative	A very high cost of compliance will reflect analogously on EU industries.	-2	-2
		Social Acceptance (1)	No impact	No impact	0	0
Total Weighted Score						**-9**

3.24.5 Conclusions and Recommendations

The available standards are generally covering adequately the requirements for adjacent area/airspace for the most critical cases. However, for the requirement that "No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume" there is a need to develop dedicated guidance to better support operators in the demonstration of compliance.

Table 373 Recommended Standards

Criteria	Requirement	Coverage	Recommended standard	Limitations/Notes	Gaps
Criterion #1	All	N.A.	NO STANDARD REQUIRED		
Criterion #2	1	Full	EUROCAE ED-270 MOPS Geocaging		

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AW DRONES

		Full	EUROCAE ED-269 MOPS Geofencing		
	2	Partial	ASTM F3309 Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	It does not provide specific guidance on how to carry out the assessment in relation to the requirements of Adjacent Area/Airspace	There is a lack of guidance on how to demonstrate compliance to the requirement that "No probable failure of the UAS or any external system supporting the operation shall lead to operation outside of the operational volume"
		Partial	SAE ARP4761A Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment		
	3	Partial	RTCA/EUROCAE DO-254/ED-80 Design Assurance Guidance for Airborne Electronic Hardware	This standard is too demanding for small UAS	There is a lack of standard for SW and AEH Development Assurance that are suitable for small UAS
		Partial	EUROCAE/RTCA ED 12/DO-178 Software Considerations in Airborne Systems and Equipment Certification	This standard is too demanding for small UAS	

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4 Conclusions and recommendations

From the analysis presented in this document the following conclusions can be made:

1. For all SORA requirements that are applicable up to SAIL IV there is at least a partial coverage from existing standards. The absence of full coverage derives from several reasons:
    - Standards often have a low maturity as they are still in a development phase.
    - Standards are only covering part of what SORA requires
    - Standards have a limited scope (e.g. MTOM less than 25kg, only rotorcraft, etc.)
    - Standards that were developed for the manned aviation can be too demanding for the UAS sector and hardly applicable in practice
2. Even for the requirements with a full coverage, this might have been achieved on the basis of standards which are not published yet.
3. Given the above, the analysis identified the following standards as those that can be already recommended for actual use (for the details on the level of coverage see the detailed analysis above):
    - M1 – non tethered
        - Methodology for the UAS Operational Risk for non-geographical flight permits – ENAC-LG 2017/001-NAV
        - DGAC - AÉRONEFS CIRCULANT SANS PERSONNE A BORD : ACTIVITÉS PARTICULIÈRES Ed 1 rev 4
    - M1 – tethered
        - No published standard available
    - M2 – Effects of Ground Impact are Reduced
        - F3322-18 Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes
    - M3 – Emergency response Plan
        - ISO 21384-3: Operational Procedures
    - TACTICAL MITIGATIONS PERFORMANCE REQUIREMENTS
    - TMPR VLOS
        - F1583-95 (2019): Standard Practice for Communications Procedures – Phonetics
    - TMPR BVLOS
        - DO-365: MOPS for Detect and Avoid (DAA) Systems - Phase 1
    - OSO #1 – Operator competent and/or proven
        - ISO 21384-3 UAS – Part 3: Operational Procedures
        - F3178-16: Standard practice for Operational Risk Assessment of Small Unmanned Aircraft Systems (sUAS)
    - OSO #2 – UAS manufactured by competent and/or proven entity
        - F2972 – 15 Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System
        - F3003-14 Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)
        - ISO 9001:2015 Quality Management System

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- EN 9100:2018 Quality Management Systems - Requirements for Aviation, Space and Defence Organizations

- OSO #3 – UAS maintained by competent and/or proven entity
  - ASTM F2909-19: Standard Specification for Continued Airworthiness of Lightweight Unmanned Systems
  - ASTM 2483-18: Standard Practice for Maintenance and the Development of Maintenance Manuals for Light Sport Aircraft
  - ASTM 3366-19: Standard Specification for General Maintenance Manual (GMM) for a Small Unmanned Aircraft System (sUAS)
- OSO #4 - UAS developed to authority recognized design standards
  - To be completed after coordination with EASA
- OSO #5 - UAS is designed considering systems safety and reliability
  - ASTM F3309 – Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft
  - SAE ARP4761 – Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
- OSO #6 – C3 link characteristics appropriate for the operation
  - ASTM F3002 – 14 - Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)
  - IEEE 802.11, IEEE 802.11a – WIFI technology (2.4 GHz + 5 GHz Band)
  - IEEE 802.15.1 – Bluetooth technology
  - IEEE 802.22 - Wireless regional area network (WRAN)
  - 3GPP - TR 36.777 Technical Specification Group Radio Access Network; Study on Enhanced LTE Support for Aerial Vehicles
- OSO #7 – Inspection of the UAS
  - ISO 21384-3: Operational Procedures
- OSO #08, 11, 14, 21 – Operational Procedures
  - ISO 21384-3: Operational Procedures
- OSO #09, 15, 22 - Remote Crew Training
  - F3330-18: Standard specification for Training and the Development of Training Manuals for the UAS Operator
- OSO #10,12 – Safe recovery from technical issues
  - ASTM F3309 – Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft
- OSO #13 – External Services
  - No published standard available yet
- OSO #16 – Multi-crew coordination
  - F3330-18: Standard specification for Training and the Development of Training Manuals for the UAS Operator
  - ARP5707: Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations
- OSO #17 – Remote crew is fit to operate
  - ISO 21384-3 UAS – Part 3: Operational Procedures
- OSO #18 – Automatic Protection of the Flight Envelope
  - STANAG 4701 – UAV System Airworthiness Requirements (USA)
  - STANAG 4703 – Light Unmanned Aircraft Systems Airworthiness Requirements

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- JARUS – Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)
- JARUS – Certification Specification for Light Unmanned Aeroplane Systems (CS-LUAS)

- OSO #19 – Safe recovery from Human Error
  - ISO 21384-3 UAS – Part 3: Operational Procedures
  - F3330-18: Standard specification for Training and the Development of Training Manuals for the UAS Operator
- OSO #20 – Human Factors evaluation and HMI
  - No standard available yet
- OSO #23 - Environmental conditions for safe operations defined, measurable and adhered to
  - ISO 21384-3 Unmanned aircraft systems -- Part 3: Operational procedures
  - F3330 – 18 Standard Specification for Training and the Development of Training Manuals for the UAS Operator
- OSO #24 – UAS designed and qualified for adverse environmental conditions
  - JARUS CS-LURS – "Certification Specification for Light Unmanned Rotorcraft Systems"
  - JARUS CS LUAS – "Certification Specification for Light Unmanned Aeroplane Systems"
  - ASTM F3298-19 – "Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems"
  - UL 3030 – "Standard for Unmanned Aircraft Systems"
  - IEC 60529 – "Degrees of protection provided by enclosures (IP Code)"
  - RTCA DO-160 – "Environmental Conditions and Test Procedures for Airborne Equipment"

Given the above, it is recommended that:

- The maturity of the standards is continuously monitored to update the assessment. This will be done throughout the AW-Drones project and will be reflected in the next iteration of this analysis which will be developed by the end of 2020.
- The coverage identified in this document after the first iteration of project AW-Drones, is published by the project as the unique European Meta-Standard supporting the application of the SORA methodology for the specific category of operations.
- The European Commission, supported by EASA, should bring the gaps identified in paragraph 2.2 to the attention of the European UAS Standard Coordination Group (EUSCG) to possibly initiate actions to fill the gap.

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5 References

[1] EASA (2019, AMC & GM to Commission Implementing Regulation (EU) 2019-947 - Issue 1
[2] AW-Drones (2019), D2.2: Methodology for the assessment of drone standards
[3] EASA (2017), Research Programme On Collision with Drones: Work Area 1 Final Report, Issue 4.0
[4] SJU (2016), SJU European Drones Outlook Study
[5] European Union (2019), Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft

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Annex 1 Standards' assessment

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1 JARUS

1.1 Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (Open) and category B (Specific) & guidance material (GM) to JARUS RECOMMENDATION UAS RPC CAT A AND CAT B Regarding Recognised Assessment Entity (RAE)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Recommendations for remote PILOT COMPETENCY (RPC) for UAS OPERATIONS in category A (Open) and category B (Specific) & guidance material (GM) to JARUS RECOMMENDATION UAS RPC CAT A AND CAT B	JARUS WG 1	Maturity (2)	External Consultation	The document has reached the external consultation phase.	0	0
		Type of standards (1)	Standard specification	The combination of the Recommendation for RP competency and the GM is here considered as a unique standard.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard fully covers OSO 9,15,22 for remote pilot training. However, no training requirements for supporting personnel (e.g.	0	0

Regarding Recognised Assessment Entity (RAE)[1]				visual observers are provided). Such personnel may have responsibilities in the safe management of the flight and therefore training requirements should be developed ad hoc.		
		Cost of compliance (2)	Medium	The cost for the preparation of training material compliant with this standard is considered low. However, the cost of compliance to the requirements posed for recognised assessment entities (RAE) (i.e. entities recognised by Authorities as provider of theoretical and practical examinations) is high as these includes requirements on qualification, equipment and tools used, management etc. The final result is judged as Medium	0	0
		Environmental Impact (1)	Good	The training course developed according to this standard should increase pilot's sensitivity in terms of possible environmental impact deriving fromfrom the use of drones Article 5 of the recommendations states that the remote pilot should be in a physical and mental condition such that they would not	2	2

[1] Although these are two separate documents, they are assessed as a whole since they constitute a unique standard comprising a main body plus an annex.

				endanger the safe operation of the UAS, other aircraft, persons, environment, animals or property.		
		Impact on EU Industry competitiveness (1)	Very Good	This standard provides requirements that may consolidate the role of training organisations within the Specific Category where most of business is expected to grow in the next years. In addition, the establishment of requirements and privileges established for RAE will create new profiles, possibly expanding the company's business. As outlined in **Errore. L'origine riferimento non è stata trovata.**, development of harmonised training requirements will enable the supply of pilots needed to reach market potential while preserving a strong focus on safety.	2	2
		Social Acceptance (1)	Very positive	The adoption of a standard to harmonise training requirements can be positively seen by public opinion. In addition, the recognition of RAEs by Competent Authorities will possibly create new job opportunities.	2	2
ADDITIONAL NOTES						
Total Weighted Score						8

1.2 RPAS C2 link Required Communication Performance (C2 link RCP) concept

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
JARUS - **RPAS C2 link Required Communication Performance (C2 link RCP) concept** (No. 332)	JARUS WG 5	Maturity (2)	Recognized	The standard is published by JARUS and RPAS communications standardization groups requests an update thus making it recognized.	2	4
		Type of standards (1)	Information Guidance	It is a concept which is derived from 'ICAO Doc 9869-Ed 1.0 RCP Manual' while being aligned with 'ICAO Doc 10019 RPAS Manual'. Due to it being a concept it is ranked as information guidance.	0	0
		Effectiveness to fulfil SORA requirement	Partial	The standard addresses many aspects relevant for OSO #6. The standard specifies requirements at different levels (manufacturer, service provider, monitoring etc.) to fulfill the safety for the operation. However, it does not seem to address how the requirements are verified / certified along with country specific limitations.	0	0
		Cost of compliance (2)	Medium	It is assumed that the manufacturers of RPAS communication links will design, develop, and certify 'solutions' fulfilling selected operational requirements. It will thus have an impact on the manufacturer in terms of development cost but not as much on the end user as specifications can be compared with requirements for the RPAS operation.	0	0

		Environmental Impact (1)	Neutral	Radio communication can influence other radio communication systems negatively if not designed properly. Although, a neutral rating is given because radio communication is already highly regulated.	0	0
		Impact on EU Industry competitiveness (1)	Positive	A positive rating is given since drone operations are on the rise and becoming more and more complex which in term requires better and standardized RPAS communication links.	1	1x1= 1
		Social Acceptance (1)	Positive	The standard addresses safety which is a factor in the social acceptance of drones.	1	1x1: 1
ADDITIONAL NOTES						
Total Weighted Score						6

1.3 Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Certification Specification for Light Unmanned Rotorcraft Systems (CS-LURS)	JARUS	Maturity (2)	Published	The Certification Specification has been published in October 2013	1	2
		Type of standards (1)	Standard Specification	The document specifies the airworthiness code applicable to Light Unmanned Rotorcraft Systems (with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 600 kg) and thus is a certification specification	2	2
		Effectiveness to fulfil SORA requirement	Full	OSO#4: The standard defines minimum design requirements but only for Light Rotorcraft UAS. Moreover the requirements contained in the document might be too demanding for a Low level of robustness. A guidance is needed to determine which subset of the proposed requirements should be used for each level of robustness.	2	6
		Cost of compliance (2)	Low	The document provides the airworthiness code applicable to Light Unmanned Rotorcraft Systems with Light Unmanned Rotorcraft maximum certified take-off weights not exceeding 600 kg. It is judged as low in terms of costs as it does not require specific costs for the end users or other stakeholders in addition to tests and requirements costs on the design for the manufacturers	1	2
		Environmental Impact (1)	Neutral	No positive or negative impact is expected from the compliance to the airworthiness code	0	0

		Impact on EU Industry competitiveness (1)	Positive	The standard specification might have a positive impact on EU Industry competitiveness as the standard is issued by Joint Authorities for Rulemaking on Unmanned Systems where most of European NAAs seats and thus it is expected low cost of compliance specifically for the European stakeholders	1	1
		Social Acceptance (1)	Positive	The standard specifies the airworthiness code, guaranteeing a set of requirements for safe UA operations that can have a positive impact on social acceptance	1	1
ADDITIONAL NOTES						
Total Weighted Score						14

2 EUROCAE

2.1 Guidelines for the use of multi-GNSS solutions for UAS

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Guidelines for the use of multi-GNSS solutions for UAS	EUROCAE WG 105/ SG 62	Maturity (2)	Internal Consultation	The document is a draft under consultation within the members of SG 62.	-1	-2
		Type of standards (1)	Information Guidance	The document contains guidelines for GNSS application on UAS.	0	0
		Effectiveness to fulfil SORA requirement (3)	Partial	The document represents the basis for the development of standards able to fulfil OSO #13 requirements.	0	0
		Cost of compliance (2)	Not applicable	This criterion is not applicable as the document is a guidance and no specific technical requirements are provided.	0	0
		Environmental Impact (1)	Good	The adoption of this AMC has both positive on the environment. In fact, the use of EGNOS may bring benefits in terms of navigation accuracy and design of more efficient drone routes (which lead to less power consumption and emissions).	2	2
		Impact on EU	Very positive	GSA studies show that adoption of GNSS on	2	2

		Industry competitiveness (1)		drones is recognised to foster the market growth.		
		Social Acceptance (1)	Positive	GNSS is an important element to manage and increase efficiency of drone traffic, reduce emissions and power consumptions. This aspect is socially relevant. However, enabling a large number of drone missions in populated areas at VLL may be seen in a negative way from part of the public opinion as these intrinsically represent a significant element of risk.	1	1
ADDITIONAL NOTES						
Total Weighted Score						3

2.2 MASPS for DAA under IFR In Class A-C airspace

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
MASPS for DAA under IFR In Class A-C airspace	EUROCAE WG 105 SG 11	Maturity (2)	External Consultation	The MASPS have been published for external consultation phase within WG 105.	0	0
		Type of standards (1)	Standard specification	The document provides MASPS for DAA in A-C airspace classes under IFR.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard partially fulfils TMPR (Arc-d) in the sense that MOPS will be needed to define details at component level. In addition the standard only covers a portion of airspace and only drones able to fly IFR.	0	0
		Cost of compliance (2)	High	The cost of compliance for manufacturers to develop DAA solutions in compliance with these MASPS is considered high. As the MASPS are technologically agnostic, the cost of compliance is evaluated considering the tests/simulations needed to comply with performance and safety requirements. The main performance verification is related to the Risk Ratio evaluation. Risk Ratio evaluation needs to be performed through extensive simulations in which the rate of NMAC is recorded and compared, in a framework which incorporates realistic aircraft dynamics, pilot response and non-response, and relevant measurement models of noise and bias. The simulations need to be for operationally realistic aircraft trajectories, and the simulations needs to cover the full range of possible trajectories.	-1	-2

				Given the wide set of factors to be considered for RR evaluation and their complexity the number of simulation run are estimated to be around millions. During simulation different encounters and equipment needs to be simulated, which affects the DAA sensors ability to detect and track the intruder as well as coordinate avoidance manoeuvres. The simulation also needs to include stress testing scenarios (e.g. incorrect intruder pilot response). Interoperability tests (e.g. with Extended Squitters 1090ES ADS-B Out emitted by ACAS capable intruders) shall be performed as well. In addition, the DAA solution will be effective only under IFR and in Airspace classes A-C, resulting ineffective in other conditions, thus increasing the cost for operators willing to fly in different airspace classes or flight conditions.		
		Environmental Impact (1)	Neutral	It is not possible to evaluate the impact on environment as the MASPS do not provide technological details. In addition, this DAA concept does not address possible conflicts with wildlife, natural obstacles etc..	0	0
		Impact on EU Industry competitiveness (1)	Very positive	Manufacturing such DAA solution may become a remarkable element of business for avionics industries. As outlined in *SJU European Drones Outlook Study*, European players are expected to play a key role in developing and commercialising drone technologies compatible with future airspace management requirements, including detect and avoid technology. Compliance with this standard may represent one of the	2	2

				pillars for safe integration of drones in the civilian airspace and may enable complex operations (such as cargo), potentially expanding business of several companies.		
		Social Acceptance (1)	Positive	As outlined in *SJU European Drones Outlook Study*, the development of reliable DAA solution, especially for operations in A-C airspace classes where manned traffic is expected to operate, will be one of the pillars of social acceptance of drones in the civil airspace.	1	1
ADDITIONAL NOTES						
Total Weighted Score						3

2.3 ED 258 Operational Services and Environment Description for DAA for DAA in Class D-G airspaces under VFR/IFR

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED 258 Operational Services and Environment Description	EUROCAE WG 105/ SG 12	Maturity (2)	Published	The document has been published by EUROCAE.	1	2
		Type of standards (1)	Best practice / recommendation	The document is an OSED providing functional requirements and environmental description	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard is partially compliant with the TMPR requirements for Arc-d. In fact, it is an OSED providing functional requirements and environmental description. MASPS/MOPS are needed to fully comply with SORA requirements. In addition, this standard only covers a	0	0

for DAA for DAA in Class D-G airspaces under VFR/IFR				portion of airspace (D-G).		
		Cost of compliance (2)	Medium	As the OSED does not provide specific performance requirements or technological solutions, it is not possible to evaluate the cost of compliance. MASPS/MOPS will enable such evaluation. The cost is rated as medium not to affect the overall score and for coherency of the assessment	0	0
		Environmental Impact (1)	Neutral	As no technological solutions are proposed, it is not possible to evaluate the environmental impact. The Impact is rated as Neutral not to affect the overall score and for coherency of the assessment	0	0
		Impact on EU Industry competitiveness (1)	Positive	Manufacturing such DAA solution may become a remarkable element of business for avionics industries. As outlined in *SJU European Drones Outlook Study*, European players are expected to play a key role in developing and commercialising drone technologies compatible with future airspace management requirements, including detect and avoid technology. Compliance with this standard may represent one of the pillars for safe integration of drones in the civilian airspace and may enable complex operations (such as cargo), potentially expanding business of several companies (e.g. parcel delivery companies).	1	1
		Social Acceptance (1)	Positive	As outlined in *SJU European Drones Outlook Study*, the development of reliable DAA solutions will be one of the pillars of social acceptance of drones in the civil airspace.	1	1
ADDITIONAL NOTES						
Total Weighted Score						6

2.4 ED 267 Operational Services and Environmental Description for DAA in very Low-Level Operations

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED 267 Operational Services and Environmental Description for DAA in very Low-Level Operations	EUROCAE WG 105 SG 13	Maturity (2)	External consultation	The document has been subject to open consultation until July 2019.	0	0
		Type of standards (1)	Best practice / recommendation	The document is an OSED providing functional requirements and environmental description	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard is partially compliant with the TMPR requirements for Arc-d. In fact, it is an OSED providing functional requirements and environmental description. MASPS/MOPS are needed to fully comply with SORA requirements.	0	0
		Cost of compliance (2)	Medium	As the OSED does not provide specific performance requirements or technological solutions, it is not possible to evaluate the cost of compliance. MASPS/MOPS will enable such evaluation. A medium score is assigned to avoid affecting the overall score	0	0
		Environmental Impact (1)	Good	The proposed DAA concept for VLL includes avoidance of flying wildlife.	2	2
		Impact on EU Industry competitiveness (1)	Very positive	Manufacturing such DAA solution may become a remarkable element of business for avionics industries. As outlined in *SJU European Drones Outlook Study**Errore.***	2	2

				L'origine riferimento non è stata trovata.European players are expected to play a key role in developing and commercialising drone technologies compatible with future airspace management requirements, including detect and avoid technology. Most of commercial operations in the Specific Category are expected to take place at VLL, therefore compliance with this standard may represent one of the pillars for safe integration of drones in the civil airspace.		
		Social Acceptance (1)	Positive	As outlined in *SJU European Drones Outlook Study***Errore. L'origine riferimento non è stata trovata.***,* the development of reliable DAA solution, will be one of the pillars of social acceptance of drones in the civil airspace. In addition, this DAA concept includes avoidance of flying wildlife which represents a sensitive aspect for environmental organisations.	1	1
ADDITIONAL NOTES						
Total Weighted Score						6

2.5 Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Satellite)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Satellite)	EUROCAE WG-105	Maturity (2)	Drafting	The document is formally at Draft stage.	-2	-4
		Type of standards (1)	Standard specification	This standard could be proposed as a regulation for C2 MOPS.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document full covers OSOs #6, and #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	Equipment with the minimum specified performance must be acquired. Additionally, considerable testing is required.	0	0
		Environmental Impact (1)	Neutral	No Impact on environment can be identified from the MOPS	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document provides the rationale for the equipment characteristics having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.	1	1
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES			This assessment will be confirmed once the standard is published.			

Total Weighted Score	5

2.6 ED-251 OSED - Operational Services and Environment Description for Automatic Taxiing

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED-251 OSED - Operational Services and Environment Description for Automatic Taxiing	EUROCAE WG105	Maturity (2)	Published / best practice	The purpose of this Operational Services and Environment Definition (OSED) is to provide a basis for assessing and establishing operational, safety, performance, and interoperability requirements for the Automatic Taxiing capabilities for a Remotely Piloted Aircraft System.	1	2
		Type of standards (1)	Best practice / recommendation	See above	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	Full Coverage of OSO#8; #11; #14, #21, but OSO#4 not assessed	2	6
		Cost of compliance (2)	Medium	Cost of compliance considered as neutral regarding the scope of operation (on airfield / airports and within certified category and only for fixed wing UAS)	0	0
		Environmental Impact (1)	Neutral	No Impact on environment can be identified from the OSED	0	0
		Impact on EU Industry	No impact		0	0

		competitiveness (1)				
		Social Acceptance (1)	No impact		0	0
ADDITIONAL NOTES			The mapping and WP assessment for Effectiveness to fulfil SORA requirement has been done and showed in case for OSO#8; #11; #14; #21 a full coverage but it can be questioned how much worth that is in relation to an agreed SAIL IV operation within the first iteration (no automation, not at airports). Maybe due to this result the assessment or the methodology are maybe need to be adjusted.			
Total Weighted Score						9

2.7 ED-252 - Operational Services and Environment Definition for RPAS Automatic Take-Off and Landing (ATOL)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED-252 Operational Services and Environment Definition for RPAS Automatic Take-Off and Landing (ATOL)	EUROCAE WG 105	Maturity (2)	Published	Issued in May 2018	1	2
		Type of standards (1)	Best practice / recommendation	The document is an OSED defining tasks and requirements required for an ATOL system	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	Partially covers OSOs #4, #8,#11,#14,#21. The std. contains definitions reqs. and procedures in the aspects of take-off and landing	0	0
		Cost of compliance (2)	Low	Definitions tasks and requirements required for an ATOL system. Minor	1	2

				additional costs due to the standard given that the organization already decided to develop an ATOL system.		
		Environmental Impact (1)	Neutral	Requirements regarding ATOL systems have no effect on the environment.	0	0
		Impact on EU Industry competitiveness (1)	Positive	Contribute to harmonization and competitiveness of ATOL system developers.	1	1
		Social Acceptance (1)	No Impact	The society will be indifferent to the application of this std.	0	0
ADDITIONAL NOTES						
Total Weighted Score						6

2.8 Minimum Operational Performance Specification Geofencing

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Specification Geofencing	EUROCAE WG 105	Maturity (2)	Drafting	Latest version of the standard is V5-1, 13th September 2019 delivered as draft for internal use exclusively	-2	-4
		Type of standards (1)	Standard Specification	The document specifies the minimum performance expected from the Geofencing Function, without prescribing its design and implementation	2	2
		Effectiveness to fulfil SORA	Partial	The document partially covers SORA requirement Step # 9: Adjacent Area/Airspace	0	0

		requirement (3)		Considerations. The document does not describe hardware requirements and this has been identified as a gap.		
		Cost of compliance (2)	Low	The MOPS does not refer specific technologies to clearly define costs, but the costs are considered low for small UA industries as the development of the function in conformance to the specified standard doesn't require new technologies and the required testing activities such as environmental tests, bench tests, tests for the installed equipment (With the aircraft on the ground and using simulated or operational system inputs, With the aircraft in flight using operational system inputs appropriate to the equipment under test) and operational tests, are judged initial costs for the manufacturer. Further option such as automatic geofencing limitation are also expected to not significantly affect overall costs. Clear technical infrastructure protocols and data formats for geofencing information service are also defined in the MOPS. Costs for the exchange of information between systems, including technical infrastructure and integrity and updating of the information also can impact the costs but can be considered affordable and impacting end-users' costs.	1	2
		Environmental Impact (1)	Good	It is not possible to evaluate the direct impact of the MOPS on the environment, but the	2	2

				geofencing function can reduce the probability of hazard avoiding access to No Fly Zone areas, including avoidance of wildlife, noise restricted areas or populated areas and thus reducing the risk of accidents or reducing noise with a positive impact on environment.		
		Impact on EU Industry competitiveness (1)	Very Positive	EU Industry competitiveness can benefits of the standard if adopted considering both the function itself and the required testing activities can be supported by EU companies, as it is a EUROCAE proposed standard, where the most of European companies are represented. In addition the geofencing function is indicated as a needed function in *SJU European Drones Outlook Study*	2	2
		Social Acceptance (1)	Very Positive	The geofencing function can have a very positive impact on Social acceptance as it is indicated as a needed function in *SJU European Drones Outlook Study* and also supports the avoidance of specific areas leading to social acceptance and positive opinion from the population that can consider the conformance to the standard as a mean to guarantee safe unmanned operations	2	2
ADDITIONAL NOTES						
Total Weighted Score						6

2.9 MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) HYBRID SURVEILLANCE (ED-221)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) HYBRID SURVEILLANCE (ED-221)	EUROCAE Working Group 75	Maturity (2)	Recognized / Accepted / Used	The document has been prepared jointly by EUROCAE Working Group 75 “Traffic Collision Avoidance System (TCAS)” and RTCA SC-147 “Traffic Alert & Collision Avoidance System (TCAS)”, and has been approved by the Council of EUROCAE on 10 April 2013 and also adopted as TSO.	2	4
		Type of standards (1)	Standard Specification	The document contains Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II) equipment that uses hybrid surveillance. Hybrid surveillance includes both passive surveillance using the Mode S extended squitter as well as the active interrogations used in TCAS II systems built in compliance with EUROCAE ED-143 / RTCA DO-185B.	2	2

		Effectiveness to fulfil SORA requirement	Partial	OSO#5: the standard covers inspections of safety; however, it does not address monitoring or alerts.	0	0
		Cost of compliance (2)	Very High	Costs cannot be directly derived by the MOPS, but are considered very high for small UA industries operating below 500'due to the costs for the development of the function in conformance to the specified standard and airworthiness, security, design assurance requirements in addition to the required costs of testing activities such as environmental tests, bench tests, tests for the installed equipment and costs for safety assessment. Finally costs for the TCAS II with hybrid surveillance are very highly impacted by the need of other standards' compliance as EUROCAE ED-143 / RTCA DO-185B and other required technologies such as TCAS, ADS-B etc.	-2	-4
		Environmental Impact (1)	Bad	The standard has no direct impact on environment, but the function it addresses is aimed at improving the TCAS function that directly reduces the likelihood of accidents and is expected to reduce the number of needed interrogation through passive surveillance; in addition the major	-2	-2

				operational benefit of hybrid surveillance is the reduced spectrum use, but if considered applied to a very large volume of traffic as it is expected for drones operating below 500’ it can negatively affect the environment as the adoption of the solution might have a negative impact on the spectrum usage. In addition, the equipment generates radiated power. Finally the function radiated power is expected and acceptable for commercial traffic operating at high altitude and standard IFR separations and might be not acceptable for small drones operating at low altitude and with separations of small magnitude. Thus the function impact on environment is considered as negative.		
		Impact on EU Industry competitiveness (1)	Very Negative	EU small UA Industries’ competitiveness might be very negatively impacted by the standard considering the function is owned only by very large companies operating in commercial IFR segments even if it is an EUROCAE standard and thus supported by main EU Industry representatives. In addition it requires other technologies mainly owned by very large aircraft companies. Finally the expected tests and assurances and	-2	-2

				integrity requirements might be very huge, considering the function is dedicated to also IFR traffic flying in calss A airspace.		
		Social Acceptance (1)	Positive	The STANDARDS (MOPS) FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) HYBRID SURVEILLANCE might have a positive impact on Social acceptance as it is aimed at improving TCAS that supports the reduction of the likelihood of accidents that can be seen as a positive goal in public opinion. In addition it is a standard already taken into consideration by commercial aviation that is judged as safe and thus accepted in public opinion.	1	1
ADDITIONAL NOTES						
Total Weighted Score						-1

2.10 Minimum Operational Performance Specification Geocaging

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Specification Geocaging	EUROCAE Working Group 105	Maturity (2)	Drafting	The document was prepared jointly by EUROCAE Working Group 105 “Unmmaned Aircraft Systems”, sub-group 33: “Geo-fencing”” as a draft. Latest version is September 2019	-2	-4
		Type of standards (1)	Standard Specification	The document specifies the minimum performance expected from the Geocaging Function, without prescribing its design and implementation	2	2
		Effectiveness to fulfil SORA requirement		Geographical containment requirements of Jarus Sora V2.0 for Specific category, to cover either ground or air risk		
		Cost of compliance (2)	Low	Costs might be low to very low depending on the robustness grade of the function and the required assurance level as the development of the function does not require new technologies or unaffordable technologies only owned by very large aircraft companies. Main costs are the development of the function and the required testing activities such as environmental tests (also requiring conformance to ED-14G /DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment), bench tests, tests for the installed equipment (With the aircraft on the ground and using simulated or operational system inputs, With the aircraft in flight using operational system inputs appropriate to the equipment under test) and operational tests.	1	2

				Costs for pilot in command training of the function also affects the overall costs.		
		Environmental Impact (1)	Good	The geocaging function has a very positive impact on environment as it is aimed at maintaining the UA within a pre-defined zone or cage and thus preventing access to forbidden zone preventing contamination. In addition it can reduce the risk of accidents by containing the UA in specific zone.	2	2
		Impact on EU Industry competitiveness (1)	Very Positive	EU Industry competitiveness might benefits of the standard considering both the function itself and the required testing activities can be supported by EU companies being an EUROCAEE standard and thus participated and accepted by main EU Industry representatives. In addition it is not based on new technologies or technology owned by very large aircraft companies only and it is complementary to the geofenicng function indicated as a need in the SJU European Drones Outlook Study	2	2
		Social Acceptance (1)	Very Positive	The geocaging function might have very a positive impact on Social acceptance as it is complementary to the geofenicng function indicated as a need in the SJU European Drones Outlook Study and it is aimed at maintaining the UA within a pre-defined zone or cage leading to social acceptance and positive opinion from the population that can consider the application of the function as a mean to guarantee safe and contained unmanned operations. Indeed the geocaging is intended to be used as a containment or safety barrier with regard	2	2

				to ground population or other traffic		
ADDITIONAL NOTES						
Total Weighted Score						6

2.11 MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) HYBRID SURVEILLANCE (ED-143)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) HYBRID SURVEILLANCE (ED-143)	EUROCAE – RTCA SC-147	Maturity (2)	Recognized / Accepted / Used	The document has been prepared jointly by Working Group -75 (WG-75) and RTCA Special Committee 147 (SC-147) and approved by the Council of EUROCAE on 15th September 2008. It is equivalent to and technically identical with RTCA DO-185B. It has also been adopted as TSO.	2	4
		Type of standards (1)	Standard Specification	The document sets forth minimum operational performance standards for Traffic Alert and Collision Avoidance System II (TCAS II) equipment.	2	2
		Effectiveness to fulfil SORA requirement				
		Cost of compliance (2)	Very High	Costs might be very high and unaffordable for small UA operating below 500'companies due to the costs for the development of the function in conformance to the specified standard and the other needed means, the airworthiness, security,	-2	-4

				design assurance requirements and the required testing activities such as environmental tests, bench tests, tests for the installed equipment. In addition it requires other technologies mainly owned by very large aircraft companies such as Mode S		
		Environmental Impact (1)	Good	The function is intended to improve air safety by acting as a last-resort method of preventing mid-air collisions or near collisions between aircraft and thus can have a positive impact on environment reducing the likelihood of accidents	1	1
		Impact on EU Industry competitiveness (1)	Negative	EU small UA Industry competitiveness might be negatively impacted by the standard considering the function is owned only by very large companies operating in commercial segments even if it is an EUROCAE standard and thus supported by main EU Industry representatives.	-1	-1
		Social Acceptance (1)	Positive	The standard might have a positive impact on Social acceptance as it improves air safety by acting as a last-resort method of preventing mid-air collisions or near collisions between aircraft that can be seen as a positive goal in public opinion	1	1
ADDITIONAL NOTES						
Total Weighted Score						3

2.12 Minimum Operational Performance Standard for Galileo/GPS/Satellite-Based Augmentation System Airborne Equipment

Standard title	SDO	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Standard for Galileo/GPS/Satellite-Based Augmentation System Airborne Equipment	EUROCAE	Maturity (2)	Published	The document has been approved and published in February 2019	1	2
		Type of standards (1)	Standard Specification	The document contains Minimum Operational Performance Standards (MOPS) for Galileo/GPS/Satellite-Based Augmentation System Airborne Equipment	1	1
		Effectiveness to fulfil SORA requirement	No coverage	The document contains minimum operational performance standards (MOPS) for GPS/GALILEO/SBAS dual-frequency L1/L5 airborne equipment. Although equipment performance metrics are basically the same, performance requirements (and test methods) are not applicable for all UAS given the different flight dynamics (i.e. ground speed, accelerations), especially for small drones operating in the Specific Category (low altitudes, low dynamics etc.). For large drones with flight dynamics comparable to manned aircraft (likely to operate in the Certified Category) the document could be instead applicable.		

		Cost of compliance (2)	Low	It is expected a low cost of compliance to the airborne equipment minimum operational standard for Galileo/GPS/Satellite-Based Augmentation System as no new technology is needed to be developed and no other specific costs in addition to the testing costs are envisaged	1	2
		Environmental Impact (1)	Neutral	No impact on environment is expected from the standard compliance	0	0
		Impact on EU Industry competitiveness (1)	Positive	EU Industry competitiveness might benefits of the standard considering both the function itself and the required testing activities can be supported by EU companies being an EUROCAEE standard and thus participated and accepted by main EU Industry representatives.	1	1
		Social Acceptance (1)	Positive	Social acceptance can be positive considering it is an exploitation of GALILEO	1	1
ADDITIONAL NOTES						
Total Weighted Score						7

3 NATO

3.1 UAV Systems Airworthiness Requirements (USAR)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
3UAV Systems Airworthiness Requirements (USAR) for North Atlantic Treaty Organization (NATO) Military UAV Systems	NATO	Maturity (2)	Recognised / accepted / used	Used for military applicant to military authorities	2	2
		Type of standards (1)	Standard Specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Full coverage	OSO#02-UAS manufactured by competent and/or proven entity Subpart D: No real Mapping found→proposal to remove mapping to OSO#02 OSO#04-UAS developed to authority recognized design standards All sections OSO#05-UAS is designed considering system safety and reliability Covered in USAR.1309 Equipment, systems and installations	2	6

				Note: reference to other standards as ARP4761, DO178B…. OSO#10-Safe recovery from technical issue See above OSO#12-The UAS is designed to manage the deterioration of external systems supporting UAS operation See above OSO#23-Environmental conditions for safe operations defined, measurable and adhered to See " UAV SYSTEM FLIGHT MANUAL" OSO#24-UAS designed and qualified for adverse environmental conditions (e.g. adequate sensors, DO-160 qualification) See USAR.867 Electrical bonding and protection against lightning and static electricity		
		Cost of compliance (2)	Very High	Some points not easy to comply with: As example, reference do DAL table DAL B for CAT failures conditions DAL C for HAZ failures conditions	-2	-4
		Environmental Impact (1)	Neutral	This document only focuses on safety: its compliance does not have environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Very negative	Very negative if all of this document is considered for lower SAILs: DAL requirements as example	-2	-2

		Social Acceptance (1)	Neutral	This document only focuses on safety: its compliance does not have direct effect on social acceptance	0	1*0=0
ADDITIONAL NOTES						
Total Weighted Score						4

3.2 STANAG 4703 - Light Unmanned Aircraft Systems Airworthiness Requirements

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
STANAG 4703 (AEP-83) Light Unmanned Aircraft Systems Airworthiness Requirements	NATO 4703 (AEP-83)	Maturity (2)	Recognized	This standard was published by NATO, and is therefore classified as recognized.	2	4
		Type of standards (1)	Standard Specification	This standard defines a set of criteria for system design and which may be shown by different methods (testing, analysis, etc.)	2	2
		Effectiveness to fulfil SORA requirement (3)		Note: Differs for different OSOs		
		Cost of compliance (2)	High	The methods presented within this standard are partially derived from manned aviation standards and require a high level of compliance proof. Might even be very high if software requirements are to be considered.	-1	-2
		Environmental Impact (1)	Neutral	No environmental impact and therefore a neutral score is assigned.	0	0

		Impact on EU Industry competitiveness (1)	Neutral	Does not contain requirements/demands to be met.	0	0
		Social Acceptance (1)		No impact on social acceptance.	0	0
ADDITIONAL NOTES						
Total Weighted Score						4

3.3 STANAG4702 - Rotary Wing Unmanned Aerial Systems Airworthiness Requirements

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
STANAG4702 Rotary Wing Unmanned Aerial Systems Airworthiness Requirements	NATO FINAS	Maturity (2)	Recognized	The std. is recognized by several civil authorities such as CAAI	2	4
		Type of standards (1)	Standard Specification	Contains reqs. for certification	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	Fully covers OSOs #2,#3,#4,#5,#6, #10, #23 for rotary wing, and partially covers OSOs #12,#24	2	6
		Cost of compliance (2)	Very High	The standard contains many requirements and some require ground and flight tests that might be relatively expensive	-2	-4
		Environmental Impact (1)	Neutral	The standard does not deal with environmental impact such as noise	0	0
		Impact on EU Industry	Very Positive	Compliance with this std. will help to	2	2

		competitiveness (1)		create products of higher quality. It is assumed that the EU industry is ready to adopt the std.		
		Social Acceptance (1)	Positive	will create more jobs due to the effort required to comply with the std	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

4 ISO

4.1 ISO 23665 Unmanned aircraft systems -- Training for personnel involved in UAS operations

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ISO 23665 Unmanned aircraft systems -- Training for personnel involved in UAS operations	ISO TC/20 SC 16 WG 3	Maturity (2)	External Consultation	The document is formally at Committed Draft stage (CD). However, the voting period is closed, and the document has been approved for circulation as DIS.	0	0
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO 9,15,22 and other OSOs dealing with training requirements. The lack of a training syllabus for BVLOS conditions is identified as the main gap.	0	0
		Cost of compliance (2)	Medium	The cost for the preparation of training material compliant with this standard is considered low. However, the training organisation requirements given in terms of facilities, equipment, flight simulators, etc... is expected to increase the cost of compliance. In addition, the standard is currently covering training for VLOS OPS, increasing the cost for operators willing	0	0

				to fly in BVLOS who should refer to different standards/organisations for the training of their pilots.		
		Environmental Impact (1)	Good	The training course proposed by the standard should increase the trainee's sensitivity in terms of safety (e.g. it includes the awareness of environmental hazards generated by batteries). In addition, the trainee is expected to acquire knowledge about how to handle emergency situations in which the loss of control may affect environment. Also, notions of electromagnetic compatibility could be included in the training syllabus.	2	2
		Impact on EU Industry competitiveness (1)	Positive	This standard provides requirements that may consolidate the role of training organisations within the Specific Category where most of business is expected to grow in the next years As outlined in**Errore. L'origine riferimento non è stata trovata.**, development of harmonised training requirements will enable the supply of pilots needed to reach market potential while preserving a strong focus on safety. In addition, companies developing flight simulators may have benefits from the adoption of this standard.	1	1
		Social Acceptance (1)	Very Positive	The adoption of a standard for harmonised training requirements can be positively seen by public opinion. In addition, the procedures established for training organisations may lead to the necessity to employ additional dedicated personnel (e.g. safety managers). All drone pilots – both full-time pilots and trained end-users – will require appropriate training, resulting in additional 5 000 and 10 000 jobs in 2035 and 2050	2	2

				respectively.		
ADDITIONAL NOTES			Future versions of this standards are expected to cover also training for BVLOS conditions and other UAS personnel, possibly determining full coverage with OSO 9,15,22 and reducing the cost of compliance.			
Total Weighted Score						7

4.2 ISO 21384-3 Unmanned aircraft systems -- Part 3: Operational procedures

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ISO 21384-3 Unmanned aircraft systems -- Part 3: Operational procedures	ISO TC20/SC 16	Maturity (2)	External consultation	The document is at DIS stage.	0	0
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial		0	0
		Cost of compliance (2)	Medium	The standard defines operational procedures but also a complete safety and security management system to be developed within the operator's organisation, thus increasing the cost of compliance.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified from the standard	0	0
		Impact on EU Industry	Neutral	No significant impact on EU industry competitiveness.	0	0

		competitiveness (1)				
		Social Acceptance (1)	Positive	The adoption of harmonised procedures may have appositive impact on public opinion.	1	1
ADDITIONAL NOTES						
Total Weighted Score						3

4.3 ISO 21384-2 Unmanned aircraft systems -- Part 2: Product systems

Standard title	**SDO & WG**	**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ISO 21384-2 Unmanned aircraft systems -- Part 2: Product systems	ISO TC20/SC 16 WG2	Maturity (2)	External consultation	The document is circulating at CD level.	0	0
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)				
		Cost of compliance (2)	High	The standard covers all possible types of UAS and flight conditions. The cost of compliance is evaluated as high due to the high number of design requirements and tests to be performed to ensure compliance. These include safety, cyber security and environmental qualification tests.	-1	-2
		Environmental Impact (1)	Good	Design requirements include climate, biological and environmental adaptability. Propulsion design include noise mitigation. Battery	2	2

				design shall respect criteria of environmental reliability. In addition, the standard includes electromagnetic compatibility considerations.		
		Impact on EU Industry competitiveness (1)	Very Positive	The adoption of this standard could harmonise manufacturing of UAS systems and components, thus leading to cost effective and reliable solutions. The standard covers several domains, including structures, propulsion and avionics, thus bringing potential benefits to a large number of industries.	2	2
		Social Acceptance (1)	Positive	Design requirements included in the standard follow principles of safety, security and environmental compatibility and ergonomics. Therefore, social acceptance is judged as positive.	1	1
ADDITIONAL NOTES						
Total Weighted Score						5

5 ASTM

5.1 F3366-19 Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
F3366-19 Standard Specification for General Maintenance Manual (GMM) for a small Unmanned Aircraft System (sUAS)	ASTM F38	Maturity (2)	Published	The standard has been already published by ASTM. No evidence is available about whether the standard is already accepted/recognised by Authorities.	1	2
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially fulfils OSO #3 and OSO #7.	0	0
		Cost of compliance (2)	Very low	The standard simply provides a template to develop a maintenance manual. The cost of compliance is therefore very low.	2	4
		Environmental Impact (1)	Neutral	No impact on environment can be traced	0	0

		Impact on EU Industry competitiveness (1)	Positive	Task specific training are mentioned (e.g. engine manufacturer heavy maintenance, parachute repair course). The adoption of such standard may lead to the development of training courses “ad hoc”, possibly representing a new business value.	1	1
		Social Acceptance (1)	Positive	A standardised manual for maintenance has positive effect on social acceptance as	1	1
ADDITIONAL NOTES						
Total Weighted Score						10

5.2 F3330 - 18 Standard Specification for Training and the Development of Training Manuals for the UAS Operator

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
F3330 - 18 Standard Specification for Training and the Development of Training Manuals for the UAS Operator	ASTM F38	Maturity (2)	Published	No evidence that the document has been accepted/recognised by Authorities.	1	2
		Type of standards (1)	Standard specification			
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard partially fulfils OSO #9,15,22.	0	0
		Cost of compliance (2)	Very Low	The cost of compliance is very low as the standard only provides a template to be used to develop training manuals. In addition, the	2	4

				adoption of this standard will facilitate the development of the operator's training programs. This standard in principle makes no distinction on the type of operation and is applicable in the general case.		
		Environmental Impact (1)	Neutral	No impact on environment can be identified	0	0
		Impact on EU Industry competitiveness (1)	No impact		0	0
		Social Acceptance (1)	Positive	The development of standardised training manuals can be positively evaluated by trainees.	1	1
ADDITIONAL NOTES						
Total Weighted Score						7

5.3 F3266-18 - Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
F3266-18 Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement	ASTM F38	Maturity (2)	Published	The document has been published by ASTM.	1	2
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO #9,15,22 as there no training requirements are provided for personnel other than remote pilot.	0	0
		Cost of compliance (2)	Medium	The standard includes a wide range of training subjects (wider than prescribed by SORA), thus increasing the cost of compliance for both training organisations (responsible to develop the training material) and operators/trainees.	0	0
		Environmental Impact (1)	Neutral	No impact on environment can be identified	0	0
		Impact on EU Industry competitiveness (1)	Positive	Training organisations may have benefits in delivering new training courses to cover the topics covered by the standard.	1	1
		Social Acceptance (1)	Positive	The establishment of ad hoc training programmes can be positively seen by public opinion. At the same time new job opportunities for instructors/examinators may emerge.	1	1
ADDITIONAL NOTES						
Total Weighted Score						6

5.4 F2849-10 Standard Practice for Handling of Unmanned Aircraft Systems at Divert Airfield

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
F2849-10 Standard Practice for Handling of Unmanned Aircraft Systems at Divert Airfield	ASTM F38	Maturity (2)	Published		1	2
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard is partially compliant with M3 (ERP) and with OSO #8,11,14,21.	0	0
		Cost of compliance (2)	Medium	The cost of compliance is considered medium. This is due to specific automatic functions which should be implemented on fixed wing UAS to allow compliance with the prescribed recovery procedure.	0	0
		Environmental Impact (1)	Good	The emergency procedure described in the standard allows a safe recovery of the aircraft, thus preventing damages on infrastructures, fires, release of hazardous materials etc..	2	2
		Impact on EU Industry competitiveness (1)	No impact	Manufacturers may develop fixed wing UAS in compliance with this standard. However, the standard is not suitable for multicopters and VLOS operations which currently represent the majority of use cases.	0	0
		Social Acceptance (1)	Very Positive	The availability of recognised UAS emergency procedures can be positively seen by public opinion.	2	2
ADDITIONAL NOTES						
Total Weighted Score						8

5.5 F3364-19 Standard Practice for Independent Audit Program for Unmanned Aircraft Operators

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
F3364-19 Standard Practice for Independent Audit Program for Unmanned Aircraft Operators	ASTM F38	Maturity (2)	Published	The standard has been published by ASTM.	1	2
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard partially covers OSO #1, in particular it fulfils the medium level of assurance but does not cover integrity requirements. It could be also used to comply with high level of assurance for other OSOs where it is required to validate operational procedures by external third parties.	0	0
		Cost of compliance (2)	Medium	The standard basically describes how to carry out an audit process of the operator's organisation. The main costs are related to the effort of personnel involved in performing the audit, in terms of economic effort for qualification and certification. In addition, additional costs may derive from the timing of the proposed audit structure (up to 90 days).	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	Positive	Qualified entities (as defined in Art.69) of EU Reg.1139/2018 may have benefit from the application of this standard as they could be tasked by competent authority to perform audits	1	1

				of operators or directly called into question by operators when performing a SORA process.		
		Social Acceptance (1)	Positive	The presence of recognised audit process to verify operator competencies in terms of safety management, procedures, etc, is positively seen by public opinion. In addition, areas of improvements can be identified thanks to dedicated audit processes, thus improving the labour quality of employed personnel.	1	1
ADDITIONAL NOTES						
Total Weighted Score						6

5.6 WK62744 - New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM WK62744 - New Practice for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Drafting	The document is formally at Draft Under Development stage.	-2	-4
		Type of standards (1)	Standard specification	The document is a standard that could be proposed for a general operations manual for Professional Operator of Light Unmanned Aircraft Systems	2	2

				(UAS).		
		Effectiveness to fulfil SORA requirement (3)	Partial	Expected to partially cover OSOs #1, #7, #8, #11, #14, #21, #16, #17, #19, and #23	0	0
		Cost of compliance (2)	Very Low	The standard is expected to simply provide a template to develop a general operations manual. The cost of compliance is, therefore, very low.	2	4
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES			This assessment will be confirmed once the standard is completed/published.			
Total Weighted Score						2

5.7 ASTM F3002-14a Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3002-14a Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (sUAS)	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	The document is a standard that could be proposed for the C2 of sUAS.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers OSO #6 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	Equipment with the minimum specified performance must be acquired. Additionally, considerable testing is required.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document provides the rationale for the equipment characteristics having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies	1	1
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						11

5.8 ASTM F3153 - Standard Specification for Verification of Avionics Systems

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3153 - Standard Specification for Verification of Avionics Systems	ASTM F39 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard Specification	The document defines a process by which safety of avionic systems may be verified.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO #5 up to SAIL IV.	0	0
		Cost of compliance (2)	Low	The costs of documentation to be recorded are considered low	1	2
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	Positive	The adoption of a standard for harmonised verification requirements can be positively seen by public opinion.	1	1
ADDITIONAL NOTES						
Total Weighted Score						7

5.9 F3322-18 - Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
F3322-18 - Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This is a standard specification that could be proposed for the specification of sUAS parachutes.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements OSO #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The standard mandates a large number of tests which must be completed successfully without any failure.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document provides the rationale for the design of sUAS parachutes having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.	1	1
		Social Acceptance (1)	Positive	This standard is to be included for permission to fly a sUA over people. The adoption of a standard which directly improves the safety of UAV in case of fall over people can be positively seen by public opinion.	1	1
ADDITIONAL NOTES						
Total Weighted Score						12

5.10 ASTM F2490-05(2013) - Standard Guide for Aircraft Electrical Load and Power Source Capacity Analysis

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F2490-05(2013) - Standard Guide for Aircraft Electrical Load and Power Source Capacity Analysis	ASTM F39 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	The document covers guidelines on how to prepare an electrical load analysis (ELA) to meet Federal Aviation Administration (FAA) requirements.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements OSO #4, and partially covers OSO#10 up to SAIL IV.	2	6
		Cost of compliance (2)	Low	The costs for testing are considered low	1	2
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness	No Impact		0	0

		(1)				
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						11

5.11 F2799-14 - Standard Practice for Maintenance of Aircraft Electrical Wiring Systems

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
F2799-14 - Standard Practice for Maintenance of Aircraft Electrical Wiring Systems	ASTM F39 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	The document defines acceptable practices for the maintenance and repair of electric systems in general aviation aircraft. It does not change or create any additional regulatory requirements.	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers the requirements OSO #3.	0	0
		Cost of compliance (2)	Medium	The documents refers to a large number of maintenance activities to be performed.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry	Positive	The adoption of this document may lead to the development of training courses “ad	1	1

		competitiveness (1)		hoc", possibly representing a new business value.		
		Social Acceptance (1)	Positive	The adoption of a standard for constant maintenance can be very positively seen by public opinion. Additionally, this document creates job opportunities for maintenance of the systems.	1	1
ADDITIONAL NOTES						
Total Weighted Score						5

5.12ASTM F2910-14 - Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F2910-14 - Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	The document defines best practices for the design of sUAS.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements OSO #4 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document refers to a large number of tests which	0	0

				must be performed.		
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						10

5.13 ASTM F3298-19 - Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3298-19 - Standard Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	The document is a standard that could be proposed to a specific regulation.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSOs #4 and #5, and partially the requirements of OSOs #10 and #12 up to SAIL IV.	2	6

		Cost of compliance (2)	Medium	The document refers to a large number of tests which must be performed	0	0
		Environmental Impact (1)	Good	The document refers to the necessity of having a safe battery system which will not cause any fires or explosions	1	1
		Impact on EU Industry competitiveness (1)	Positive	The documents refer to the need for training for unmanned aircraft potentially creating a business opportunity.	1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						13

5.14ASTM F2911-14e1 - Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F2911-14e1 - Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	This document can lead to a reliable product acceptance procedure.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSOs #4 and #5, and partially the requirements of OSOs #10 and #12 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The documents mentions that the manufacturer must have a configuration management, a product specific and a product verification, and a test plan, among others. These may require time to complete specially since there are no specific details in the document on how to formulate these plans.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document establishes the requirements for product acceptance having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.	1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.15 ASTM F3003-14 - Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3003-14 - Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard Specification	This document defines the quality assurance requirements for the design, manufacture, and production of a small unmanned aircraft system (sUAS).	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #4 and partially covers OSO #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document defines a considerable amount of documentation which must be produced by the applicant.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environemnt	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document establishes the requirements for quality assurance having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.	1	1
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						5

5.16 ASTM F3201-16 - Standard Practice for Ensuring Dependability of Software Used in Unmanned Aircraft Systems (UAS)

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3201-16 - Standard Practice for Ensuring Dependability of Software Used in Unmanned Aircraft Systems (UAS)	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	This document can lead to a reliable verification of the software.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #4 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The documents requires several product artifacts which require time to complete, specially taking into account that no specific format is defined. Useful resources are mentioned, however these are not filtered per relevance.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on enviornment	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document establishes the requirements for software in UAS having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.	1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.17 ASTM F2909-19 - Standard Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F2909-19 - Standard Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard Specification	This document establishes the requisites for maintenance and continued airworthiness of a lightweight unmanned aircraft system.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	The document partially covers the requirements for OSO #7 and fully covers requirements for OSO #3 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document defines the need for continuous maintenance and testing as well the record of all maintenance and repair activities.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	Positive	The document defines that manufacturers may assign operational safety monitoring and continued airworthiness support duties to other entities. Such may create a business opportunity.	1	1

		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies, especially in referring to hazard to people, is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.18 ASTM F2908-18 - Standard Specification for Aircraft Flight Manual (AFM) for a Small Unmanned Aircraft System (sUAS)

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F2908-18 - Standard Specification for Aircraft Flight Manual (AFM) for a Small Unmanned Aircraft System (sUAS)	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard Specification	This document can lead to a reliable practice for AFMs.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers the requirements for OSO #2 up to SAIL IV.	0	0
		Cost of compliance (2)	Very Low	The standard is expected to simply provide a template to develop an AFM. The cost of compliance is, therefore, very low.	2	4

		Environmental Impact (1)	Neutral	No Impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						8

5.19 ASTM F3178-16 - Standard Practice for Operational Risk Assessment of Small Unmanned Aircraft Systems (sUAS)

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3178-16 - Standard Practice for Operational Risk Assessment of Small Unmanned Aircraft Systems (sUAS)	ASTM F38 Unmanned Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	This document can lead to a reliable practice for AFMs.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Very Low	The document defends that conducting an ORA will produce cost savings in operations.	2	4

		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	Positive	The documents refer to the need for training programs potentially creating a business opportunity for companies providing these trainings.	1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						15

5.20 ASTM F2245-16c - Standard Specification for Design and Performance of a Light Sport Aeroplane

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F2245-16c - Standard Specification for Design and Performance of a Light Sport Aeroplane	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This document can be proposed as an acceptable means of compliance for the design of a light sport aeroplane.	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers the requirements for OSO #4 up to SAIL IV.	0	0

		Cost of compliance (2)	Medium	The document refers to a considerable number of necessary tests and documentation.	0	0
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	Positive	By complying to the required performance, products by EU manufacturers may become more competitive than products by non-EU manufactures .	1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						5

5.21 ASTM F3180/F3180M-18 - Standard Specification for Low-Speed Flight Characteristics of Aircraft

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3180/F3180M-18 - Standard Specification for Low-Speed Flight Characteristics of Aircraft	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This document can be proposed as an acceptable means of compliance for low-speed flight characteristics.	1	1

		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #4 up to SAIL IV.	2	6
		Cost of compliance (2)	Low	The document does not have significant testing requisites. For some requirements, a simple analysis from the applicant is sufficient, and for others, test methods shall be proposed by the applicant.	1	2
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						12

5.22 ASTM F3116/F3116M-15 - Standard Specification for Design Loads and Conditions

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3116/F3116M-15 - Standard Specification for Design Loads and Conditions	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This document can be proposed as an acceptable means of compliance for low-speed flight characteristics.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #4 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document refers to a considerable number of necessary tests and documentation.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						10

5.23 ASTM F1583 - Practice for Communications Procedures—Phonetics

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F1583 - Practice for Communications Procedures—Phonetics	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	This document can be proposed as a best practice for phonetic in communications.	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers the requirements for OSO #16 up to SAIL IV.	0	0
		Cost of compliance (2)	Very Low	Only a one-off cost of training the crew for this practice is necessary	2	4
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						7

5.24 ASTM F3227 - Specification for Environmental Systems in Small Aircraft

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3227 - Specification for Environmental Systems in Small Aircraft	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This document can be proposed as an acceptable means of compliance for low-speed flight characteristics.	1	1
		Effectiveness to fulfil SORA requirement (3)	Full	The document fully covers the requirements for OSO #4 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document refers to a considerable number of necessary tests.	0	0
		Environmental Impact (1)	Neutral	No environmental impact has been identified	0	0
		Impact on EU Industry competitiveness (1)	Positive		1	1
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies for occupants is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.25 ASTM F3231 - Specification for Electrical Systems in Small Aircraft

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3231 - Specification for Electrical Systems in Small Aircraft	ASTM	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard Specification	This document covers international standards for the electrical systems aspects of airworthiness and design for “small” aircraft.	2	2
		Effectiveness to fulfil SORA requirement (3)		The document fully covers the requirements for OSO #4 and partially covers the requirements for OSO #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Medium	The document refers to a considerable number of necessary tests.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.26 ASTM F3232 - Specification for Flight Controls in Small Aircraft

Standard title		**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
ASTM F3232 - Specification for Flight Controls in Small Aircraft	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Standard specification	This document can be proposed as an acceptable means of compliance for flight controls .	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers the requirements for OSOs #5 and #10 up to SAIL IV.	0	0
		Cost of compliance (2)	Medium	The document refers to a considerable number of necessary tests.	0	0
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	No Impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						4

5.27 ASTM F3309 - Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
ASTM F3309 - Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft	ASTM F38 Aircraft Systems	Maturity (2)	Published	Standard is classified as final and available in the public domain.	1	2
		Type of standards (1)	Best Practice	This document can be proposed as a best practice for conducting a simplified safety assessment of aircraft systems and equipment.	1	1
		Effectiveness to fulfil SORA requirement (3)		The document fully covers the requirements for OSOs #10 and #12, and partially covers the requirements for OSO #5 up to SAIL IV.	2	6
		Cost of compliance (2)	Low	The documents covers a safety assessment more simple than other existent standards.	1	2
		Environmental Impact (1)	Neutral	No impact has been identified on environment	0	0
		Impact on EU Industry competitiveness (1)	No Impact		0	0
		Social Acceptance (1)	Positive	The adoption of a standard which reinforces safety policies is seen favourably by the public.	1	1
ADDITIONAL NOTES						
Total Weighted Score						11

5.28 Standard Practice for Methods to Safely Bound Flight Behaviour of Unmanned Aircraft Systems Containing Complex Functions

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Standard Practice for Methods to Safely Bound Flight Behaviour of Unmanned Aircraft Systems Containing Complex Functions	ASTM F3269	Maturity (2)	Published	F3269 is a published standard but it is for unmanned aircraft only and due to the lack of worldwide regulations on UAS it can be expected that this standard is not well recognized yet.	1	2
		Type of standards (1)	Standard specification	The standard describes a reference architecture for safely bounding flight behaviour. As such it can be used to monitor/supervise external as well as internal systems and prevent single points of failures and initiate potential contingencies.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document fully covers OSO 4 but only partially covers OSO 10 and 12	0	0
		Cost of compliance (2)	Low	The cost for the development and implementation of this functionality can be seen more than low as high due to the fact that applicants could benefit if the competent authorities accept this standard as an acceptable means of compliance against single point of failure. The design automatically supports independence, separation and	0	0

				redundancy. A suitable contingency/redundancy/mitigation must be available and executable.		
		Environmental Impact (1)	Neutral	No impact has been identified	0	0
		Impact on EU Industry competitiveness (1)	No impact		0	0
		Social Acceptance (1)	No impact		0	0
ADDITIONAL NOTES						
Total Weighted Score						4

6 RTCA

6.1 Minimum Operational Performance Standards for Airborne Collision Avoidance System Xu (ACAS Xu)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Standards for Airborne Collision Avoidance System Xu (ACAS Xu)	RTCA SC 147	Maturity (2)	External Consultation	The latest version of the draft was published for consultation on the 15th October 2019.	0	0
		Type of standards (1)	Standard specification	The standard represents Minimum Operational Performance Requirements (MOPS).	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard partially fulfils Tactical Mitigation Performance Requirements. Some limitations have been recognised in term of airspace applicability.	0	0
		Cost of compliance (2)	Medium	The core of Xu logic maintains interoperability throughout the airspace, but the operational service volume where DAA is provided depends on equipage. Increasing equipage results in increasing operational service volume but also increasing costs. Greater equipages can operate in the operational service volumes of lesser equipages, but not vice	0	0

				versa. The amount of tests is the same as for DO 365. Therefore, the cost of compliance will depend on the actual equipage chosen for the operation. The more complex is the operation, the large will be the cost of compliance. However, this logic is proportional to the economic capabilities of operators and manufacturers so a medium score is selected.		
		Environmental Impact (1)	Bad	The adoption of this solution might have a negative impact on the spectrum usage (mainly 1090 MHz). In addition, equipment generates radiated power.	-2	-2
		Impact on EU Industry competitiveness (1)	Very Positive	The standard represents an effective DAA solution effective for small drones at VLL where most of the business is concentrated in the next years. This would constitute the basis for the safe integration of drones.	2	2
		Social Acceptance (1)	No impact	No impact on social acceptance.	0	0
ADDITIONAL NOTES						
Total Weighted Score						2

6.2 DO-178C (AMC20-115D) Software Considerations in Airborne Systems and Equipment Certification

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-178C (AMC20-115D) *Software Considerations in Airborne Systems and Equipment Certification*	RTCA SC-167/ EUROCAE WG-12	Maturity (2)	Recognised/ Accepted/ Used	Has been approved and accepted by RTCA	2	4
	RTCA SC-167/ EUROCAE WG-12	Type of standards (1)	Information guidance	The purpose of this document is to provide guidelines for the production of software for airborne systems and equipment	0	0
	RTCA SC-167/ EUROCAE WG-12	Effectiveness to fulfil SORA requirement (3)	Full Coverage	Provides safety assessment for the determination of the system life cycle. **This is relevant to OSO#5 ''UAS is designed considering system safety and reliability'' rather than OSO#4 as it was initially mapped**	2	6
	RTCA SC-167/ EUROCAE WG-12	Cost of compliance (2)	Low	Modifications to the software development processes may apply a small added cost for the developing companies, but on the other hand may relief the operational costs	1	2
	RTCA SC-167/ EUROCAE WG-12	Environmental Impact (1)	Neutral	Increased life cycle of software may have very small positive impact but cannot be quantified	0	0

	RTCA SC-167/ EUROCAE WG-12	Impact on EU Industry competitiveness (1)	Positive	Following the proposed processes can lead to more quality services and products	1	1
	RTCA SC-167/ EUROCAE WG-12	Social Acceptance (1)	Positive	Social opinion usually responds positively to security improvements, but does not improve penetration rates or make drone use easier for certain applications, nor brings additional benefits to the end users	1	1
ADDITIONAL NOTES			More relevant to OSO#5 ‘’UAS is designed considering system safety and reliability’’			
Total Weighted Score						**14**

6.3 ED 264 Minimum Aviation System Performance Standards (MASPS) for the Interoperability of Airborne Collision Avoidance Systems (CAS)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED 264 *Minimum Aviation System Performance Standards (MASPS) for the Interoperability of Airborne Collision Avoidance Systems (CAS)*	RTCA SC-147/ EUROCAE WG-75	Maturity (2)	External Consult.	Has not been published but issued for external consultation	0	0
		Type of standards (1)	Information guidance	Presents high level requirements for interoperability of airborne Collision Avoidance Systems (CAS). Compliance is recommended as one means of assuring acceptable interaction	0	0
		Effectiveness to fulfil SORA requirement (3)	Full Coverage	Expected to fully cover OSO#5 & 21	2	6
		Cost of compliance (2)	Medium	Technical specifications refer to the initial stages of designing and thus cost is not expected to be a factor of importance	0	0
		Environmental Impact (1)	Neutral	No impact expected to the environment	0	0
		Impact on EU Industry competitiveness (1)	Positive	Manufacturers and operators will face added competitiveness for the adoption of the proposed requirements	1	1
		Social Acceptance (1)	Very Positive	Larger interoperability is expected to remove technological barriers,	2	2

				increase market penetration through wider usage but also allow the entrance of additional service providers		
ADDITIONAL NOTES				This assessment will be confirmed once the standard is completed/ published.		
Total Weighted Score						**9**

6.4 DO 282 (ETSO C154c) Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO 282 (ETSO C154c) *Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B)*	RTCA SC-186	Maturity (2)	Recognised/ Accepted/ Used	Has been approved and published by the RTCA on 2009	2	4
		Type of standards (1)	Best Practice	Specifies desired system characteristics that should prove useful to designers, manufacturers, installers and users of UAT equipment and reflected by thorough technical and scientific procedures	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial Coverage	It partially covers the technical OSO#2,4 and 5	0	0
		Cost of compliance (2)	High	Minimum operational performance standards are expected to impose additional manufacturing costs	-1	-2

		Environmental Impact (1)	Neutral	No impact on the environment	0	0
		Impact on EU Industry competitiveness (1)	Very Positive	Promotes increased interoperability and higher quality of services provided	2	1
		Social Acceptance (1)	Positive	Following the increased competitiveness, this will have an impact to the services provided to the end user	1	1
ADDITIONAL NOTES						
Total Weighted Score						**5**

6.5 DO 260 B (ETSOC166b) Minimum Operational Performance Standards for 1090 MHZ Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information

Standard title	**SDO & WG**	**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
DO 260 B (ETSOC166b) *Minimum Operational Performance Standards for 1090 MHZ Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information*	RTCA SC-186	Maturity (2)	Recognised/ Accepted/ Used	Has been approved and published by the RTCA on 2009	2	4
		Type of standards (1)	Best Practice	Specifies desired system characteristics that should prove useful to designers, manufacturers, installers and users of airborne equipment and reflected by thorough technical and scientific procedures	1	1

		Effectiveness to fulfil SORA requirement (3)	Partial Coverage	It partially covers the technical OSO#2, 4, 5 and 23	0	0
		Cost of compliance (2)	High	Minimum operational performance standards are expected to impose additional manufacturing costs	-1	-2
		Environmental Impact (1)	Neutral	No impact on the environment	0	0
		Impact on EU Industry competitiveness (1)	Very Positive	Promotes increased interoperability and higher quality of services provided	2	1
		Social Acceptance (1)	Positive	Following the increased competitiveness, this will have an impact to the services provided to the end user	1	1
ADDITIONAL NOTES						
Total Weighted Score						**5**

6.6 DO-254 Design Assurance Guidance for Airborne Electronic Hardware

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-254 Design Assurance Guidance for Airborne Electronic Hardware	RTCA	Maturity (2)	Recognised	DO-254 is a recognized standard which is widely used as means of compliance for airborne electronic hardware of the certified category.	2	4
		Type of standards (1)	Standard specification	DO-254 is a standard specification document and defines the means of compliance to substantiate item integrity level.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	DO-254 is used in the certified category and therefore fully covers SORA requirements.	2	6
		Cost of compliance (2)	High	The cost of compliance is dependent on the selected design assurance level (DAL) of the corresponding hardware items. However the overall cost is to be estimated high.	-1	-2
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	Impact on EU Industry is expected to be neutral. The requirements of this standard might be too strict for UAS of	0	0

				the specific category which could lead to a reduction in competiveness due to increasing development cost.		
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES			This standard specification document for the development of airborne electronic hardware fully covers SORA requirements. The requirements could be too strict for UAS of the category specific which could lead to a reduction in competiveness due to increasing development cost.			
Total Weighted Score						10

6.7 DO-248C Supporting Information

Standard title	**SDO & WG**	**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
DO-248C Supporting Information	RTCA	Maturity (2)	Recognized	This document is to be seen as additional information to DO-178 and DO-278A. Therefore the corresponding maturity level of those documents is assigned.	2	4
		Type of standards (1)	Standard Specification	This supporting document includes FAQs and rationale concerning the named standards. It supports standard specification documents and therefore the standards specification score is assigned.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial coverage	Since this document only contains supporting information the effectiveness to fulfil SORA	0	0

				requirement as a standalone document is to be judged as partial.		
		Cost of compliance (2)	Medium	So a medium score is assigned to avoid affecting the overall score	0	0
		Environmental Impact (1)	Neutral	No environmental impact.	0	0
		Impact on EU Industry competitiveness (1)	Neutral	No impact on EU Industry competitiveness.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance.	0	0
ADDITIONAL NOTES			This document might be used in combination with DO-178 and DO-278A but is not applicable as means as a standalone standard document.			
Total Weighted Score						6

6.8 DO-331 Model Based Development & Verification Supplement

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-331 Model Based Development & Verification Supplement	RTCA	Maturity (2)	Recognised	DO-331 is a recognized standard which is widely used as means of compliance for software development of the certified category.	2	4
		Type of standards (1)	Standard specification	DO-331 is a standard specification document and it is a supplement to DO-178C	2	2

				and cannot be used without it.		
		Effectiveness to fulfil SORA requirement (3)	Partial	DO-331 is used in the certified category and therefore fully covers SORA requirements. However, it is assessed to partly cover OSO-4 (developed recognized standards)	0	0
		Cost of compliance (2)	Very High	The cost of compliance is dependent on the selected software level. However the overall cost for full compliance at the highest criticality is to be estimated very high.	-2	-4
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	Impact on EU Industry is expected to be neutral. The requirements of this standard might be too strict for UAS of the specific category which could lead to a reduction in competiveness due to increasing development cost.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						2

6.9 DO-332 Object Oriented Technology and Related Techniques Supplement

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-332 Object Oriented Technology and Related Techniques Supplement	RTCA	Maturity (2)	Recognised	DO-332 is a recognized standard which is widely used as means of compliance for software development of the certified category.	2	4
		Type of standards (1)	Standard specification	DO-332 is a standard specification document and it is a supplement to DO-178C and cannot be used without it.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	DO-332 is used in the certified category and therefore fully covers SORA requirements. However, it is assessed to partly cover OSO-4 (developed recognized standards)	0	0
		Cost of compliance (2)	Very High	The cost of compliance is dependent on the selected software level. However the overall cost for full compliance at the highest criticality is to be estimated very high.	-2	-4
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	Impact on EU Industry is expected to be neutral. The requirements of this standard might be too strict for UAS of the specific category which could lead to a reduction in competiveness due to increasing development cost.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						2

6.10 DO-333 Formal Methods Supplement

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-333 Formal Methods Supplement	RTCA	Maturity (2)	Recognised	DO-333 is a recognized standard which is widely used as means of compliance for software development of the certified category.	2	4
		Type of standards (1)	Standard specification	DO-333 is a standard specification document and it is a supplement to DO-178C and cannot be used without it.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	DO-333 is used in the certified category and therefore fully covers SORA requirements. However, it is assessed to partly cover OSO-4 (developed recognized standards)	0	0
		Cost of compliance (2)	Very High	The cost of compliance is dependent on the selected software level. However the overall cost for full compliance at the highest criticality is to be estimated very high.	-2	-4
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	Impact on EU Industry is expected to be neutral. The requirements of this standard might be too strict for UAS of the specific category which could lead to a reduction in competiveness due to increasing development cost.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						2

6.11 DO-304 Guidance Material and Considerations for Unmanned Aircraft Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-304 Guidance Material and Considerations for Unmanned Aircraft Systems	RTCA	Maturity (2)	Published	DO-304 is published, but not overly popular	**1**	**2**
		Type of standards (1)	Information Guidance	DO-304 is guidance material and gives high-level recommendations only.	**0**	**0**
		Effectiveness to fulfil SORA requirement (3)		Note: Too many assessments are missing at the moment to determine an effectiveness		
		Cost of compliance (2)	Very Low	Since it does not make demands, there is nothing to comply.	**2**	**4**
		Environmental Impact (1)	Neutral	No environmental impact	**0**	**0**
		Impact on EU Industry competitiveness (1)	Neutral	Does not contain requirements/demands to be met.	**0**	**0**
		Social Acceptance (1)	No impact	No impact on social acceptance	**0**	**0**
ADDITIONAL NOTES						
Total Weighted Score						**6**

6.12 DO-320 Operational Services and Environmental Definition (OSED) for Unmanned Aircraft Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-320 Operational Services and Environmental Definition (OSED) for Unmanned Aircraft Systems	RTCA	Maturity (2)	Published	DO-320 is published, but not overly popular	**1**	**2**
		Type of standards (1)	Best practice / recommendation	DO-320 is a OSED and provides high-level recommendations	**1**	**1**
		Effectiveness to fulfil SORA requirement	PArtial	Note: For most OSOs this document is assessed as not or only partially applicable.	**0**	**0**
		Cost of compliance (2)	Very Low	Since it does not make demands, there is nothing to comply.	**2**	**4**
		Environmental Impact (1)	Neutral	No environmental impact	**0**	**0**
		Impact on EU Industry competitiveness (1)	Neutral	Does not contain requirements/demands to be met.	**0**	**0**
		Social Acceptance (1)	No impact	No impact on social acceptance	**0**	**0**
ADDITIONAL NOTES						
Total Weighted Score						**7**

6.13 DO-330 Software Tool Qualification Considerations

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-330 Software Tool Qualification Considerations	RTCA	Maturity (2)	Recognised	DO-330 is a recognized standard which is widely used as means of compliance for software tool qualification of the certified category.	2	4
		Type of standards (1)	Standard specification	DO-330 is a standard specification document and defines the means of compliance to substantiate tool qualification	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	DO-330 is used in the certified category and therefore fully covers SORA requirements. However, it is assessed to partly cover OSO-4 (developed recognized standards)	0	0
		Cost of compliance (2)	Very High	The cost of compliance is dependent on the selected tool qualification level of the corresponding software tool. However, for full compliance in the highest criticality the overall cost is to be estimated very high.	-2	-4
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Neutral	Impact on EU Industry is expected to be neutral. The requirements of this standard might be too strict for UAS of the specific category which could lead to a reduction in competiveness due to increasing development cost.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						2

6.14 DO-160G Environmental Conditions and Test Procedures for Airborne Equipment

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-160G Environmental Conditions and Test Procedures for Airborne Equipment	RTCA	Maturity (2)	Recognized	The std. is recognized by civil authorities. (FAA AC 21-16G)	2	4
		Type of standards (1)	Standard Specification	Contains reqs. for certification	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	Fully covers OSO #24	2	6
		Cost of compliance (2)	Very High	The std. contains many reqs. some require ground tests that might be relatively expensive	-2	-4
		Environmental Impact (1)	Neutral	The std. does not deal with environmental impact.	0	0
		Impact on EU Industry competitiveness (1)	Very Positive	Compliance with this std. will help to create products of higher quality. It is assumed that the EU industry is ready to adopt the std.	2	2
		Social Acceptance (1)	Positive	will create more jobs due to the effort required to comply with the std	1	1
ADDITIONAL NOTES			The std. contains many reqs. that are relevant for LRUs that are installed in UAVs designated to show compliance with OSO#24 with high robustness (high SAIL operations)			
Total Weighted Score						11

6.15 DO-289 Minimum Aviation System Performance Standards for Aircraft Surveillance Applications

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
DO-289 Minimum Aviation System Performance Standards for Aircraft Surveillance Applications	RTCA	Maturity (2)	Recognized	The std. is recognized by civil authorities. FAA AC 120-86 \ AC25-11A	2	4
		Type of standards (1)	Standard Specification	Contains reqs. for certification	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	Fully covers OSO #4	2	6
		Cost of compliance (2)	Very High	The std. contains many requirements to be compliant	-2	-4
		Environmental Impact (1)	Good	This std. will improve airborne conflict management. Minimizing flight times and using optimum descent profiles will reduce the environmental load due to both exhaust emission and noise	1	1
		Impact on EU Industry competitiveness (1)	Very Positive	Compliance with this std. will help to create products of higher quality. It is assumed that the EU industry is ready to adopt the std.	2	2
		Social Acceptance (1)	Positive	This std. can support the increase of airspace uses and thus the creation of new jobs and the economy	1	1

ADDITIONAL NOTES	This std. is very extensive and contains many reqs. as it is very suitable for large certified system it might be too demanding for showing compliance with low robustness.
Total Weighted Score	12

6.16 Minimum Operational Performance Standards (MOPS) for Air-to-Air Radar for Traffic Surveillance

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Standards (MOPS) for Air-to-Air Radar for Traffic Surveillance	RTCA Paper No. 170-16/SC228-034)	Maturity (2)	Recognized / Accepted / Used	The document was prepared and published by RTCA Inc Special Committee (SC)-228 on the 9th of November 2016 and also adopted as TSO.	2	4
		Type of standards (1)	Standard Specification	The document contains Phase 1 Minimum Operational Performance Standards (MOPS) for the air-to-air radar for traffic surveillance. The intended application is supporting DAA operations for aircraft transitioning to and from Class A or special use airspace, traversing Class D, E, and G airspace in the National Airspace System (NAS)	2	2
		Effectiveness to fulfil SORA requirement	Partial	SORA TMPR: The document covers the Detect functionality but there are some limitations in terms of airspace	0	0

				applicability (i.e. VLL not covered).		
		Cost of compliance (2)	High	Costs cannot be directly measured through the MOPS, but might be considered high for small UA industries due to the development of the function in conformance to the specified standard and airworthiness, security, design assurance requirements in addition to the costs for the required testing activities such as environmental tests, bench tests, tests for the installed equipment (With the aircraft on the ground and using simulated or operational system inputs, With the aircraft in flight using operational system inputs appropriate to the equipment under test) and operational tests as the function is expected to be operated by traffic in Class A airspace also. Costs to be compliant to other required standards such as RTCA DO-160G or Technical Standard Order (TSO) 145/146 also affect the overall assessment of the costs.	-2	-4
		Environmental Impact (1)	Good	The impact on environment cannot be directly measured by the MOPS, but considering it supports the detect and avoid function that is a pillar in SJU European Drones Outlook Study it might have a positive impact on environment, even if the	2	2

				equipment generates radiated power		
		Impact on EU Industry competitiveness (1)	Negative	The standard is clearly excluding small Unmanned Aircraft Systems and is directly applied to aircraft transitioning to and from Class A or special use airspace out of the core business of EU small unmanned aircraft Industries. In addition it is mainly focused on US companies and regulation compliance, being a RTCA MOPS	-1	-1
		Social Acceptance (1)	Positive	The Minimum Operational Performance Standards (MOPS)for Air-to-Air Radar for Traffic Surveillance might have a positive impact on Social acceptance as it is aimed at supporting Detect and Avoid System to reduce the likelihood of accidents that can be seen as a positive goal in public opinion, supporting safe operations, and is a pillar in SJU European Drones Outlook Study.	1	1
ADDITIONAL NOTES						
Total Weighted Score						4

6.17 Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Terrestrial)

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Command and Control (C2) Data Link Minimum Operational Performance Standards (MOPS) (Terrestrial)	RTCA Paper No. 263-15/PMC-1402	Maturity (2)	Published	The first draft document was issued in May 2016 as draft and there is no new release of the document	1	2
		Type of standards (1)	Standard Specification	The document specifies Minimum Operational Performance Standards for the Unmanned Aircraft Systems (UAS) Control and Non-Payload Communication (CNPC) Link System used to support the Command and Control (C2) function of a UAS	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	OSO #6: The standard provides a description of the scope of the UAS Terrestrial (not satellite) CNPC Link System MOPS	2	6
		Cost of compliance (2)	Very high	Different aspects impacts the cost of compliance that might be very high: -The required testing activities such as environmental tests, bench tests, tests for the installed equipment, Interference Effects tests, Flight tests in several conditions, operational tests, Power Fluctuation tests; -The MOPS would support the development of a TSO for a CNPC Link System equipment manufacturer and a Type Certification (TC)	-2	-4

				for a UAS manufacturer; - The development of the function in conformance to the specified standard and airworthiness, security, design assurance requirements; -The MOPS document addresses only the CNPC Link System, which is part of a larger system that seeks to exchange control information between a UA and its Pilot Station meaning that other systems and standards are required; as examples a FRMS is required or also a UAS equipped with a CNPC Link System must be compliant with other requirements not specified directly in the MOPS in order to safely operate within the NAS. These include a requirement that the UA airworthiness is not compromised by the installation of the CNPC Link System, that the UAS complies with applicable rules set up to govern the use of the frequency spectrum, and that any and all controls needed for operation of the CNPC Link System not reduce the reliability of the equipment on-board the aircraft or in the Pilot Station -The general operational concept is envisaged in 2 steps (and thus impacting the time of the compliance to the standard) to be addressed a Phase 1 MOPS development (terrestrial) and a potential Phase 2 MOPS development		

				(satellite) -There are concerns raised that the assumed level of permitted L-Band output power may cause operationally unacceptable interference with some existing aircraft systems		
		Environmental Impact (1)	Neutral	The primary intended function of CNPC Link Systems addressed in the MOPS is to provide CNPC Link capabilities supporting the UAS information exchanges that allow the pilot to safely control, monitor, and manage the UA: -The CNPC Link System will need to provide all data exchanges to allow the pilot and UAS systems to detect and avoid other aircraft, terrain, and obstacles. This function includes allowing both collision avoidance and self-separation operations. This can reduce the risk of accidents with a consequent positive impact on environment, but on the other hand it impacts the frequency bands already allocated to other systems, with consequent negative impact on environment and possible interferences if applied to specific drone operations. This has led to a neutral score for environmental impact	0	0
		Impact on EU Industry competitiveness (1)	Negative	The standard is mainly focused on US companies and FAA regulation compliance, being a RTCA MOPS, and might be out of the core business of EU small unmanned aircraft	-1	-1

				Industry with a consequent negative impact on EU Industry competitiveness. In addition it requires other technologies mainly owned by very large aircraft companies		
		Social Acceptance (1)	Positive	The primary intended function of CNPC Link Systems addressed in the MOPS is to provide CNPC Link capabilities supporting the UAS information exchanges that allow the pilot to safely control, monitor, and manage the UA. This might lead to social acceptance and positive opinion of the standard	1	1
ADDITIONAL NOTES						
Total Weighted Score						6

6.18 Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems	RTCA SC-228	Maturity (2)	Recognized / Accepted / Used	The document has been published and also adopted as TSO	2	4
		Type of standards (1)	Standard Specification	The document contains Phase I Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) systems used in Unmanned Aircraft Systems (UAS) transitioning	2	2

				to and from Class A or special use airspace (above 500'AGL), traversing Class D, E, and G airspace in the National Airspace System (NAS). It does not apply to small UAS operating in low level environments (below 500') or other segmented areas. Likewise, it does not apply to operations in the Visual Flight Rules (VFR) traffic pattern of an airport. The standards specify DAA system characteristics that should be useful for designers, manufacturers, installers and users of the equipment. Phase I MOPS is focused on Unmanned Aircraft (UA), which require approval to fly in airspace normally frequented by commercial transport aircraft and general aviation aircraft. The UAS will need to carry relatively large and high-power sensor systems, which may be an average weight of 200 pounds. Therefore, it is unlikely to be applicable to smaller size UA systems, but such aircraft are not prohibited from carrying this equipment if possible. Future revisions of the document are expected to address other operational scenarios and sensors more applicable to smaller aircraft, as well as other DAA architectures, including ground-based sensors.		
		Effectiveness to fulfil SORA requirement (3)	Partial	All the functionalities are covered. However, gaps have been identified in terms of minimum drone size and airspace applicability	0	0

		Cost of compliance (2)	Very High	The standard is clearly excluding small UA due to the weight of the equipment, in addition other standards and systems are required to operate the function that requires interoperability in Class A and that might have very high costs unaffordable for small UA operating below 500' in the specific category. Finally costs might be very high due to the development of the function in conformance to the specified standard and airworthiness, security, design assurance requirements and the required testing activities such as environmental tests, bench tests, tests for the installed equipment	-2	-4
		Environmental Impact (1)	Good	Detect and Avoid function is fundamental to reduce the probability of accidents and thus has a positive impact on environment. Also it is indicated as a pillar in the SJU European Drones Outlook Study	1	1
		Impact on EU Industry competitiveness (1)	Negative	The standard is mainly focused on US companies and FAA regulation compliance, being a RTCA TSO, and might be out of the core business of EU small unmanned aircraft Industry with a consequent negative impact on EU Industry competitiveness	-1	-1
		Social Acceptance (1)	Positive	Detect and Avoid function is fundamental to reduce the probability of accidents and thus can be easily accepted and supported by public opinion. In addition it is indicated as a pillar in the SJU European Drones Outlook Study	1	1

ADDITIONAL NOTES	
Total Weighted Score	3

6.19 Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment

Standard title		Criteria (Weight)	Result	Rationale	Score	Weighted Score
Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment	RTCA	Maturity (2)	Published	The document has been approved and published	1	2
		Type of standards (1)	Standard Specification	The document contains minimum operational performance standards (MOPS) for airborne navigation equipment using GPS augmented by Satellite Based Augmentation Systems	1	1
		Effectiveness to fulfil SORA requirement	No coverage	The document contains minimum operational performance standards (MOPS) for airborne navigation equipment using GPS augmented by Satellite Based Augmentation Systems (WAAS in the US but also applicable for EGNOS and other SBAS). Although equipment performance metrics are basically the same, performance requirements (and test methods) are not applicable for UAS given the different flight		

				dynamics (i.e. ground speed, accelerations), especially for small drones operating in the Specific Category (low altitudes, low dynamics etc.).		
		Cost of compliance (2)	Low	It is expected a low cost of compliance for airborne navigation equipment using GPS augmented by Satellite Based Augmentation Systems as no new technology is needed to be developed and no other specific costs in addition to the testing costs are envisaged	1	2
		Environmental Impact (1)	Neutral	No impact on environment is expected from the standard compliance	0	0
		Impact on EU Industry competitiveness (1)	Negative	The standard is mainly focused on US companies and FAA regulation compliance, being a RTCA MOPS, and might be out of the core business of EU small unmanned aircraft Industry with a consequent negative impact on EU Industry competitiveness	-1	-1
		Social Acceptance (1)	No impact	No impact on social acceptance is expected from the standard compliance	0	0
ADDITIONAL NOTES						
Total Weighted Score						4

7 OTHER

7.1 Resolución de 8 de marzo de 2019, de la Dirección de la Agencia Estatal de Seguridad Aérea, por la que se publican los medios aceptables de cumplimiento y material guía, aprobados para las operaciones con aeronaves pilotadas por control remoto, en virtud del Real Decreto 1036/2017, de 15 de diciembre.

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Resolución de 8 de marzo de 2019, de la Dirección de la Agencia Estatal de Seguridad Aérea, por la que se publican los medios aceptables de cumplimiento y	AESA	Maturity (2)	Recognised/Accepted	The document is published and recognised by AESA (the CAA of Spain).	2	4
		Type of standards (1)	Information Guidance	The document is an AMC containing guidelines to comply with the objectives.	0	0
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially fulfils requirements for OSO #13 (navigation).	0	0
		Cost of compliance (2)	Medium	This criterion is not applicable as the document is a guidance and does not provide specific technical requirements. A medium score is assigned to avoid affecting the overall score.	0	0

material guía, aprobados para las operaciones con aeronaves pilotadas por control remoto, en virtud del Real Decreto 1036/2017, de 15 de diciembre.		Environmental Impact (1)	Neutral	The adoption of this AMC has both positive and negative effects on the environment. In fact, the use of EGNOS may bring benefits in terms of navigation accuracy and design of more efficient drone routes (which lead to less power consumption and emissions). However, one the prescribed requirements include the use of aural alerts which may produce noise. For the moment it is conservatively assumed a neutral impact on environment.	0	0
		Impact on EU Industry competitiveness (1)	Very positive	The 2019 GNSS market report *2019, GSA GNSS Market Report, Issue 6* shows that the GNSS is the key to unlock the drone market. GNSS positioning information will enable safe and harmonious drone market growth. The number of GNSS devices shipped on these drones has greatly increased in recent years, especially starting in 2015 when prices had decreased sufficiently for consumer drones to become more widely available. The shipments of GNSS devices by drone category have reached the 11 million units in 2018 and are expected to grow more. In addition, GNSS is one of the main enablers for BVLOS missions and several European companies have been developing drones with beyond visual line of sight capabilities (e.g. Airbus, Delair-Tech etc.)	2	2

				In general, it is estimated that the global GNSS downstream market revenues from both devices and services are forecast to grow from €150 billion in 2019 to €325 billion in 2029. This growth is mainly due to revenues from mass market and mid-end devices (<€150) and from augmentation services.		
		Social Acceptance (1)	Positive	As GNSS is an important element to manage and increase efficiency of drone traffic, reduce emissions and power consumptions. This aspect is socially relevant. However, enabling a large number of drone missions in populated areas at VLL may be negatively see by part of the public opinion as these intrinsically represent a significant element of risk.	1	1
ADDITIONAL NOTES						
Total Weighted Score						7

7.2 IATA Emergency Response Plan

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
IATA Emergency Response Plan	IATA	Maturity (2)	Published	The document is published but no evidence of its application/effectiveness is available.	1	2
		Type of standards (1)	Best practice	The document provides best practices for the preparation of an ERP for air carriers operators.	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The document is partially compliant with mitigation for ground risk M3 (Emergency Response Plan).	0	0
		Cost of compliance (2)	Low	The cost of compliance is relatively low, as the standard defines operational procedures to cope with emergency conditions (i.e. the definition of roles and responsibilities of emergency response team, the adoption of checklists, risk management processes etc.). The document is tailored for manned operators and is not directly applicable to UAS. However, the same principles could be applicable to UAS although on a lower scale (i.e. reduced costs). Additional costs may derive from the necessity to train personnel to emergency conditions and risk management.	1	2
		Environmental Impact (1)	Good	Some emergency conditions may deal with environmental risks (such as fire, release of hazardous materials etc.) The emergency response plan should limit the escalation effect, thus mitigating the environmental risks.	2	2
		Impact on EU Industry competitiveness (1)	No impact		0	0

		Social Acceptance (1)	Very Positive	The presence of standardised emergency procedures can be positively judged by public opinion.	2	2
ADDITIONAL NOTES						
Total Weighted Score						9

7.3 Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations

Standard title	**SDO & WG**	**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations	SAE G30	Maturity (2)	Published	The document has been published by ASTM.	1	2
		Type of standards (1)	Standard specification		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO #9,15,22.	0	0
		Cost of compliance (2)	High	The training structure recalls the manned aviation model. In addition, the standard only covers the theoretical aspects, leading to the necessity to adopt other standards for practical skill tests, thus increasing the cost.	-1	-2
		Environmental Impact (1)	Neutral	No impact on environment has been identified	0	0
		Impact on EU	Positive	Training organisation may have benefits in	1	1

		Industry competitiveness (1)		delivering new training courses to cover the standard subjects.		
		Social Acceptance (1)	Very Positive	As the training requirements are inspired by manned aviation model, the adoption of this standard (that only covers the theoretical aspects) may be seen in a very positive way by public opinion.	2	2
ADDITIONAL NOTES						
Total Weighted Score						5

7.4 MIL-STD-1796A - Avionics Integrity Program

Standard title	**SDO & WG**	**Criteria (Weight)**	**Result**	**Rationale**	**Score**	**Weighted Score**
MIL-STD-1796A - **Avionics Integrity Program** (No. N/A)	US DOD	Maturity (2)	Accepted	The standard was in late 1980's replaced by a prescriptive handbook but reinstated 13 October 2011 which must imply that there is need for it and it is thus accepted. Is has also been used to built build robust avionics in the past.	2	2
		Type of standards (1)	Information guidance	The standard provides a program for how to ensure integrity performance requirements. It addresses environment tolerances, reliability and a process of how to determine and adhere to these. It does not focus on specification requirements.	0	0
		Effectiveness to fulfil	High	The standard addresses environment tolerances and	0	0

		SORA requirement		reliability so it could be relevant for OSO #4, #5, #10, and #24. Although, it should be noted that the standard might be combined with other standards not as high-level to provide a better AMC.		
		Cost of compliance (2)	High	The program requires all the requirements to be adhered to which is estimated to be costly.	-1	-2
		Environmental Impact (1)	Neutral	The standard does not seem to have a direct environmental impact.	0	0
		Impact on EU Industry competitiveness (1)	Positive	Companies using this program are assumed to obtain better safety.	1	1
		Social Acceptance (1)	Positive	A big part of social acceptance is safety and this standard shows a program for ensuring safe design of avionics.	1	1
ADDITIONAL NOTES			Might also be relevant for OSO #2 and #23			
Total Weighted Score						2

7.5 MIL-STD-882E - Department of Defense Standard Practice System Safety

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Department of Defense Standard Practice System Safety	US DOD - MIL-STD-882E	Maturity (2)	Published	The document is published and approved for use by all Military Departments and Defense Agencies within the Department of Defense (DoD) of USA.	2	4
		Type of standards (1)	System Safety		2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO 2,3,7 and other OSOs dealing with system safety. The lack of a system safety requirements is identified as the main gap.	0	0
		Cost of compliance (2)	Medium	The cost for the preparation of system safety standard practice compliant with this standard is considered low.	0	0
		Environmental Impact (1)	Good	The fact that the standard is addressed to not only system safety professionals, but also to other functional disciplines such as fire protection engineers, occupational health professionals, and environmental engineers to identify hazards and mitigate risks through the SE process provides good environmental impact.	2	2
		Impact on EU Industry	Positive	This standard provides requirements for identifying hazards and assessing and mitigating associated risks	1	1

		competitiveness (1)		encountered in the development, test, production, use and disposal of defense systems will improve the industry competitiveness if apply correctly.		
		Social Acceptance (1)	Very Positive	The adoption of a standard that protects personnel from accidental death, injury, or occupational illness and safeguarding defense systems, infrastructure, and property from accidental destruction, or damage while executing its mission requirements is of high social acceptance	2	2
ADDITIONAL NOTES			The standard refers to defense systems but in principle it can be easily adopted to civil systems. It is well written and comprehensive.			
Total Weighted Score						11

7.6 PrEN 16803-1/2 - Space - Use of GNSS-based positioning for road Intelligent Transport Systems - Part1 & Part2

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
PrEN 16803-1/2 Space - Use of GNSS-based positioning for road Intelligent Transport Systems- Part1 & Part2	CEN	Maturity (2)	Internal Consultation		-1	-2
		Type of standards (1)	Standard specification	The document is a standard specification defining requirements for GNSS, although it is does not contain MOPS.	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially fulfils OSO #13 (navigation part).	0	0
		Cost of compliance (2)	High	The standard prescribes to perform a large number of tests and post-processing activities to ensure that GNSS performance are met in different conditions.	-1	-2
		Environmental Impact (1)	Good	GNSS might improve efficiency and reduce emissions	2	2
		Impact on EU Industry competitiveness (1)	Very Positive	GSA studies show that adoption of GNSS on drones is recognised to foster the market growth.	2	2
		Social Acceptance (1)	Positive	As GNSS is an important element to manage and increase efficiency of drone traffic, reduce emissions and power consumptions. This aspect is socially relevant.	1	1
ADDITIONAL NOTES						
Total Weighted Score						3

7.7 Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
NFPA 2400 - Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations	NFPA 2400	Maturity (2)	Recognised / accepted / used	Used for fire protection operations in VLOS	2	1*2=2
		Type of standards (1)	Standard Specification	Standard for fire protection operations	2	1*2=2
		Effectiveness to fulfil SORA requirement	Partial coverage	OSO#07 - Inspection of the UAS (product inspection) to ensure consistency to the ConOps Guidance in chapter 4 OSO#08 - Operational procedures are defined, validated and adhered to Basic guidance in chapter 5 and annex A OSO#11 - Procedures are in-place to handle the deterioration of external systems supporting UAS operation N/A OSO#14 - Operational procedures are defined, validated and adhered to Basic guidance in chapter 5 and annex A OSO#21 - Operational procedures are defined, validated and adhered to Basic guidance in chapter 5 and annex A OSO#09 - Remote crew trained and current and able to control the abnormal	0	3*0=0

				and emergency situations (i.e. Technical issue with the UAS) Guidance in chapter 5 OSO#15 - Remote crew trained and current and able to control the abnormal and emergency situations (i.e. Human Error) Not really covered OSO#22 - The remote crew is trained to identify critical environmental conditions and to avoid them Guidance in chapter 5 Guidance limited to a very limited kind of operations: VLOS over controlled ground area		
		Cost of compliance (2)	Low	The cost of compliance is contained. But, it has to be kept in mind that its purpose is to fit to firefighting operations: VLOS over controlled ground area That is a narrow subset of the whole specific category	1	2
		Environmental Impact (1)	Good	The standard has a positive impact on environment since it is a standard for fire protection operations	2	2
		Impact on EU Industry	Low	It has to be kept in mind that its purpose is to fit to firefighting operations: VLOS	-1	-1

		competitiveness (1)		over controlled ground area That is a narrow subset of the whole specific category		
		Social Acceptance (1)	Neutral	This document only focuses on safety : its compliance does not have direct effect on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						9

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

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
UAS / RPAS AIRWORTHINESS CERTIFICATION “1309” System Safety Objectives and Assessment Criteria		Maturity (2)	Recognised / accepted / used	General guidelines for adaptation of manned aviation regulation 1309 section to unmanned aviation	2	2
		Type of standards (1)	Information guidance	See above : this document complements sections 1309 from manned aviation regulation	0	0
		Effectiveness to fulfil SORA requirement	Partial coverage	OSO#05 - UAS is designed considering system safety and reliability Some guidance material, but not	0	0

				complete as this document refers to 1309 sections from manned aviation OSO#10 - Safe recovery from technical issue Some guidance material, but not complete as this document refers to 1309 sections from manned aviation "SORA Step #9" - Containment - Containment requirements for adjacent airspace and area considered Some guidance material, but not complete as this document refers to 1309 sections from manned aviation		
		Cost of compliance (2)	Very High	Some points not easy to comply with: For example, indirect reference do DAL table DAL B for CAT failures conditions DAL C for HAZ failures conditions	-2	-4
		Environmental Impact (1)	Neutral	This document only focuses on safety: its compliance does not have environmental impact	0	0

		Impact on EU Industry competitiveness (1)	Very negative	Very negative if all of this document is considered for lower SAILs : DAL requirements as example	-2	-2
		Social Acceptance (1)	Neutral	This document only focuses on safety : its compliance does not have direct effect on social acceptance		1
ADDITIONAL NOTES						
Total Weighted Score						-4

7.9 OPERATIONAL SERVICES AND ENVIRONMENT DEFINITIONS (OSED) FOR REMOTELY PILOTED AIRCRAFT SYSTEMS (RPAS) AUTOMATION AND EMERGENCY RECOVERY (A&ER) FUNCTIONS

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
OPERATIONAL SERVICES AND ENVIRONMENT DEFINITIONS (OSED) FOR REMOTELY PILOTED AIRCRAFT SYSTEMS (RPAS) AUTOMATION AND EMERGENCY RECOVERY (A&ER) FUNCTIONS		Maturity (2)	External consultation	Best practices for automation and emergency recovery functions in IFR flight	0	0
		Type of standards (1)	Best practice	See above	1	1
		Effectiveness to fulfil SORA requirement	Partial coverage	OSO#04 - UAS developed to authority recognized design standards	0	0

				This document covers some of UAS functions. It does not cover plenty of aspects as structural aspects, handling qualities, systems development … OSO#08 - Operational procedures are defined, validated and adhered to (to address technical issues with the UAS) Only a part of normal and abnormal procedures are covered OSO#11 - Procedures are in-place to handle the deterioration of external systems supporting UAS operation Only a part of abnormal procedures are covered OSO#14 - Operational procedures are defined, validated and adhered to (to address human errors) Only a part of normal and abnormal procedures are covered OSO#21 - Operational procedures are defined, validated and adhered to (to address Adverse Operating Conditions) N/A OSO#10 - Safe recovery from		

				technical issue N/A - Architecture aspects not covered OSO#12 - The UAS is designed to manage the deterioration of external systems supporting UAS operation OSO#19 - Safe recovery from Human Error "SORA Step #9" - Containment - Containment requirements for adjacent airspace and area considered		
		Cost of compliance (2)	Medium	Compliance considered as neutral regarding the scope of operation (IFR ops)	0	0
		Environmental Impact (1)	Neutral	This document only focuses on safety : its compliance does not have environmental impact	0	0
		Impact on EU Industry competitiveness (1)	No impact	No Impact is the use of this document is narrowed to IFR ops	0	0
		Social Acceptance (1)	Neutral	This document only focuses on safety : its compliance does not have direct effect on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						1

7.10 ED 194 (ETSO C195b) - MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR AIRCRAFT SURVEILLANCE APPLICATIONS (ASA) SYSTEM

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
ED 194 (ETSO C195b) - MINIMUM OPERATIONAL PERFORMANCE STANDARDS (MOPS) FOR AIRCRAFT SURVEILLANCE APPLICATIONS (ASA) SYSTEM		Maturity (2)	published		1	1
		Type of standards (1)	Standard Specification	Standard for surveillance application for manned aircraft	2	2
		Effectiveness to fulfil SORA requirement	Partial coverage	Tactical Mitigations Performance Requirements (TMPR): efficient for flights in controlled airspace Reduced efficiency outside as other airspace users may not be equipped TMPR – low and med not taken into account	0	0
		Cost of compliance (2)	Very High	Standard from manned certified A/C Can be used for TMPR-high robustness flights in controlled airspace. For other cases, it appears to be useless	-2	-4
		Environmental Impact (1)	Neutral	This document only focuses on safety: its compliance does not	0	0

				have environmental impact		
		Impact on EU Industry competitiveness (1)	Neutral	Neutral if uses narrowed to TMPR -high needs in controlled airspace Very High otherwise	0	0
		Social Acceptance (1)	Neutral	This document only focuses on safety: its compliance does not have direct effect on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						7

7.11 Safety Assessment of Remotely Piloted Aircraft Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
AMC RPAS 1309 Safety Assessment of Remotely Piloted Aircraft Systems	AMC RPAS 1309	Maturity (2)	Recognized	This standard specification document was prepared by JARUS a recognized standardization organisation. Therefore this document is classified as recognized.	2	4
		Type of standards (1)	Standard Specification	This document is a standard specification document.	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	This standard is applicable up to RPAS-23 Class III and therefore fully covers the requirements stated by SORA.	2	6

		Cost of compliance (2)	High	The corresponding development activities are referenced to ARP4754. The cost of compliance highly depends on the RPAS Class which might reduce requirements stated in ARP4754. The overall cost of compliance is to be estimated high.	-1	-2
		Environmental Impact (1)	Neutral	No environmental impact and therefore a neutral score is assigned.	0	0
		Impact on EU Industry competitiveness (1)	No impact	No impact on EU Industry competitiveness.	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance.	0	0
ADDITIONAL NOTES			This document can be used as AMC for the safety assessment of RPAS. It references ARP4754 as AMC but reduces the set of requirements based on RPAS Class to an appropriate level.			
Total Weighted Score						10

7.12 OGC 12-000 Model and XML Encoding Standard

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
OGC 12-000 Model and XML Encoding Standard		Maturity (2)	Published	OGC 12-000 is published, but not overly popular	1	2
		Type of standards (1)	Standard Specification	The document provides interoperability standards for sensor and processes and offers test instructions.	2	2
		Effectiveness to fulfil SORA requirement	Partial coverage	This standard refers to the interoperability between sensors/process and machines. Thus it is not totally applicable to OSO #23. It refers to sensor properties that can capture environmental conditions.	0	0
		Cost of compliance (2)	Low	Adapting the interoperability requirements from this standard is expected to be quick and cheap.	1	2
		Environmental Impact (1)	Neutral	No environmental impact	0	0
		Impact on EU Industry competitiveness (1)	No impact	No impact on EU Industry competitiveness	0	0
		Social Acceptance (1)	No impact	No impact on social acceptance	0	0
ADDITIONAL NOTES						
Total Weighted Score						**6**

7.13 UL3030 Standard for Unmanned Aircraft Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
UL3030 **Standard for Unmanned Aircraft Systems**	UL Standards	Maturity (2)	Recognized	The std. is recognized by Transport Canada (CAA)	2	4
		Type of standards (1)	Standard Specification	Contains reqs. for certification	2	2
		Effectiveness to fulfil SORA requirement (3)	Full	Fully covers OSO #24 medium robustness and partially covers OSOs #5, #6, 10, #12	2	6
		Cost of compliance (2)	Very High	Std. contains many requirements	-2	-4
		Environmental Impact (1)	Neutral	The std. does not deal with environmental impact such as noise.	0	0
		Impact on EU Industry competitiveness (1)	Very Positive	Compliance with this std. will help to create products of higher quality. It is assumed that the EU industry is ready to adopt the std.	2	2
		Social Acceptance (1)	No Impact	The society will be indifferent to the application of this std.	0	0
ADDITIONAL NOTES			Assessment was performed based on the std. scope available on UL standards catalog website.			
Total Weighted Score						10

7.14 Regulation- general flight plan for UAS

Official Governement Gazette 3152/ 30 September 2016 - **Regulation- general flight plan for UAS** (No. N/A)	Greek Government	Maturity (2)	Used	It is a published regulation by the Greek Government implying that it is being used for drone flight in Greece.	2	2
		Type of standards (1)	Standard Specification	ACM required by the Greek Government to conduct legal drone operations.	2	2
		Effectiveness to fulfil SORA requirement	N/A	N/A	0	0
		Cost of compliance (2)	High	The required technical infrastructure for pilot and drone registration along with making flight plans is estimated to be high. Also, the requirements for the certified category are costly to comply with.	-1	-2
		Environmental Impact (1)	Neutral	The regulation is not assumed to have a direct environmental impact although it might reduce drone crashes and thus impact the environment positively.	0	0
		Impact on EU Industry competitiveness (1)	Positive	Clear guidelines could accelerate the commercial drone market.	1	1
		Social Acceptance (1)	No impact	A rating of 'no impact' is given because the regulation restricts drone use (especially for recreational pilots) but clear regulation could have a positive impact of the social acceptance of drones.	0	0
ADDITIONAL NOTES						
Total Weighted Score						3

7.15 prEN 4709-001: Product Systems

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
prEN 4709-001: Product Systems	ASD-STAN D5WG8	Maturity (2)	Drafting	The document is in internal drafting process but with assistance and full support and future recognition of EASA and EU Commission	-2	-4
		Type of standards (1)	EU Harmonized Standard	prEN 4709-001 is a harmonized Standard to fulfil product requirements of Commission Delegated Regulation (EU) 2019:945	2	2
		Effectiveness to fulfil SORA requirement (3)	Partial	The standard in the current drafting phase has full coverage on OSO#4, OSO#5 and partially covers OSO#2 and OSO#6	0	0
		Cost of compliance (2)	Low/High	For Discussion: Option a) High: prEN4709-001 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 Option b) Low: prEN4709-001 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 although these product requirements can be seen as commonly agreed minimum level of product safety and quality	0/-1	0/-2
		Environmental Impact (1)	Neutral	No environmental impact has been identified	0	0
		Impact on EU Industry competitiveness (1)	Very positive	The standard will be used for UAS manufacturers to show compliance for the product requirements on the harmonized EU drone regulation and allows and EU wide	2	2

				placement of UAS on the market using well established CE sign and validation methods. This will have a very positive impact on EU competitiveness due to this harmonized approach and same ruleset and minimum level of product quality and product safety.		
		Social Acceptance (1)	Very Positive	The standard supports CE compliance of UAS placed on the EU market with a common high level of quality. To fulfil these requirements UAS manufacturer have to comply which will have a very positive effect on the product quality and the acceptance.	2	2
ADDITIONAL NOTES			prEN4709-001 should be mapped again in Q1 2020 after first official draft to check which OSOs should be linked with and for its effectiveness to fulfil SORA requirements			
Total Weighted Score						

7.16 prEN4709-002 “Remote Identification”

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
	ASD STAN D5 WG8	Maturity (2)	Drafting	The document is in internal drafting process but with assistance and full support and future recognition of EASA and EU Commission and will be complying with ASTM F38 Remote ID standard as requested by EU commission which will be recognized by FAA.	-2	-4
		Type of standards (1)	EU Harmonized Standard	prEN 4709-002 is a harmonized Standard to fulfil product requirements of Commission Delegated Regulation (EU) 2019:945	2	2

prEN4709-002 "Remote Identification"		Effectiveness to fulfil SORA requirement (3)	Full	Due to its nature of an EU harmonized standard it will have full coverage of OSO#4	2	6
		Cost of compliance (2)	Low/High	For Discussion: Option a) High: prEN4709-002 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 Option b) Low: prEN4709-002 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 although these product requirements can be seen as commonly agreed minimum level of product safety and quality	0/-1	0/-2
		Environmental Impact (1)	Good	Remote ID will enhance UAS operator accountability due to the fact that complying with prEN4709-002 the Operator ID will be automatically broadcasted by the UAS and can be identified by people on the ground. For UAS flying in permitted areas like environmental protection zones with more accountability it can be expected that less operators will fly in these areas with a positive impact on the environment.	1	1
		Impact on EU Industry competitiveness (1)	Very positive	The standard will be used for UAS manufacturers to show compliance for the product requirements on the harmonized EU drone regulation and allows and EU wide placement of UAS on the market using well established CE sign and validation methods. This will	2	2

				have a very positive impact on EU competitiveness due to this harmonized approach and same rule set and minimum level of product quality and product safety		
		Social Acceptance (1)	Very Positive	Remote ID will enhance UAS operator accountability due to the fact that complying with prEN4709-002 the Operator ID will be automatically broadcasted by the UAS and can be identified by people on the ground. Remote ID is one main element for public and social acceptance of UAS due to the fact that all UAS can be identified by the public and law enforcement activities can be initiated.	2	2
ADDITIONAL NOTES			prEN4709-002 should be mapped again in Q1 2020 after first official draft to check which OSOs should be linked with and for its effectiveness to fulfil SORA requirements			
Total Weighted Score						9

7.17 prEN4709-003: “Geo-Awareness”

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
prEN4709-003: “Geo-Awareness”	ASD-STAN D5WG8	Maturity (2)	Drafting	The document is in internal drafting process but with assistance and full support and future recognition of EASA and EU Commission. In addition, this standard is developed in accordance to MOPS Geo-Fencing from EUROCAE WG105.	-2	-4
		Type of standards (1)	EU Harmonized Standard	prEN 4709-003 is a harmonized Standard to fulfil product requirements of Commission Delegated Regulation (EU) 2019:945	1	1

		Effectiveness to fulfil SORA requirement (3)	Full	Due to its nature of an EU harmonized standard it will have full coverage of OSO#4	2	6
		Cost of compliance (2)	Low/High	For Discussion: Option a) High: prEN4709-003 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 Option b) Low: prEN4709-003 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 although these product requirements can be seen as commonly agreed minimum level of product safety and quality	0/-1	0/-2
		Environmental Impact (1)	Good	Geo-Awareness will allow EU member states to define areas to protect the environment (No-Fly-Zones / limited access) which will then cause to alarm when a UAS enters such a zone. This function will enhance UAS operator awareness to not to fly in such zones. It can be therefore expected that less operators will fly in these areas with a very positive impact on the environment.	2	2
		Impact on EU Industry competitiveness (1)	positive	The standard will be used for UAS manufacturers to show compliance for the product requirements on the harmonized EU drone regulation and allows and EU wide placement of UAS on the market using well established CE sign and validation methods. This will have a very positive impact on EU competitiveness due to this	1	1

				harmonized approach and same ruleset and minimum level of product quality and product safety. .		
		Social Acceptance (1)	Very Positive	Geo-Awareness will allow EU member states to define areas to protect the public interests from unwanted drone flights (No-Fly-Zones / limited access) which will then cause to alarm when a UAS enters such a zone. Therefore, it can be expected that Geo-Awareness will reduce UAS flights in areas where it is not allowed to fly under regulation EU 947:2019 which will have a very positive effect on the social acceptance.	2	2
ADDITIONAL NOTES			prEN4709-003 should be mapped again in Q1 2020 after first official draft to check which OSOs should be linked with and for its effectiveness to fulfil SORA requirements			
Total Weighted Score						8

7.18 prEN4709-004 "UAS Lights"

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
prEN4709-004 **"UAS Lights"**	ASD STAN D5 WG8	Maturity (2)	Drafting	The document is in internal drafting process but with assistance and full support and future recognition of EASA and EU Commission. In addition, this standard is developed in accordance to MOPS Geo-Fencing from EUROCAE WG105.	-2	-4
		Type of standards (1)	EU Harmonized Standard	prEN 4709-004 is a harmonized Standard to fulfil product requirements of Commission Delegated Regulation (EU) 2019:945	2	2

		Effectiveness to fulfil SORA requirement (3)	Full	Due to its nature of an EU harmonized standard it will have full coverage of OSO#4	2	6
		Cost of compliance (2)	Low/High	For Discussion: Option a) High: prEN4709-004 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 Option b) Low: prEN4709-004 consists of several product requirements and tests procedures for UAS manufacturers to verify and comply with the regulation (EU) 2019:945 although these product requirements can be seen as commonly agreed minimum level of product safety and quality	0/-1	0/-2
		Environmental Impact (1)	Neutral	No environmental impact has been identified	0	0
		Impact on EU Industry competitiveness (1)	positive	The standard will be used for UAS manufacturers to show compliance for the product requirements on the harmonized EU drone regulation and allows and EU wide placement of UAS on the market using well established CE sign and validation methods. This will have a very positive impact on EU competitiveness due to this harmonized approach and same ruleset and minimum level of product quality and	1	1

				product safety. .		
		Social Acceptance (1)	Positive	The purpose of the prEN4709-004 is to comply with regulation EU 2019/945 on the requirement to have lights installed for the purpose of conspicuity which allows people on the ground to distinguish a UA from a manned aircraft. This will enhance social acceptance of UAS due to the fact that they can be easily identified at such at night.	1	1
ADDITIONAL NOTES			prEN4709-004 should be mapped again in Q1 2020 after first official draft to check which OSOs should be linked with and for its effectiveness to fulfil SORA requirements			
Total Weighted Score						6

7.19 Interoperable Command and Control Data Link for Unmanned Systems (IC2DL) – Operational Physical Layer / Signal in Space Description

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
Interoperable Command and Control Data Link for Unmanned Systems (IC2DL) – Operational Physical Layer / Signal in	AEP-77	Maturity (2)	Draft	The document is in the Edition A Version 1 Ratification Draft 1.	0	0
		Type of standards (1)	Standard specification	The Interoperable Command and Control Data Link for Unmanned Systems (IC2DL) is considered as a unique standard.	2	2

Space Description		Effectiveness to fulfil SORA requirement (3)	Partial	The standard partially fulfils OSO#5 (C3 link performance is appropriate for the operation) but the purpose is to define a standard Line Of Sight (LOS) Interoperable Command and Control Data Link (IC2DL) for Unmanned Systems that will facilitate and support NATO interoperability between heterogeneous Unmanned Systems (e.g. an Unmanned Aircraft (UA) from one system operated by a ground control system from another UA system (UAS)).	0	0
		Cost of compliance (2)	High	The cost to comply with this standard is high since all the manufacturers need to cooperate and agree	-1	-2
		Environmental Impact (1)	Bad	The environmental impact might be negative due to radiated power	-2	-2
		Impact on EU Industry competitiveness (1)	Good	It may increase the EU industry competitiveness if all EU UAS are able to cooperate and communicate between each other through a common standard. This could have long term value	1	1
		Social Acceptance (1)	Low	The social acceptance cannot be affected by this standard	0	0
ADDITIONAL NOTES						
Total Weighted Score						-1

7.20 Regulation for Training centers and certification of UAS operators

Standard title	SDO & WG	Criteria (Weight)	Result	Rationale	Score	Weighted Score
1Regulation for Training centers and certification of UAS operators.	Official Government Gazette Greek Govenment 4527 /30 December 2016	Maturity (2)	Recognised/Accepted	The document is published in the official gazette of and is recognised by the Greek Government).	2	4
		Type of standards (1)	Standard Specification	The document refers to the minimum standards for the certification of UAS operators and training centres	1	1
		Effectiveness to fulfil SORA requirement (3)	Partial	The document partially covers OSO 9,15,22 and other OSOs dealing with training requirements but the lack of standards for the training centres is identified as a main gap	0	0
		Cost of compliance (2)	High	The cost for the preparation of the training centres to be compliant with this standard is not negligible. The training organisation requirements given in terms of facilities, equipment, personnel etc. is expected to increase the cost of compliance.	-1	-2
		Environmental Impact (1)	Good	The training procedure proposed by the standard for the operators should increase the trainee's sensitivity in terms of safety. On the other hand the fact that the training should comply with specific standards and regulations, including environmental regulations can	2	2

				also contribute to this purpose.		
		Impact on EU Industry competitiveness (1)	Very positive	The fact that all the operators and all the training centres should follow the same procedures increased the EU Industry competitiveness and the quality,	2	2
		Social Acceptance (1)	Very Positive	The adoption of a standard for harmonised training requirements and training centres can be positively seen by public opinion. In addition, the procedures established for training organisations may lead to the necessity to employ additional dedicated personnel (e.g. safety managers).	2	2
ADDITIONAL NOTES						
Total Weighted Score						9