

## Overview of mapping between standards and SORA requirements

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- 1. Methodology for the assessment of the standards
  - Assessment criteria
  - Assessment process
- 2. Verification of standard compliance with SORA requirements
  - Overview of the mapping process
  - Example #1: Operational Safety Objectives #9,15,22
  - Example #2: Mitigation for Ground Risk Class (M3-Emergency Response Plan)
  - Example #3: Tactical Mitigations Performance Requirements (VLOS)
- 3. Conclusions & Next Steps



**EXAMORONES** Methodology for the assessment of the standards

### Standard collection

-	-	U INTIDITION			1	1		IN OF		LIDIE GREE DICTIONARY DECISION OF THE MALE STREET
1	General	and classificatio	x			AS6969		AS-4UCS Unmanned Systems (UxS)	ongoing	set of definitions for quantity types used in data models for unmanned systems. In this data dictionary, a quantity is
2	General	Definition and classificatio		x		ARP6128	Unmanned Systems Terminology Based on the ALFUS Framework	SAE AS-4JAUS Joint Architecture for	published	Infs SAE Aerospace ketominences Practice (ARP) describes terminology specific to unmanned systems (UMSs) and definitions for those terms. It focuses only on terms used
3	General	and classificatio	х			AS####	UAS Propulsion System Terminology	E-39 Unmanned Aircraft Propulsion	planned	
4	General	and classificatio				ASTM WK62416	New Standard Terminology for Unmanned Aircraft Systems	ASTM F38 Unmanned Aircraft Systems	planned	Develop a standard that presents a lexicon for unmanned aircraft systems (UAS). The Standard Terminology for Unmanned Aircraft Systems ("Standard Terminology") is
5	General	and classificatio	х			ISO 21895	Requirements for the categorization and classification of civil UAS	ISO TC20/SC16/WG1	ongoing	Requirements for the categorization and classification or civil UAS. The standard applies to their industrial regulation, development and production, delivery and
6	General	and classificatio	х			ISO 21384-1	General requirements for UAS for civil and commercial applications, UAS terminology and classification	ISO TC20/SC16/WG1	ongoing	Provides the roundation and common terms, definitions and references relevant to the whole Standard, the purpose of which is to provide a safety quality standard for the safe
7	General	and classificatio	х			ASTM WK62744	General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)	ASTM F38 Unmanned Aircraft Systems	onging	Inis standard derines the requirements for General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS). The standard addresses
8	General	Manuals	х			ASTM WK62743	Development of Maintenance Manual for Small UAS	ASTM F38 Unmanned Aircraft Systems	onging	This specification provides the minimum requirements for a General Maintenance Manual (GMM) for an unmanned aircraft system (UAS) designed, manufactured, and here the second of the second second by the second sec
9	General	and classificatio	х			ANSI/CTA - 2063	Small Unmanned Aerial Systems Serial Numbers	Handled and In- Vehicle Electronics	published	This standard outlines the elements and characteristics of a serial number to be used by small unmanned aerial systems.

- Identified more than 600 standards developed by relevant SDOs, including EUROCAE, ASTM, ISO, SAE, ASD-STAN, etc.
- Both **published** and **under development** standards are considered
- List of standards for each domain reviewed with EASA experts
- Possibility to include additional standards in next iterations of the project



The methodology for the assessment fo the standards comprises three different cases:

- CASE 1: Assessment of standards potentially suitable to comply with a certain SORA requirement (e.g. OSO #6)
- CASE 2: Assessment of the gaps (i.e. SORA requirements not covered)
- CASE 3: Assessment of standards not mappable with any requirement ("orphan" standard)
  - Multi Criteria Analysis to address each CASE
  - CASE 3 not addressed in the first iteration
  - Today's Workshop focused on CASE 1





- Analytic method to compare and rank options
- Allows to translate any assessment (qualitative or quantitative with different units of measurements) into non-dimensional numerical scores ... which can be algebraically summed
- Scores may have different 'weight'
- Allows to scope analysis considering any relevant perspective:
- > KPAs
- Environment
- > Maturity
- ≻ Etc..

**Recommendations** for Authorities/ Standard Making Bodies on the basis of the results (i.e. the weighted algebraic totals)





CASE 1

CASE 1: Assessment of standards potentially suitable to comply with a given SORA requirement

Criterion	Weight
Effectiveness to fulfill SORA requirement (e.g. OSO #6)	3
Maturity	1
Type of standard	1
Cost of compliance	2
Environmental impact	1
Impact on EU industry competitiveness	1
Social acceptance	1

Scoring system

Criterion X	-2	-1	0	1	2
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#### **CONCLUSIONS FOR CASE 1** +10SCORE RANGE B SCORE RANGE C SCORE RANGE C -20 +20 standard listed as Identify possible applicable standards Standard is i. possible acceptable proposed as from other industry segments (e.g. mean to comply with preferred automotive); or the requirement on a acceptable mean Recommend the amendment of the ii. case-by-case basis to comply with the standard requirement







- AW DRONES

Criterion

Effectiveness to fulfill SORA requirement

Maturity

Type of standard

Cost of compliance

Environmental impact

Impact on EU industry competitiveness

Social acceptance

SORA ( <b>v2.0</b> ) requirements is on-going	۲. ۲.
<ul> <li>Mitigations for Ground Risk</li> </ul>	

Weight

3

1

1

2

1

1

1

• Tactical Mitigations Performance **Requirements (TMPR)** 

Mapping between standards and

- OSOs (Robustness up to SAIL IV)
- Adjacent Area/Airspace **Considerations**



Current progress

Standards assessed (either published or under development by main SDOs):



**100%** standards from **TC 20/SC 16** 

RTCA ~ 50% Standards (most from SC 228)

### EUROCAE







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### **Standards coverage of SORA requirements**





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### **OSO 9,15,22** Remote Crew training

REMOTE CREW COMPETENCIES         OSO #09, OSO #15 and OSO #22         Criteria         REMOTE CREW COMPETENCIES		LEVEL of INTEGRITY			
		Low Medium		High	
		The competency-based, theoretical and p a) UAS regulation b) UAS airspace operating print c) Airmanship and aviation safe d) Human performance limitatio e) Meteorology f) Navigation/Charts g) UA knowledge h) Operating procedures and is adequate for the operation. <sup>1/2</sup>	practical training ensures knowledge of: ciples ety ns		
		LEVEL of ASSURANCE			
		Low	Medium	High	
OSO #09, OSO #15 and OSO #22	Criteria	Training is self-declared (with evidence available).	<ul> <li>Training syllabus is available.</li> <li>The operator provides competency-based, theoretical and practical training.</li> </ul>	<ul> <li>A competent third party:</li> <li>Validates the training syllabus.</li> <li>Verifies the remote crew competencies.</li> </ul>	





### **OSO 9,15,22** Remote Crew training

### Main standards assessed:

Organisation	WG	#	Title
SAE	G-30	ARP 5707	Pilot Training Recommendations for UAS Civil Operations
ASTM	F-38	F3266-18	Standard Guide for Training for Remote Pilot in Command of UAS Endorsement
ISO	TC20/SC16 (WG3)	ISO 23665	Unmanned aircraft systems -Training for personnel involved in UAS operations
JARUS	WG1	-	<ul><li>JARUS Recommendation for remote PILOT COMPETENCY (RPC) for UAS</li><li>OPERATIONS in category A (OPEN) and category B (specific)</li><li>+ GM on RAE (Recognised Assessment Entity)</li></ul>
ASTM	F-38	F3330-18	Standard Specification for Training and the Development of Training Manuals for the UAS Operator



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### **Remarks**:

- Developed hoc by JARUS to cover OSO 9,15,22 requirements
- Includes training syllabus for RP in VLOS and BVLOS
- **Easily Complemented** by GM for the Recognised Assessment Entity (RAE) for the assurance part.

### Gaps:

 Not covering training of other remote crew members (VO, Payload operator)







### Remarks:

- Defines requirements for a RAE (**Recognised assessment entity**)
- RAE is an entity recognised by the competent authority as a provider for theoretical knowledge examination and practical skill assessment as described in Article 3 (c) of the JARUS Recommendation UAS RPC Cat A and Cat B.







ISO 23665 Training for personnel involved in UAS OPS

Status: Draft (CD)

#### **Remarks**:

- Full coverage of all integrity requirements in relation to Remote Pilots
- Very comprehensive and detailed training syllabus
- Provides requirements for training organization
- Planned to include annexes covering other remote crew members

- Current version not covering training of other remote crew members (e.g. VO, Payload operator)
- Current version only limited to VLOS conditions (further Annex to cover BVLOS is expected)







#### **Remarks**:

- Training for RP operating in the NAS
- Training syllabus developed following manned aviation models (PPL and CPL)

- Only requirements for practical training
- Training requirements limited to rotary wing aircraft
- No requirements for VOs, payload operators, etc
- Distinction between VFR and IFR flights (not VLOS/ BVLOS)
- No requirements for the training organisation







#### **Remarks**:

- Full coverage of all integrity requirements for Remote Pilots
- Contains a schematic training syllabus

- Not covering training of other remote crew members (VO, Payload operator)
- Not much details about Emergency/contingency procedures
- No distinction between VLOS and BVLOS conditions
- No requirements for the training organisation







#### **Remarks**:

- Well-structured guidance to develop an operator training program
- Potentially suitable for any kind of UAS (up to 600 kg) and operation
- May constitute evidence of competency-based training





**Conclusions: OSO 9,15,22 Remote Crew training** 

- The **combination** of JARUS recommendations for RPC and JARUS GM for RAE identified as the **best standard** to cover OSOs 9,15,22
- ISO 23665 (still under development) is also a good candidate to meet OSO requirements (new annexes expected to cover gaps)
- A general gap is **absence** of training requirements for remote crew members other than Remote pilot

Further standards to be monitored:

ASTM F38: WK62741 New Guide for Training UAS Visual Observers





### M3 Emergency Response Plan (Integrity)

			LEVEL of INTEGRITY	
		Low/None	Medium	High
M3 - An Emergency Response Plan (ERP) is in place, operator validated and	Criteria	No ERP is available, or the ERP does not cover the elements identified to meet a "Medium" or "High" level of integrity	<ul> <li>The ERP:</li> <li>is suitable for the situation;</li> <li>limits the escalating effects;</li> <li>defines criteria to identify an emergency situation;</li> <li>is practical to use;</li> <li>clearly delineates Remote Crew member(s) duties.</li> </ul>	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.
effective	Comments	N/A	N/A	N/A





### M3 ERP (Assurance criterion #1: procedures)

		LEVEL of ASSURANCE	
	Low/None	Medium	High
Criterion #1 (Procedures)	<ul> <li>Procedures do not require validation against either a standard or a means of compliance considered adequate by the competent authority.</li> <li>The adequacy of the procedures and checklists is declared.</li> </ul>	<ul> <li>The ERP is developed to standards considered adequate by the competent authority and/or in accordance with means of compliance acceptable to that authority<sup>1</sup>.</li> <li>The ERP is validated through a representative tabletop exercise<sup>2</sup> consistent with the ERP training syllabus.</li> </ul>	<ul> <li>Same as Medium. In addition:</li> <li>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.</li> <li>The applicant has coordinated and agreed the ERP with all third parties identified in the plan.</li> <li>The representativeness of the tabletop exercise is validated by a competent third party.</li> </ul>





M3: ERP (Assurance criterion #2: Training)

		LEVEL of ASSURANCE	
	Low/None	Medium	High
Criterion #2 (Training)	Does not meet the "Medium" level criterion	<ul> <li>An ERP training syllabus is available.</li> <li>A record of the ERP training completed by the relevant staff is established and kept up to date.</li> </ul>	Same as Medium. In addition competencies of the relevant staff are verified by a competent third party.





### M3 ERP

## Main standards assessed:

Organisation	WG	#	Title
ASTM	F38	F3266	ASTM F3266: Standard Guide for Training for Remote Pilot in Command of Unmanned Aircraft Systems (UAS) Endorsement
ISO	TC20/SC16	21384-3	UAS Operational procedures
ISO	TC20/SC16	23665	Training for UAS personnel
ISO	TC 283	45001	Occupational health and safety management systems Requirements with guidance for use
ΙΑΤΑ	IATA (ERP) Task Force	-	Emergency Response Handbook





### **Conclusions: M3 ERP**

Int/Ass	Requirement	ASTM F-3266	ISO 21384-3	ISO 23665	ISO 45001	IATA ERP
	ERP Suitable for the situation (UAS OPS)	X	~	~	X	X
	ERP Practical to use	X	X	Х	Х	×
	Criteria to define emergency situations	X	X	~	~	~
Integrity	Remote Crew duties	X	X	X	X	Х
	Criteria for reduction of people at risk	X	X	X	X	X
Assurance	Training syllabus	×	X	~	×	X





### **TMPR: VLOS/EVLOS conditions**

**Requirement 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.

**Requirement 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.





**Conclusions: TMPR (VLOS/EVLOS)** 

General Remarks on **Requirement 1**:

• No standards providing a de-confliction scheme

General Remarks on **Requirement 2**:

 Available standards providing guidance on phraseology and communication procedures in aviation but not specific for UAS OPS







- Mapping with SORA requirements:
  - Identified a set of standards covering SORA reqs.
  - Analysis considers both published and on-going standards
  - Main gaps highlighted (e.g. requirements not covered at all)
- Next Steps:
  - Consolidate gap analysis (checking ASTM, SAE or other standards)
  - Assess standards on the basis of other criteria (environment, social acceptance, maturity, type, etc..)





# Thanks for your attention !



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	Medium	High
Integrity	No coverage	No coverage
Assurance (Training)	Full	



### 3266-18

Standard guide for Training for Remote Pilot in Command of UAS Endorsement

Status: Published

### **Remarks**:

• Provides Training syllabus dealing with emergency procedures

### Gaps:

Does not provide guidance on the ERP preparation





	Medium	High
Integrity	Partial	Partial
Assurance (Training)	No coverage	



Status: Draft (FDIS

### **Remarks**:

 High level guidance on basic operational procedures in case of emergency (including communication with external entities and predisposition of emergency equipment)

- Criteria to define emergency situations not provided
- Absence of a template for the ERP (template=practical to use)
- No clear definition of remote crew duties
- No criteria to demonstrate that the number of people at risk is reduced





	Medium	High
Integrity	Partial	Partial
Assurance (Training)	Full	



### **Remarks**:

• Guidance on the ERP content, including classification of emergency actions, procedures in case of loss of control, etc.

- Criteria to define emergency situations not provided
- Absence of a template for the ERP (template=practical to use)
- No clear definition of remote crew duties
- No criteria to demonstrate that the number of people at risk is reduced





	Medium	High
Integrity	Partial	Partial
Assurance (Training)	Partial	



ISO 45001 Occupational Health and Safety

Status: Published

#### **Remarks**:

- Includes guidance on how to compile an ERP for a generic activity
- General criteria to define emergency conditions are defined

### Gaps & remarks:

- Emergency conditions and responsibilities not tailored for UAS OPS
- ERP Training activities not specific for UAS OPS





	Medium	High
Integrity	Partial	Partial
Assurance (Training)	No coverage	



#### **Remarks**:

- First document of its kind to provide a practical ERP template
- ERP specific air carrier operators
- Roles and responsibilities defined for the ERT (Emergency Response Team)

- Duties not immediately applicable for remote crew
- Criteria to define emergency situations are provided but not tailored for UAS
- No criteria to demonstrate that the number of people at risk is reduced



## Gap analysis (F=Full, P=Partial, N=No coverage)

<b>GRC Mitigations</b>	Coverage	OSO	Coverage	OSO #	Coverage
M1	Р	# 1	Р	# 10/12	F
M2	Р	# 2	Р	# 13	Р
M3	Р	# 3	F	# 16	Р
Tactical	<b>Coverage</b>	# 4	Р	# 17	Ν
Mitigations		# 5	Р	# 18	Р
VLOS	Ν	#6	F	# 19	Р
BVLOS	F	# 7	F	# 20	Р
Adj airsp./area	Coverage	# 8/11/14/21	F	# 23	Р
Adj. airspace req.	F	# 9/15/22	F	# 24	F

