sUAS and AAM Activities at JCAB

--- Certification Overview ---

JCAB
JAPAN CIVIL AVIATION BUREAU

27 September 2024

In the beginning ••••• Classification in Japan Civil Aeronautics Act

Aircraft (UAS)

Airplane

Helicopter

eVTOL

AAM

Pilotless Aircraft
(Article 87)

aircraft equipped with apparatus which enables it to fly without being boarded by a pilot may

Pilotless large airship

Pilotless Airplane

Pilotless eVTOL

sUAS

Of those which can be used for aviation and which are structurally incapable of being carried by people, they can be made to fly by remote control or autopilot (100g or more)

Drone (multi-rotor type)

Drone (Airplane type)

Drone (Lift&Cruise type)

Pesticide spray Drone (Heli type)

sUAS

Categories of sUAS Operations in Japan

Manual control → Automated/Autonomous control

VLOS → BVLOS

Non-populated area
(e.g. isolated islands or mountainous area)

Populated area

Level 1
Manual control + VLOS

e.g. Photo shooting

e.g. Bridge inspection

Level 2
Automated/ Autonomous + BVLOS

e.g. Agricultural chemical spraying

e.g. Civil engineering survey

Level 3
BVLOS over non-populated area

e.g. Transportation between post offices

Level 4
BVLOS over populated area

(From December 2022)

Cargo delivery including 3rd party overflights, etc.

Amendment to Civil Aeronautics Act

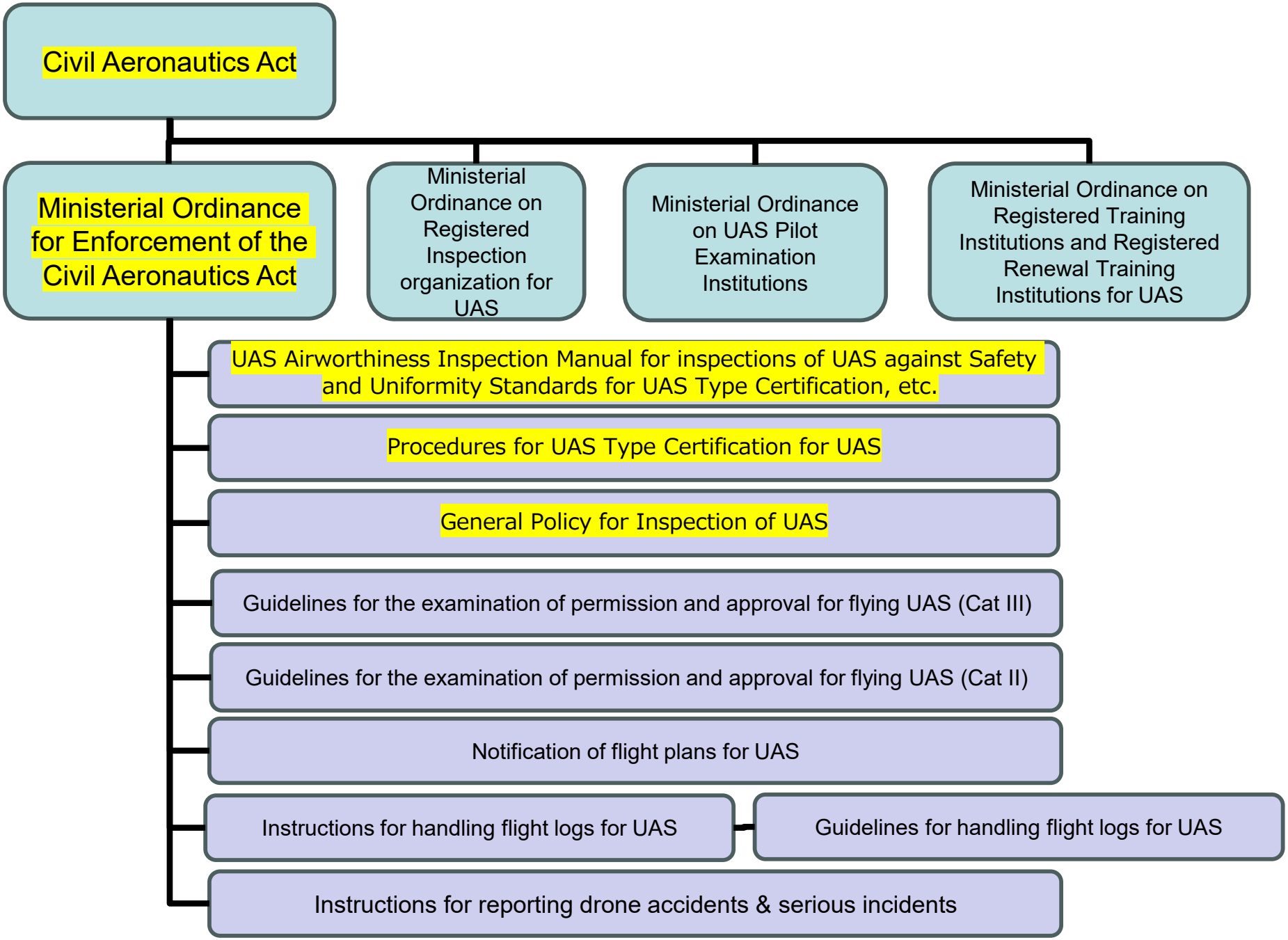
- To realize Level 4 operations (BVLOS over populated areas), the Japanese government amended the Civil Aeronautics Act of Japan.
- The main amendments are to include rules for
  - Safety (Airworthiness),
  - Pilot Qualifications, and
  - Rules of Operation.
- Detailed regulations have already been issued.
- Effective date: 5 December 2022

Operations Categories and Flight Requirements

- Level 4 operations: UAS certification, pilot's license, permission and approval for each flight are mandatory.
- Below Level 3: Permission and approval for each flight are not required in principle once the aircraft is certified and the pilot license is obtained.

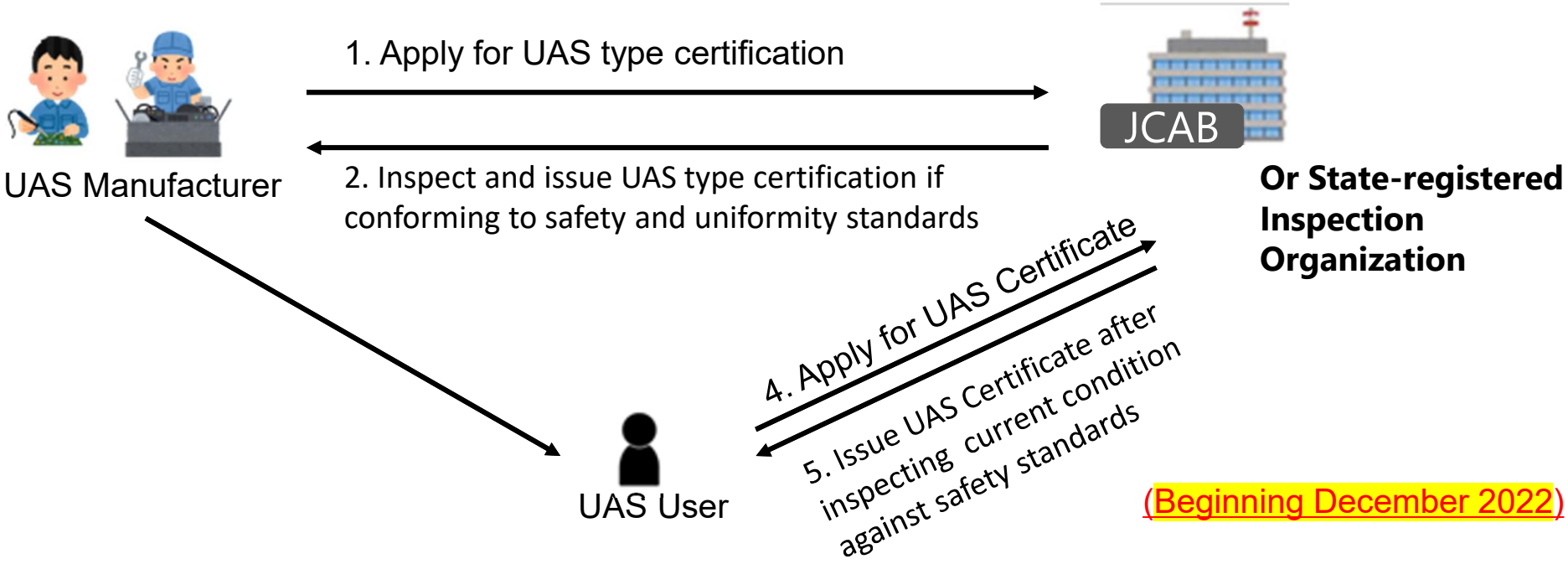
<table>
<tr><th rowspan="2"></th><th colspan="3">Minimum Flight Requirements</th></tr>
<tr><th>Type Certification and Pilot Licensing</th><th>Flight Permits and Approvals</th><th>Entry Control to Limit Uninvolved Personnel</th></tr>
<tr><td>Level 4
(BVLOS flights in populated areas)</td><td>① Aircraft with Class 1 type certification
② Piloted by a person with a first class pilot's license</td><td>Permit/approval required for each flight</td><td>Unnecessary</td></tr>
<tr><td rowspan="2">Level 3
(BVLOS flights in uninhabited areas)</td><td>① Aircraft with Class 1 or Class 2 type certification
② Piloted by a person with a first/second class pilot's license</td><td>In principle, no permission or approval is required for each flight.</td><td rowspan="2">Necessary</td></tr>
<tr><td>Other than above</td><td>Permit/approval required for each flight</td></tr>
<tr><td>Level 2
(Automatic Control within VLOS)
Level 1
(Manual Control within VLOS)</td><td colspan="2">In principle, no procedures are required</td><td></td></tr>
</table>

Civil Aeronautical Act, Ministerial Ordinance, etc.



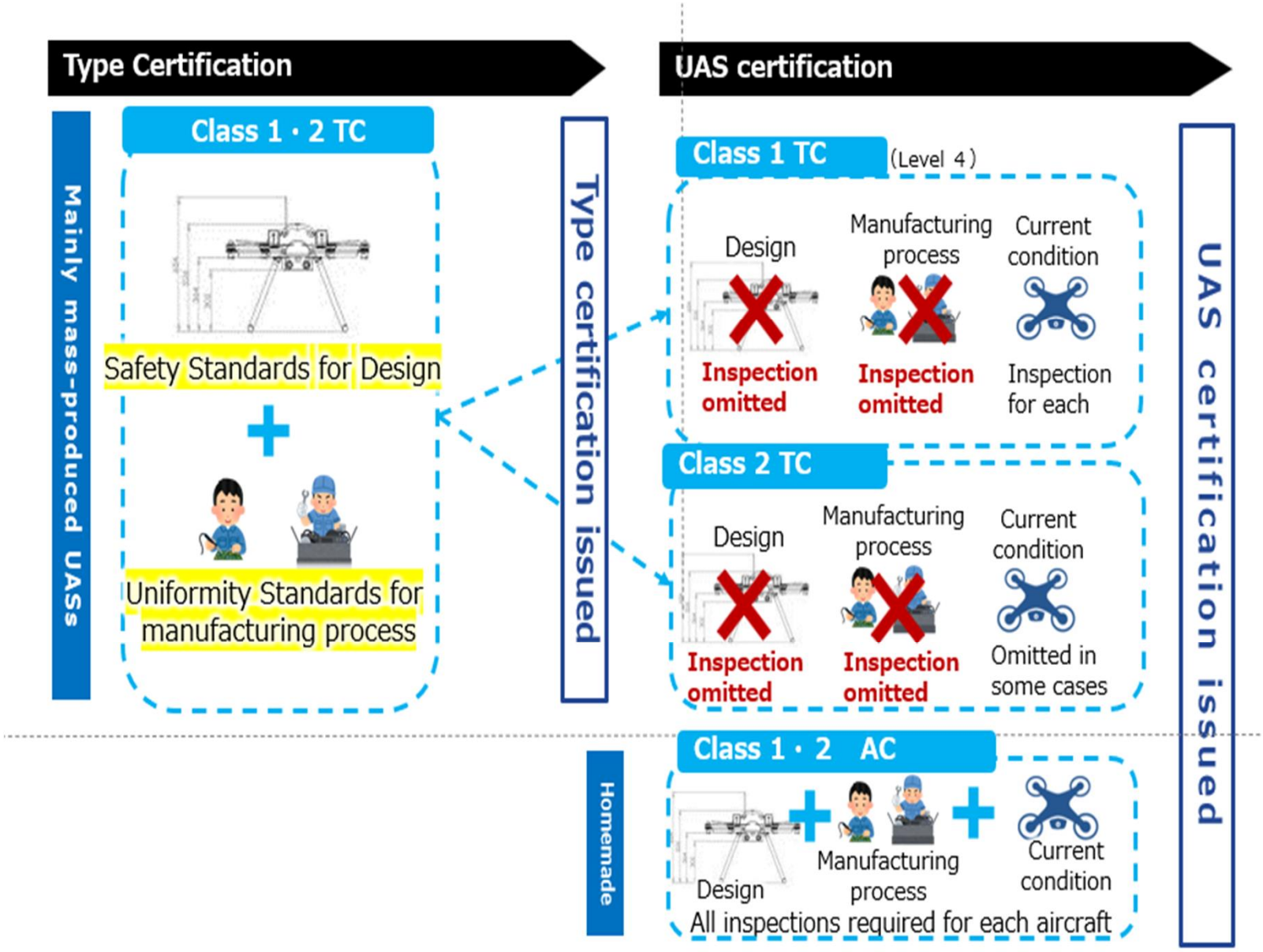
Rules for Airworthiness

- **UAS certification system** has been established.
- For specific drones with **UAS type certification**, inspection for the individual UAS certificate may be simplified.
- Two classes of certificate:
  - ➢ Class 1 UAS Certificate For level 4
  - ➢ Class 2 UAS Certificate For level 1 - level 3
- **State-registered inspection organizations** are allowed to conduct relevant inspections on behalf of JCAB.



Rules for Airworthiness

- Established a **UAS certification system** to inspect the conformity of UAS to standards (design, manufacturing process, current condition)
- For UAS that have received **type certification (mainly mass-produced)**, all or part of the inspections that are conducted for each UAS during UAS certification are omitted.



Standards for Airworthiness

Part 2: Safety Standards (Class 1)	Part 3: Safety Standards (Class 2)	Part 4: Uniformity Standards
➢ 001 CONOPS	➢ 001 CONOPS	➢ Facilities
➢ 005 Definitions	➢ 005 Definitions	・Equipment
➢ 100 UA Signal Monitoring and Transmission	➢ 100 UA Signal Monitoring and Transmission	・Workshop
➢ 105 UAS AE Required for Safe UA Operations	➢ 105 UAS AE Required for Safe UA Operations	・Storage facility
➢ 110 Software	➢ 110 Software	・Borrowing facilities and equipment, etc.
➢ 115 Cybersecurity	➢ 115 Cybersecurity	➢ Organization
➢ 120 Contingency Planning	➢ 120 Contingency Planning	➢ Personnel
➢ 125 Lightning	➢ 125 Lightning	➢ Implementation method of work
➢ 130 Adverse Weather Conditions	➢ 130 Adverse Weather Conditions	➢ Quality control system
➢ 135 Flight Essential Parts	➢ 135 Flight Essential Parts	・Maintenance and management of facilities
➢ 140 Other Necessary Design and Configurations	➢ 140 Other Necessary Design and Configurations	・Education and training of personnel
➢ 200 Flight Manual	➢ 200 Flight Manual	・Revision of implementation method of work
➢ 205 ICA	➢ 205 ICA	・Acquisition, management, and operation of technical materials
➢ 300 Durability and Reliability	➢ 302 Operational Demonstration	・Management of materials, parts, and equipment, etc.
➢ 305 Probable Failures	➢ 305 Probable Failures	・Acceptance inspections of materials, parts, and equipment, etc., and intermediate and final inspections of the unmanned aircraft system and equipment, etc.
➢ 310 Capabilities and Functions	➢ 310 Capabilities and Functions	・Process control
➢ 315 Fatigue	➢ 317 Fatigue	・Management of implementation of work by the outsource in case of outsourcing
➢ 320 Verification of Limits	➢ 322 Flight Envelope Safety Margin	・Management of work records
		・Audits conducted by a unit independent of units implementing work

※English version of our standard：
https://www.mlit.go.jp/koku/content/001751887.pdf

：Japan Unique

ASTM Standards Called Out by JCAB as MOCs

Part 2: Safety Standards (Class 1)

- 001 CONOPS
- 005 Definitions
- 100 UA Signal Monitoring and Transmission
- 105 UAS AE Required for Safe UA Operations
- 110 Software
- 115 Cybersecurity
- 120 Contingency Planning
- 125 Lightning
- 130 Adverse Weather Conditions
- 135 Flight Essential Parts
- 140 Other Necessary Design and Configurations
- 200 Flight Manual
- 205 ICA
- 300 Durability and Reliability
- 305 Probable Failures
- 310 Capabilities and Functions
- 315 Fatigue
- 320 Verification of Limits

ASTM F3153-22 (Standard Specification for Verification of Avionics Systems and Equipment)

ASTM F3532-22 (Standard Practice for Protection of Aircraft Systems from Intentional Unauthorized Electronic Interactions)

ASTM F3322-22 (Standard Specification for Small Unmanned Aircraft System Parachutes)

ASTM F3298-19 (Standard Spec. for Design, Construction,and Verification of Lightweight UAS)

ASTM F3442-20 (Standard Specification for DAA System Performance Requirements)

ASTM F3228-17 (Standard Specification for Flight Data and Voice Recording in Small Aircraft)

ASTM F2908-18 (Standard Specification for UFM for an UAS)

ASTM F3478-20 (Standard Practice for Development of a D&R Flight Demonstration Program for Low-Risk UAS)

※English version of our standard：
https://www.mlit.go.jp/koku/content/001751887.pdf

ASTM Standards Called Out by JCAB as MOCs

140 Other Necessary Design and Configurations

- 140-1 Structures

(a) Materials and procedures to be used for the UA must be appropriately defined.

(b) The UA must be of a structure free of sharp protrusions, except as structurally necessary.

(c) UA with the maximum takeoff weight of 25 kg or more must be so structured that, in the case of failure of the engine, motor, propeller, or rotor, the possibility of scattering of damaged parts of such components is kept as low as possible.

(d) UA supposed to fly over a third party or areas with a dense population of people or houses, less than 30 meters above a person or object on the ground or water, or over an event venue where many people gather, must have a function to reduce the risk of harm to third parties or objects such as the following examples.

JCAB and our applicants are seeking industry standards.

(1) Propeller guard

(2) Material for mitigating impact of collisions

(3) Cover for mitigating impact of collisions

JCAB and our applicants are seeking industry standards.

(4) Parachute for mitigating impact of collisions

（ASTM F3322-22）

ASTM Standards Called Out by JCAB as MOCs

140 Other Necessary Design and Configurations

- 140-2 Lights, marks, etc.

(a) The UA must have lights, markings, etc. which make the position and orientation of the aircraft accurately visible.

(b) UA supposed to fly in the vicinity of an airport or in air space 150 meters or more above the ground, or to perform beyond visual line of sight operations must be equipped with lights so as to be recognized by another aircraft as easily as possible, or must be painted in a manner that makes the aircraft easy to recognize during the flights.

(c) UA supposed to fly at night must be equipped with lights so that its attitude and orientation can be accurately seen.

（ASTM F3289-19）

ASTM Standards Called Out by JCAB as MOCs

140 Other Necessary Design and Configurations

- 140-3 Autopilot system, cameras, etc.

  (a) UA supposed to perform beyond visual line of sight operations must be equipped with an autopilot system so that conditions outside the airframe can be monitored through cameras, etc. installed on the airframe.

  (b) UA supposed to perform beyond visual line of sight operations must be so equipped that its status, as well as conditions of other aircraft in the vicinity of its flight path, can be continuously monitored on the ground by cameras, etc. installed on the airframe. If this requirement is not met, the UAS Flight Manual must provide methods for continuously monitoring conditions of the unmanned aircraft, as well as those of other aircraft in the vicinity of the flight path, as operational limitations.

（requirements in BVLOS）

（ASTM F3442/F3442M-20）

- 140-4 Transportation of dangerous objects

  UA supposed to transport dangerous objects must have equipment suitable for that purpose.

（Mainly pesticide spraying）

JCAB and our applicants are seeking industry standards.

ASTM Standards Called Out by JCAB as MOCs

140 Other Necessary Design and Configurations

- 140-5 Recording flight characteristics

  UA with maximum takeoff weight of 25 kg or more must have functions that enable the UAS Type Certificate holder to record flight characteristics (such as flight path (aircraft position, altitude, speed and time), airframe attitude, power supply voltage, remaining battery level, and global navigation satellite system (hereinafter referred to as "GNSS" in this chapter) positioning) to contribute to improvement of performance of the type and cause analysis of defects and to utilize the data to determine causes of accidents.

（ASTM F3228-17）

- 140-6 Reciprocating Engine and Fuel Carriage

  The applicant must show that the engine meets the following requirements.

  (a) Lines containing or conveying flammable fluids subject to high temperatures must be fire resistant.

  (b) Components must be shielded or located to safeguard against the ignition of leaking flammable fluid.

  (c) Compartments, including fuel tanks, where flammable fluid or vapor may exist must have adequate and effective ventilation and drainage.

  (d) The powerplant installation must be designed to prevent hazardous amounts of contamination of the fuel supplied to the engine.

  (e) The fuel system must protect the UA from damage that could result in spillage of enough fuel to constitute a fire hazard as a result of a reasonably foreseeable UA accident, based on the operating environment documented in the CONOPS.

（Same as FAA standards ）

JCAB and our applicants are seeking industry standards.

sUAS Type Certifications Issued（～Aug 2024）

1. Class 1 TC （5 types of applications have been accepted, one of them has already been certified.）

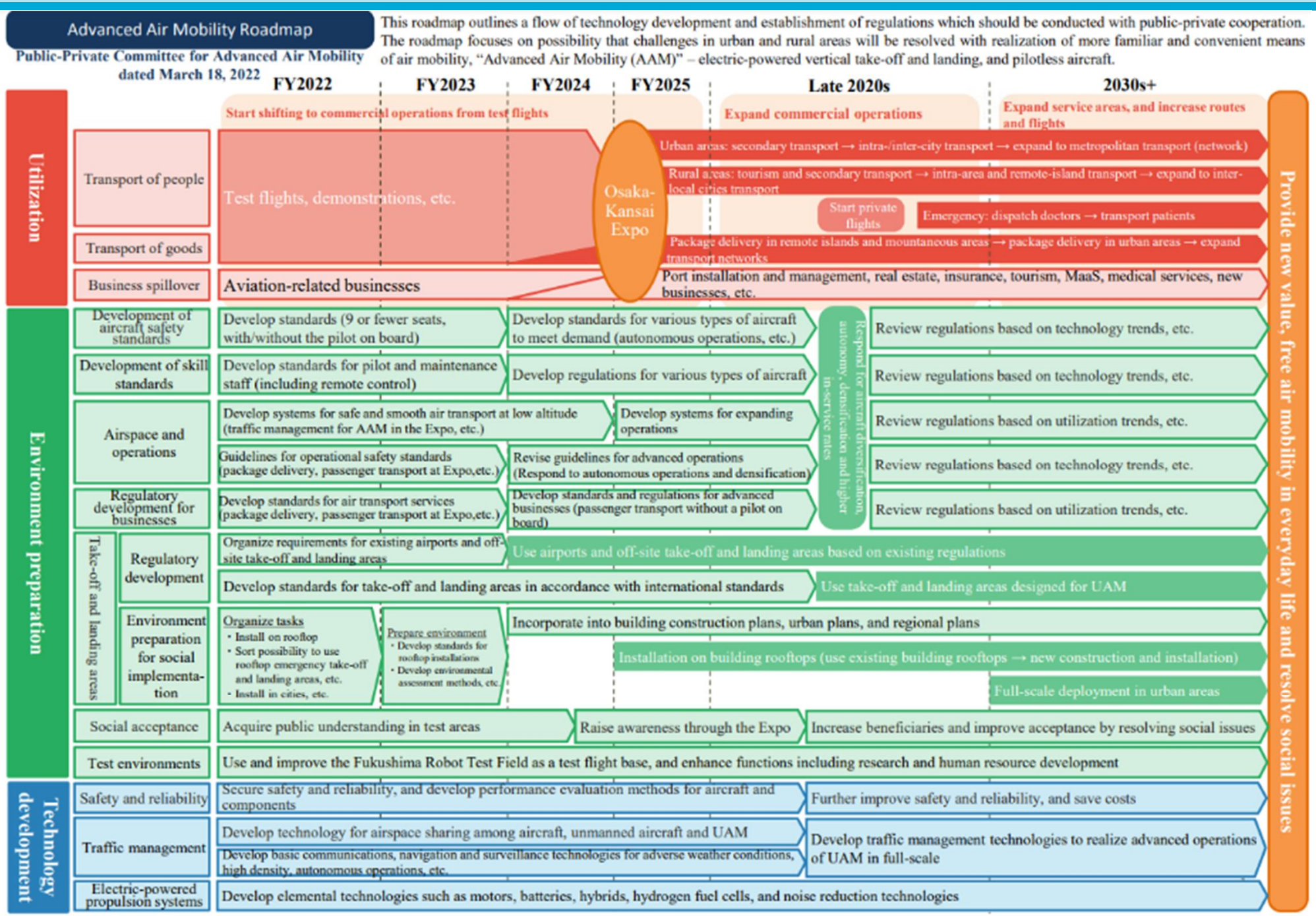
TC holder	Model Name	Type certification		MTOW (Maximum payload)	Photo
		Application date	Acquisition Date		
ACSL	**PF2-CAT3**	2022.12.5	2023.3.13	9.8kg (1.0kg)	
EAMS ROBOTICS	**E600-100**	2023.5.25	-	24.9kg (5.0kg)	-
PRODRONE	**PD6B-CAT3**	2023.11.10	-	45.0kg (20.0kg)	
Wingcopter(Germany)	**198**	2024.3.28	-	24.9kg (4.5kg)	
ACSL	**PF4-CAT3**	2024.6.27	-	24.9kg (5.0kg)	

2. Class 2 TC （6 types of applications have been accepted so far (one of them has not been disclosed at the request of the applicant), and 5 of them have already been certified.）

TC holder	Model	Type certification		MTOW (Maximum payload)	Photo
		Application date	Acquisition Date		
EAMS ROBOTICS	**E6150TC**	2023.3.31	2024.4.5	24.0kg (6.0kg)	
Sony Group	**ARS-S1**	2023.6.2	2023.12.22	7.5kg (2.1kg)	
Drone WORK System	**EGL49J-R1**	2023.9.19	2024.3.29	90.0kg (49.0kg)	
Aerosense	**AS-VT01K**	2023.11.7	2024.6.5	10.2kg (1.0kg)	
Century	**D-HOPE I -J01**	2024.1.9	2024.3.29	17.16kg (5.0kg)	

AAM

Roadmap of AAM in Japan



AAM Concept of Operation (ConOps)

- Aims to provide industry stakeholders with necessary information and share awareness.

  (First edition published in March 2023, revised edition published in April 2024)
- Outlines key components of AAM together with expected phased introduction.

Outlines

AAM is defined as *"an accessible and sustainable next generation means of air transportation, made possible by aeronautical technologies such as electrification and automation, as well as vertical take-off and landing and other modes of operation"*

(1) Aircraft

Categorize aircrafts into three types; Multi-rotor, Lift and Cruise, Vectored Thrust

(2) Use cases

Describe use cases; Passenger Carrying, Cargo Transport, etc.

(3) On-ground infrastructure (Vertiports)

Explain facilities, configuration, charging infrastructure for Vertiports.

(4) Airspace/Traffic Management

Show new concept of airspace and traffic management

(5) Roles & Responsibilities

List roles & responsibilities of key stakeholders

- Key Challenges for AAM

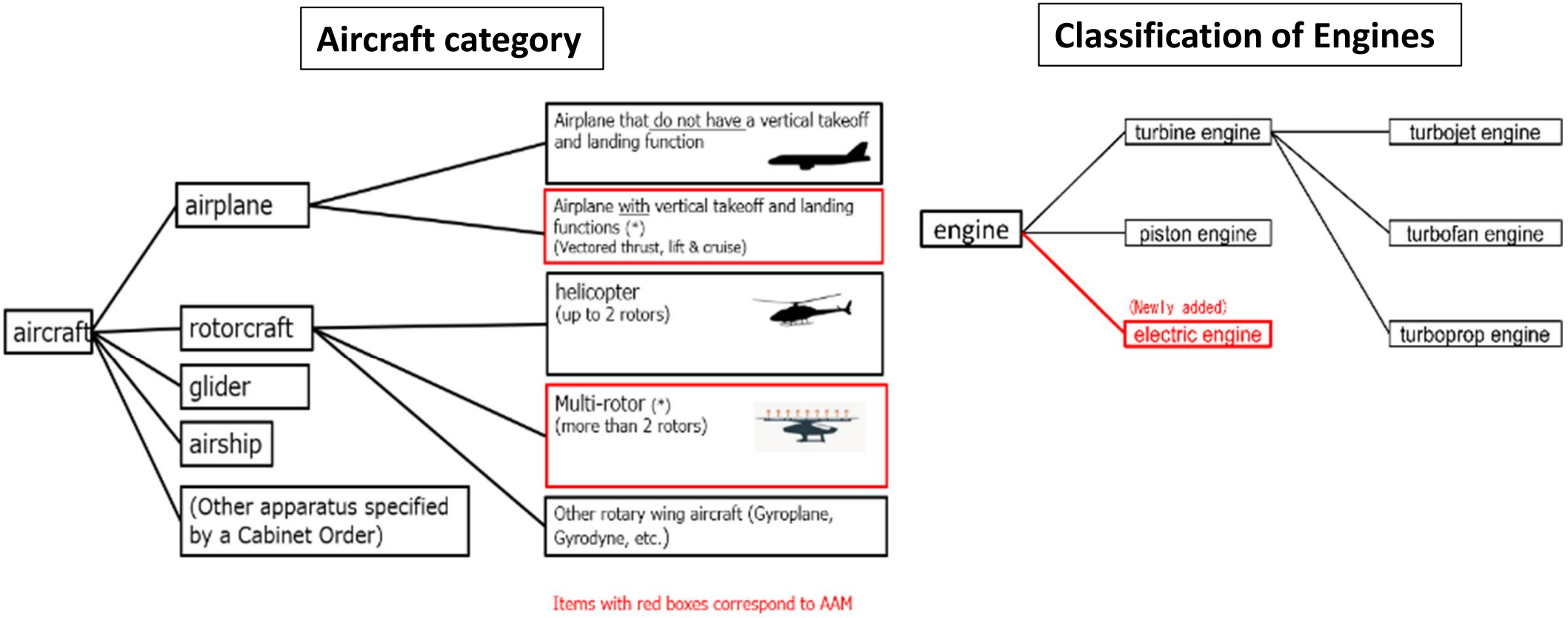
  ▶ social acceptance ▶aircraft&operations ▶urban integration ▶ traffic management in Low-Level airspace

- Phases of AAM Introduction

Phase	Maturity Level	Timeframe
Phase 0	**Test flights and proof of concept flights prior to commercial operations**	
Phase 1	**Commencement of commercial operations** **- Low density operations** **- Pilot on board , cargo transport with remotely piloted operations**	Around 2025
Phase 2	**Scaled operations** **- Medium to high density operations** **- Pilot on board and/or remotely piloted**	Late '20s or later
Phase 3	**Establishment of AAM operations which include autonomy** **- High density** **- Integrated with automated / autonomous operations**	'30s and beyond

Rulemaking for AAM

- **AAMs are defined as “Aeroplane with VTOL capability” and “Multi-rotor”.**
- **The term of "fuel" is defined to include electric energy.**
- **The term of "engine" is defined to include electric engine.**



Legal framework of AAM

Aircraft

<Characteristics of AAM>

AAM has unique design features, such as **electrification, VTOL capability, and remotely piloted**

⇒ **Establishment of "special conditions"** for those unique design features as additional safety standards

Operations

<Characteristics of AAM>

Flight range and time are limited due to battery performance.

⇒ The necessary amount of fuel (electrical energy) **can be flexibly set according to aircraft performance and flight route.(performance based criteria)**

Personnel Licensing

< Characteristics of AAM>

Maneuvering characteristics vary by aircraft type

⇒ The flight experience requirement for pilot licence **can be set for each aircraft type.**

Air Transport Regulation

< Characteristics of AAM>

・ **Flight range and time are limited** due to battery performance, etc.

・ **Operation at relatively low altitude airspace.**

⇒The minimum flight altitude **can be relaxed under conditions such as keeping distance from obstacles and complying with requirements to prevent altitude deviation**.

Vertiport

< Characteristics of AAM>

Capability of vertical takeoff and landing (However, the aircraft is currently under development and its performance is not clear at this time.)

⇒ **Vertiports Design Guideline was published** with reference to guidance in Europe.

Aircraft Safety Standards for AAM

Referring to the precedents in Europe and the U.S., where aircraft development is in progress, we use the existing safety standards for small aircraft (Part 23) as a basis for the AAM certification, and have studied additional safety standards to accommodate the unique features of AAM (e.g., electric power, vertical take-off and landing, etc.).

■ Type of AAM aircraft

○ The category of eVTOL has not been defined at ICAO.

○ For the time being, the following category will be applied for eVTOL in Japan:

— Flight with fixed wings to obtain lift : "**Aeroplane**"

— Powered propulsion by rotary blades, like helicopter : "**Rotorcraft**"

■ Safety Standards

○ Performance-based safety standards of strength, structure and performance for small aircraft will be the basis for the certification of eVTOL.

○ For the unique design features of AAM, additional requirements and exemptions will be established in accordance with individual type design.

(Possible additional requirements) EPU, auto/autonomous, remotely piloted , etc.

The following requirements are listed

○Scope of Application
○Definition of terms
○Special Requirements (Aircraft flown with a pilot on board)

- General
- Flight
- Strength
- Design and Construction
- Power Equipment
- Equipment
- Aircrew Interface

○Special requirements (aircraft with equipment that allows the aircraft to fly without a pilot on board)

- Aircraft flight control and power systems
- Aircraft electrical power systems
- Aircraft navigation systems
- Aircraft communication systems
- Aircraft structure and landing systems
- Ground control stations

○Special Requirements (Aircraft flown with a pilot on board)

（5）Chapter 5 Power Equipment

§ eVTOL 23.2430　Power storage and distribution system

Each power storage and distribution system shall not cause a dangerous loss of stored electrical energy due to malfunctions that may occur during aircraft ground operations or during ground operations.

§ eVTOL 23.2435　Lift/thrust generator auxiliary system

The pilot must be able to grasp the lift/thrust form.

§ eVTOL 23.2440　Fire protection equipment

(a) Means shall be provided to isolate and reduce the hazard to aircraft in the event of fire or overheating of the electric engine.

(b) Means shall be provided to isolate and mitigate the hazard to the aircraft in the event of a fire or thermal runaway of the batteries supplying power for propulsion to the electric engine.

○Special Requirements (Aircraft flown with a pilot on board)

（6）Chapter 6　equipment

§ eVTOL 23.2510　Equipment, systems

Continued safe flight and landing must be possible after any single failure or combination of possible failures in each system (combinations whose probability of occurrence is not extremely rare).

§ eVTOL 23.2525　Power generation, storage and distribution to the grid

(a)　For batteries, the condition of the cells shall be monitored and the cells shall be protected from harmful conditions of overvoltage, undervoltage, overcurrent and overheating.

(b)　The following functions shall be performed in the power storage and distribution system

(1) Battery cell balancing function

(2) Battery state-of-charge estimation function

(3) Battery health estimation function

(4) Battery BIT function

○Special requirements (aircraft with equipment that allows the aircraft to fly without a pilot on board)

（2）Airframe: Items related to power storage and distribution systems

§ RPA2－1

The airframe shall provide the RPIC with information regarding the configuration and monitoring information pertaining to the operational status of the airframe's power storage and distribution system.

§ RPA2－2

The airframe shall provide the RPIC with health information pertaining to sensing functions related to the operational status of the airframe's power storage and distribution system.

§ RPA2－3

The airframe shall provide the RPIC with information on the settings and monitoring information related to the function to automatically respond to malfunctions and abnormal operation of the airframe's power storage and distribution system (autopilot).

§ RPA2－4

The function to automatically respond to failures and abnormal operation of the aircraft's power storage and distribution system (autopilot) must be evaluated in advance during the design phase to assess all possible consequences of the anticipated failures, and based on the results of the evaluation, automatic response or corrective actions by RPIC must be taken to address the failures and abnormal operation.

JCAB TC Activities for AAM

SkyDrive (Application: Oct. 2021)	**Joby Aviation** (Application: Oct. 2022)
 ©SkyDrive	 Provided by Joby Aviation
Volocopter (Application: Feb. 2023)	**Vertical Aerospace** (Application: Mar. 2023)
 Provided by Volocopter	 Provided by Vertical Aerospace

We want to collaborate with CAAs and industries around the world to bring about Air Mobility revolution!

真是謝謝你

Thank you

有り難う御座いました

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