

Durability and Reliability

Type Certification of Low-Risk UA



**Federal Aviation
Administration**

Introduction to Durability and Reliability (D&R)

- The FAA is taking a risk-based approach toward the certification of unmanned aircraft
- Existing airworthiness standards were not broadly applicable to small unmanned aircraft system (sUAS) as the requirements were over burdensome for these type of aircraft
- FAA determined the need to provide a level of design assurance for UAS for complex operations such as beyond visual line of sight package delivery
- D&R process is a means of compliance primarily based on aircraft-level flight demonstrations in lieu of traditional analyses and component level testing



Main Goals Behind D&R Process for Small UAS

- D&R methodology proposes airworthiness criteria that provides an adequate balance of certification rigor with safety-related outcomes for sUAS
 - The FAA is using its existing part 21 regulatory framework for type certification to gain safety assurance of the reliability of smaller unmanned aircraft
- Demonstrate acceptable level of airworthiness by accomplishing an agreed upon number of successful representative flight hours, across the entire operational envelope
- D&R requirements and process do not align with Annex 8.
 - D&R methodology is unique (performance based) and does not impose part 23 certification requirements



D&R Type Certification

Scope

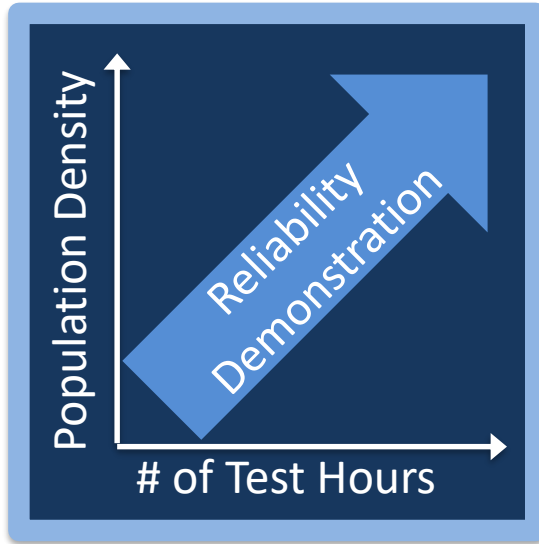
- <400ft AGL (122 Meter)
- Typically < 55 Lb (22.6 Kg)
- Kinetic Energy < 25,000 ft-lbs (33895.4 Nm)
- C2 required with contingency planning
- Electric Propulsion (adding the eligibility of Internal Combustion Engines)
- No FIKI (Flight In Known Icing)
- Aircraft: Pilot Ratio – 20:1 Max

Can be expanded through amendments to TC or STC

Applicants outside scope can coordinate on deltas



3 Elements of D&R Requirements



Durability & Reliability Demonstration

- Demonstrating UAS reliability commensurate with risk through testing
- Test cycles representative of end state conditions



Likely Failure & Specific Demonstration Tests

- Induced failures and specific tests where operationally-representative cycles alone may not provide sufficient detail

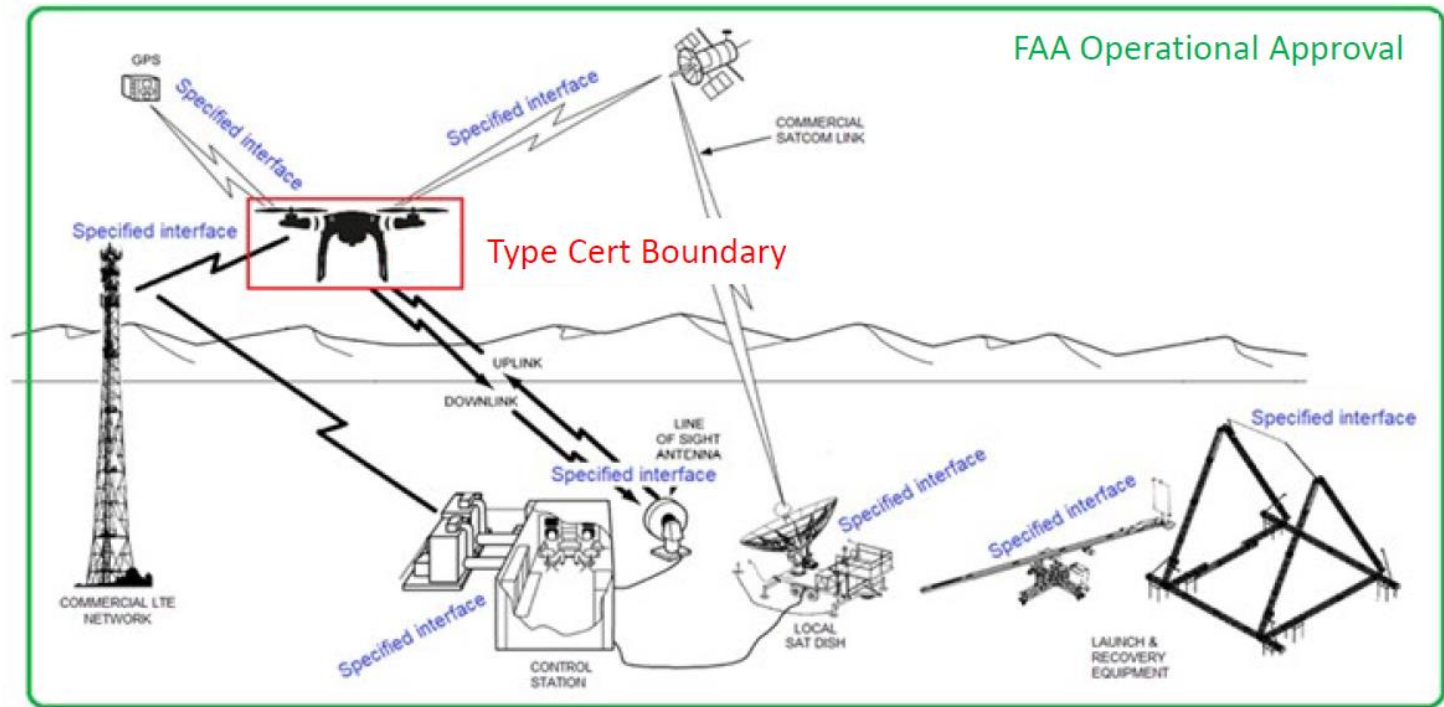


Design Requirements Checklist

- Design requirements to mitigate hazards that can't be shown mitigated by test alone

Type Certification Boundary

- TC boundary is limited to the Unmanned Aircraft
- Specified interfaces to Associated Elements (AE) part of the TC
- Approval of AE through operating limitations and operational approvals (waivers, exemptions, operating certificates)



Moving Forward – Product Certification

- FAA issued first D&R TC for Matternet in September 2022
- First 10 D&R UAS Airworthiness Criteria Notices were issued in the Federal Register
 - Issuance dates between January and March 2022
- Applicants that have not had their airworthiness criteria published will go through the CPP process or have to go through issue paper process
 - Future airworthiness criteria will expand on the scope of D&R such as including internal combustion engines, higher gross weight, levels of automation, etc...



Questions?



Associated Elements (AE) Approval Development

- Part 21 and part 43 were all written for an “aircraft” and not a “system” – did not consider:
 - Ground control station
 - Direct C2 radio
 - Cloud computing and software
 - Crew communications
 - Internet
 - Cellular/satellite communications
 - Ground radars, radios
 - UTM (Unmanned aircraft system traffic management)
- Its impractical to have part 21 oversight (both design and manufacturing) over server farms, interchangeable “portal” devices (cell phones, laptops, etc.), or a “mission control” center overseeing hundreds of UA
- Similarly, it is impractical to invoke part 43 for maintenance on these components



D&R Test Hour Requirements

Reliability Category (RC)	Baseline configuration (flight hours)	Reduced probability of injury configuration <30% Abbreviated Injury Scale (AIS) 3 or greater injury (flight hours)
RC-A	375	150
RC-B	1100	540
RC-C	2500	1300
RC-D	3600	1800
RC-E	5000	2500
RC-F	7200	3600

Note: Population Density no longer a direct element

- Reliability requirements based on CONOPS
- Provides ability to accurately tailor ops approval to demonstrated reliability



Certification Position Paper (CPPs)

D&R UAS Certification Position Paper

Subject: Certification Basis for Unmanned Aircraft Utilizing Durability and Reliability

Reference No.: CPP-D&R-1.1

Regulatory Ref.: §§ 11.25, 21.16, 21.17(b), 21.21

National Policy Ref.: 8110.4C, Type Certification;
85 FR 58251, September 18, 2020, Type Certification of Certain
Unmanned Aircraft Systems
AIR600-21-600-DM01, Deviation for the Certification of Low-
Risk Unmanned Aircraft;
AIR600-21-600-DM02, Deviation to Order 8110.118, *Commercial
Parts, to Facilitate Use of Commercial Parts for Low-Risk
Unmanned Aircraft Systems*;
AIR600-21-AIR-600-PM-01, FAA Approval of Unmanned
Aircraft Systems (UAS) Special Class UA Projects and their
Associated Elements

Statement of Issue:

The FAA's existing airworthiness standards did not envision aircraft with no pilot in the cockpit and the technologies associated with that capability. The FAA considered the size of aircraft, its maximum airspeed and altitude, and operational limitations to address the number of unmanned aircraft per operator and to address operations in which the aircraft would operate beyond the visual line of sight of the pilot to assess the potential risk the aircraft could pose to other aircraft and to human beings on the ground. Using these parameters, the FAA developed proposed airworthiness criteria to address those potential risks to ensure the aircraft remains reliable, controllable, safe, and airworthy.

The FAA has developed the framework for airworthiness criteria using a Durability and Reliability (D&R) methodology to allow for an adequate balance of certification rigor with safety-related outcomes. These airworthiness criteria provide a set of requirements that the unmanned aircraft (UA) must meet in order to receive a type certificate under title 14, Code of Federal Regulations (14 CFR) 21.17(b).

Background:

The FAA establishes airworthiness criteria to ensure the safe operation of aircraft in accordance with 49 U.S.C. 44701(a) and 44704. UA are type certified by the FAA as special class aircraft for which airworthiness standards have not been established by regulation. Under the provisions of 14 CFR 21.17(b), the airworthiness standards for special class aircraft are those the FAA finds may provide an equivalent level of safety to those parts (i.e., the airworthiness requirements contained in Parts 23, 25, 27, 29, 31, 33, and 35)

DURABILITY & RELIABILITY-BASED TYPE CERTIFICATION PROCESS FOR LOW RISK SMALLER UNMANNED AIRCRAFT SYSTEMS

MEANS OF COMPLIANCE

