

Attachment 3

Aircraft Design Standards Manual

1 Aug 2020

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This Document is to be used for Educational Purposes Only

1 Introduction

1.1 Objective

The objective of this Aircraft Design Standards Manual is to provide guidance on key design parameters to ensure safe and effective aircraft designs. These standards have been developed over the course of many decades and are representative of current Aerospace Industry best practices.

1.2 Scope

This manual is specific to design of unmanned aircraft systems for the Aircraft Design Capstone Course. While focused on aircraft designs with electrically powered propulsion systems, the standards are generally applicable to designs that conform to FAA Part 107 regulations.

2 Aircraft Performance

This section provides standards for key aircraft performance design parameters.

2.1 ConOps

- **Takeoff distance** – The air vehicle shall liftoff at design maximum gross weight within one-half of the design or available runway length, whichever is shortest. The design runway length shall be 400 ft.
- **Initial Rate of Climb** – The air vehicle shall have sufficient thrust to complete initial climb segment at rate of climb, $ROC \geq 900$ ft/min (15 ft/sec).
- **Specific Excess Power** - Air vehicles shall have sufficient thrust available to generate specific excess power, $P_s \geq 100$ ft/min (1.67 ft/sec) at all speed and altitude conditions within and at the boundaries of the flight envelope.

2.2 Mass Properties

- **Maximum Weight** – The air vehicle Maximum Takeoff Gross Weight (MTOW) shall be less than 55 lb.

3 Design Margins and Safety Factors

This section provides standards for key design margins and safety factors.

3.1 ConOps

- **Pre-landing Loiter Time** - Missions initially shall be planned with a minimum 3-minute pre-landing loiter from a location within gliding distance of the landing end of the intended runway after return to base completion. After ConOps are sufficiently well developed, the required landing loiter may be derived to meet mission requirements.
- **Primary Fuel Margin** - Air vehicles shall land with a fuel reserve equivalent to 20% of the design maximum fuel load or primary propulsion battery energy residual equivalent to 20% of the takeoff battery capacity.
- **Secondary power margins** - Air vehicles with on-board secondary power storage (batteries) shall land with 20% minimum secondary power reserves for mission critical systems. Air vehicles with on-board secondary power generators shall be sized for 150% of calculated secondary power required.
- **Flight Critical Subsystems Power** - Flight critical avionics and control subsystems shall have a separate fail-safe secondary power backup battery, sized with a 50% capacity margin.
- **Validated Stall Margin** - All in-flight mission stall speed margins (V/V_s) shall be ≥ 1.1 when stall speed for the mission segment is validated by flight test data.
- **Non-validated Stall Margin** - If the stall speed for the flight condition is not validated by flight test data, the stall margin shall be ≥ 1.25 .

3.2 Mass Properties

- **Weight (mass) Growth Margin** - Air vehicle mass properties statements shall include an unallocated internal weight growth margin of 10% empty weight, until actual vehicle weight is demonstrated by test.

3.3 Usable Volume

- **Usable Volume Margin** - Until usable volume available vs. required can be verified by demonstration, all air vehicle designs shall include a minimum unallocated internal usable volume margin of 30% above estimated installed equipment volume required.

3.4 Structural Design

- **Structural Design Safety Factor** - Wing ultimate static strength and deflections shall be predicted to establish a safe operational envelope based on a factor of safety = 1.5.