AERO 401
Spring 2022
Request for Proposal
For the Preliminary Design of a Formula 1 Racer

A. Opportunity Description

Stakeholder requires an aircraft conforming to the Formula 1 ruleset for the STIHL National Championship Air Races (formerly Reno Air Races)

B. Program Objective

The objective of this project is to design an advanced, cost effective, efficient aircraft capable of qualifying for, competing in, and winning Formula 1 class races.

C. Design Requirements and Constraints

Ferry Mission Profile: The nominal mission profile is as follows:

1. Launch (Engine Start, Taxi, Takeoff)
2. Climb
3. Cruise 300 nm (TBR)
4. Descent
5. Landing, Taxi, and Shutdown

Racing Mission Profile: As specified in the Formula 1 or race ruleset, or inferred from the course and race instructions.

Specific Requirements and Constraints

1. Certification base: FAR 21, Experimental
2. Conditions of flight: Day VFR
3. Service ceiling: 10,000 MSL (standard day)
4. Icing protection: N/A
5. Cockpit suitable for crew of 1 pilot, up to 6’1” and 200lb
6. Range: 300 nm plus day VFR reserves (TBR)

D. Deliverables

The technical design proposal must convincingly demonstrate that the proposing team can provide a superior solution to the need identified by this RFP. The final proposal, based upon the previously stated objectives, requirements, and constraints, should include sections and data on the following items listed below. **All design conclusions based upon software code or computer design applications (i.e., AAA, SolidWorks, XFLR5, et. al.) MUST be supported by a "sample analysis" or manual calculation. This material should be presented in the oral report and included as a "back-up" slide for future questions and answers**.

AERO 401:

1. Market analysis of comparable/competitor aircraft, including dimensions, performance and cost, if available.
2. Documentation of CONOPS, Requirements (stakeholder, derived & regulatory) and Subsystems
3. Sizing and supporting trade study results, with matching plots used to optimize the final selected design, and sensitivity studies.
4. Aircraft configuration layout:
    a. Dimensioned 3-view exterior drawing.
    b. Inboard profile showing general internal arrangement, subsystem locations.
5. An illustrated description of the primary load bearing airframe structure with appropriate stress/deflection results and stated rationale for material selection.
6. Material selections for major airframe components (wings, fuselage, landing gear, empennage). For metal alloys, identify only to the series level, e.g, 7XXX Series Aluminum.
7. ~~A complete V-n diagram.~~
8. Relevant Aerodynamic Data:
    a. Drag build-up
    b. Clean configuration drag polars
    c. ~~Takeoff and landing drag polars~~
    d. Maximum lift coefficients and high lift device analyses, as appropriate
    e. L/D analysis
9. A weight breakdown of major components and systems, and appropriate center of gravity excursion envelope diagrams.
10. A propulsion analysis that includes a justification for, or implications of the engine selection and data showing the variation in thrust or HP and SFC with airspeed and altitude.
11. A performance analysis with:
    a. Takeoff field length (sea level, standard day)
    b. Time to climb (to recommended cruise altitude)
    c. Rates of climb (at sea level and 10,000 feet; standard day)
    d. Service ceiling (standard day)
    e. Maximum race speed
    f. Ferry cruise speed
    g. Ferry range
    h. Race and ferry cruise fuel flow rates (gal/hr)
12. Any other performance values pertinent to the RFP
    a. A stability and control analysis for all flight and loading conditions: Longitudinal and lateral stability
    b. ~~Trim analysis, incl. trim "V" diagram~~
    c. ~~Flying Qualities (coefficients)~~
13. Justification of the final design and a detailed description of the technologies and technical approach used to meet the mission requirements