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NASA Clean-Sheet Fans: Design, Build Analyze, Test, and Report

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Abstract

A suggested topic in small fan research is presented. Presentation briefly describes the scope of an effort to design, build and test a ventilation class cooling fan. Comments are included for the following categories: information (available and needed), benefits and values, concerns, variations and alternatives, and interest.

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Project Description:

- NASA would develop a set of fans nominally suited for payload cooling and ventilation applications
- Published results would include complete fan geometry, details of aero and acoustic design methodologies, details of motor and bearing selection, details of aero and acoustic analysis methodologies, description of validation test techniques, and interpretation of data/prediction comparisons.

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Information:

- We need to determine fan requirements that are of interest to NASA and that can be designed, analyzed, and tested with existing capabilities.
- We propose beginning with a study of a 6-8” diameter, 200 cfm, 3” H20 fan suitable for spaceflight cabin ventilation because its characteristics are closest to an aircraft engine fan.
- Two year plan proposed--cost and time estimates are heavily dependent upon the fan requirements we choose

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Information:

Year 1 Plan:

- Aerodynamic design
- Motor integration and fan fabrication
- Preliminary performance tests
  - Isolated fan
  - Fan installed in ventilation system testbed

Year 2 Plan:

- Review test results
- Option 1--Redesign/retest
- Option 2--Pursue test methods suitable for accurately determining aero and acoustic performance, validating aerodynamic performance predicitions

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Benefits and Values:

- Open publication of a thorough fan design, analysis, and test exercise allows industry to independently evaluate their own methods and products.
- NASA can use knowledge gained through the project to be “smarter buyers,” to participate more fully in design reviews of spaceflight fan systems, to identify aero and acoustic problems earlier in design cycle.
- Fans can be used as benchmarks for developing new testing and analysis methods.
- Impact of this effort can grow from narrow to broad over time by adding fans to the study set.

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Concerns:

- Project could have a narrow impact--depending upon the requirements chosen for the fans in the set. Need to weigh industry interest in selection of fan requirements.
- Need to determine “what makes a fan qualified for spaceflight.” We need to have a complete set of requirements if our results and recommendations are to be relevant.
- Funding and staffing.

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Variations and Alternatives:

- NASA could conduct a more extensive study of commercially available fans. This approach may end up being mostly an experimental study. Since geometry and details of design methods could not be publicly reported, this would have less of an impact.

- NASA could use an advanced system ("Atmospheric Revitalization System of the Future") as a testbed for a number of commercially designed fans. Again, limited impact since many geometry/design details would not be publicly reported.

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Interest:

- This approach has been proven to be very useful to NASA and industry in the aircraft engine sector.
- NASA Aeronautics would be interested in this approach since it focuses on fundamental research, making a broader use of Aero expertise.
- NASA Exploration Technology Program would be interested in this approach since it would not be focused on fixing a specific engineering problem.
- Industry would be interested since they could independently evaluate their proprietary tools against a well documented set of fans.