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Recommended Practice

When Flight Modelling Is Used to Reduce Flight Testing Supporting Aircraft Certification

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Recommended Practice: When Flight Modelling Is Used to Reduce Flight Testing Supporting Aircraft Certification

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Abstract

This document outlines a set of recommended practices (six tasks) for an applicant to accomplish when flight modelling is being developed, proposed and used to reduce flight testing relative to established aircraft certification practices. The specific certification requirements considered when these recommendations were developed include aircraft performance and handling qualities, static loads and aeroelastic stability. However, the recommended tasks may also be applicable when showing compliance to other requirements.

The set of tasks provides a framework for organizing information used to determine whether or not a particular analysis method is appropriate for supporting a compliance showing in a particular application. Hypothetical examples of applying these tasks to specific certification applications are provided. However, this document does not endorse specific analysis methods and processes for showing compliance to specific requirements nor prescribe how analysis methods are utilized. It remains the responsibility of the applicant and regulatory authority to determine whether a given analysis method is appropriate for a given compliance showing. The only recommendation of this document is that the six tasks be addressed in a manner appropriate to the particular showing of compliance.

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Foreword

In June 2018, an industry-led aerospace Community of Interest (CoI), hosted by the American Institute of Aeronautics and Astronautics (AIAA), was formed to create this document, containing recommended practices for applicants to consider when using flight modelling to reduce flight testing supporting aircraft certification.

At the time of approval, the members of the AIAA **Certification/Qualification by Analysis (CQbA) Committee on Standards** were:

Robert Gregg, III, Chair	The Boeing Company
Uwe Kerlin	Airbus
Dimitri Mavris	Georgia Institute of Technology
Cord Rossow	German Aerospace Center
Jeffrey Slotnick	The Boeing Company
Richard Wahls	National Aeronautics and Space Administration

The above consensus body approved this document in February 2021.
The AIAA Standards Steering Committee (Michelle Bailey, Chair) accepted the document for publication in March 2021.

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1 Introduction

1.1 Scope

This document outlines a set of recommended practices (six tasks) for an applicant to accomplish when flight modelling is being developed, proposed and used to reduce flight testing relative to established aircraft certification practices. The specific certification requirements considered when these recommendations were developed include aircraft performance and handling qualities, static loads and aeroelastic stability. However, the framework consisting of the recommended tasks may also be applicable when showing compliance to other requirements. For the purposes of this document, flight modelling includes analysis methods of all types, including analyses based on wind tunnel results, numerical methods such as Computational Fluid Dynamics (CFD) and Computational Aeroelasticity (CA), and Flight Dynamics Simulation (FDS), i.e., simulation of aircraft flight dynamics behavior with or without a human pilot. Although many of the concepts and much of the terminology in this document originated in the field of CFD, an attempt has been made to generalize those concepts to be useful for all analysis methods. The recommended tasks, listed below and discussed in detail in Section 3, address subjects pertinent to most flight modelling analyses. The recommended tasks are:

1) configuration and process management
2) verification of the models
3) verification the models were applied correctly
4) validation of the models
5) justification of analysis adequacy in recognition of potential modelling error and/or uncertainty
6) a summary assessment of applicability for showing compliance

This set of tasks provides a framework for organizing information used to determine whether or not a particular analysis method is appropriate for supporting a compliance showing in a particular application. Hypothetical examples of applying these tasks to specific certification applications are provided in Section 4, and information on CFD, CA and FDS pertinent to these tasks is provided in the Annexes. However, this document does not endorse specific analysis methods and processes for showing compliance to specific requirements nor prescribe how analysis methods are utilized. It remains the responsibility of the applicant and regulatory authority to determine whether a given analysis method is appropriate for a given compliance showing. The only recommendation of this document is that the six tasks listed above, and detailed in Section 3, be addressed in a manner appropriate to the particular showing of compliance.

Analysis has long been a part of aircraft certification, and the recommendations in this document are not intended to supersede the many established certification analysis processes. The recommended practices within this document were specifically developed to address future potential applications of flight modelling that may, in some cases, enable the role of certification analysis to increase, with a corresponding reduction in flight testing.

The term “qualification” is often used to indicate that an object has the required qualities to be suitable for certain functions; for example, a Flight Simulation Training Device (FSTD) is “qualified” to a certain level for training purposes. For simplicity, the word “certification” is used throughout this document, but the recommended practices described for “certification” may also be appropriate for applications where the term “qualification” is used.

1.2 Purpose

One purpose of this document is to help applicants efficiently evaluate whether flight modelling analysis processes are sufficiently mature, for a given application, to support reduced flight testing relative to established aircraft certification practices. Another purpose of this document is to help regulatory agencies efficiently evaluate proposed means of compliance based on these methods. Both of these purposes are accomplished by providing recommended tasks that create a common framework for the evaluation of flight modelling processes. Use of this common framework will enhance communication across the industry, allowing more rapid identification of aspects of flight modelling that are sufficiently