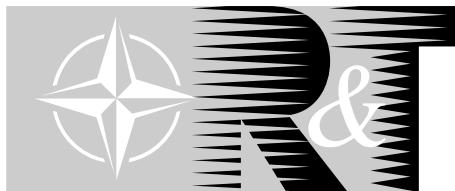


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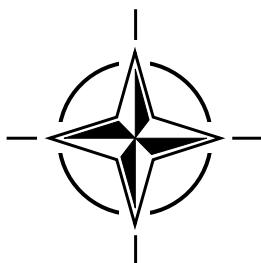
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Flight Test Techniques Series – Volume 18

Flight Testing of Radio Navigation Systems
(les Essais en vol des systèmes de radionavigation)

This AGARDograph has been sponsored by the SCI-055 Task Group, the Flight Test Technology Team of the Systems Concepts and Integration Panel (SCI) of RTO.



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Edited by

H. Bothe

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Flight Testing of Radio Navigation Systems

(RTO AG-300 Vol. 18)

Executive Summary

This AGARDograph describes the basic principles and the flight test procedures that are currently in use for testing conventional and advanced radio navigation systems and ground stations. Along with the well known conventional enroute navigation systems, like VOR, DME and TACAN, the more recent GPS navigation techniques and the test methods are discussed. Also, terminal area navigation systems like ILS, and MLS are covered.

Testing of these systems is presented including the description of test methods and procedures which flight test engineers would benefit from when writing the appropriate flight test programs and which also could be briefed to on-board test crews when assigned to fly their test missions for newly developed and installed ground systems. The flight test methods section is also dealing with the flight inspection techniques for radio navigation sites that are in operational use today. Special attention is drawn to the more general radio frequency problems like multipath and on-board antennas of the navigation systems. The inspection techniques periodically check if the current data are within the requirements, i.e. if accuracy, reliability, coverage, availability and quality of the signals correspond to the standards applicable for operational sites and ground stations. Some of these standards are summarised and presented in tables of the report and reference is given to documents containing more detailed information on that subject matter.

The requirements for the equipment and instrumentation systems of inspection aircraft are also discussed including recommendations for the user. Various flight inspection techniques are described using semi- and fully automatic methods developed in the U.S. and in Europe where the Netherlands, France, U.K. and Germany operate their own national flight inspection aircraft and facilities.

A large list of useful reference documents is added to the report. These can be helpful to the reader looking for appropriate details if the full background should be needed for the information contained in this AGARDograph.

les Essais en vol des systèmes de radionavigation

(RTO AG-300 Vol. 18)

Synthèse

Cette AGARDographie présente les principes et les procédures d'essais en vol actuellement utilisés pour les essais de stations au sol et de systèmes de radionavigation classiques et avancés. Les techniques récentes de navigation GPS et les méthodes d'essais sont examinées, ainsi que les systèmes classiques de navigation en route, tels que le VOR, le DME ou le TACAN. Les systèmes de navigation en zone terminale, tels que ILS et MLS sont également couverts.

Les essais de ces systèmes sont présentés avec la description des méthodes et procédures dont les ingénieurs d'essais en vol pourraient s'inspirer lors de l'établissement de leurs programmes et qui pourraient également être communiquées sous forme de briefings aux équipages d'essais devant réaliser des missions comportant des essais de systèmes au sol récemment développés et installés. Les chapitres sur les méthodes d'essais en vol traitent également des techniques d'inspection en vol pour des sites de radionavigation qui sont opérationnels aujourd'hui. Il est aussi demandé d'accorder une attention particulière aux problèmes plus courants des radiofréquences tels que la propagation par trajets multiples et les antennes embarquées des systèmes de navigation. Les techniques d'inspection prévoient la vérification périodique de la conformité des données aux spécifications, c'est à dire la conformité de la précision, la fiabilité, la couverture et la qualité des signaux aux normes applicables aux sites opérationnels et aux stations au sol. Certaines de ces normes sont résumées et présentées dans les tableaux joints au rapport avec renvoi à des documents présentant des informations plus détaillées.

Les cahiers des charges des équipements et des systèmes d'instrumentation des aéronefs à contrôler sont également examinés, avec des recommandations à l'intention des utilisateurs. Différentes techniques d'inspection en vol sont décrites, y compris les méthodes automatiques et semi-automatiques développées aux Etats-Unis et en Europe, où les Pays-Bas, la France, et l'Allemagne exploitent leurs propres installations nationales d'inspection en vol.

Une liste détaillée de documents de référence est jointe au rapport. Ces documents intéresseront le lecteur souhaitant s'informer sur le contexte global des informations contenues dans cette AGARDographie.

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**ANNEX — AGARD FLIGHT TEST INSTRUMENTATION AND FLIGHT TEST
TECHNIQUES SERIES**

A

Preface

During the last 40 years a number of different radio navigation systems have been introduced to civil as well as to military aviation. The progress in space and microwave technologies recently has allowed new systems with higher accuracy and reliability. These systems are developed as navigational aids for enroute and terminal navigation as well as for guidance and control during final approach and landing of an aircraft. The complexity of the systems requires extensive flight testing during the system development. Moreover, the approval of the ground facilities for use by civil and military aircraft is dependent on flight tests of every new installation. Once a radio navigation station is cleared for service, the accuracy is supervised by additional flight tests at well-defined time intervals. The considerable amount of flight test hours spent every year for the flight testing of all radio navigation stations in service and the complexity of the task requires planning of the flight test program by the flight test engineer in the most efficient manner.

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14. Abstract	<p>Civil as well as military aviation relies on a number of radio navigation systems including satellite systems in space. As new systems are developed extensive flight testing is needed to ensure that the design parameters are met. The approval of every new installation is dependent on flight tests. Moreover all installations require flight inspection in well-defined time periods. The development and application of cost effective flight test techniques and instrumentation systems including the test aircraft are presented. Room is given also to the adverse effects of radio wave propagation like multipath.</p>		

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