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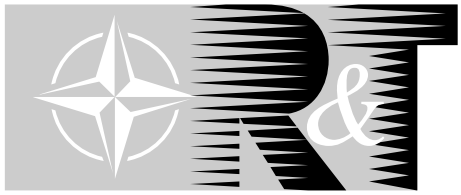

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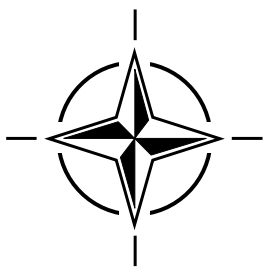
Aging Aircraft Fleets: Structural and Other Subsystem Aspects

(le Vieillissement des flottes d'avions militaires : aspects structures et autres sous-systèmes)

The material in this publication was assembled to support a Lecture Series under the sponsorship of the Applied Vehicle Technology Panel (AVT) and the Consultant and Exchange Programme of RTO presented 13-16 November 2000 in Sofia, Bulgaria.



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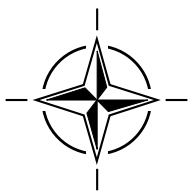

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RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote cooperative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective coordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also coordinates RTO's cooperation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of initial cooperation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS Studies, Analysis and Simulation Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier cooperation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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Aging Aircraft Fleets: Structural and Other Subsystem Aspects

(RTO EN-015 / AVT-053)

Executive Summary

Aging aircraft concerns have dramatically escalated in the military community during the past decade. The percentage of aircraft, operated beyond their original design life both in terms of flight hours and/or calendar years is steadily increasing. Some models, which have already been in service for more than 30 years, will need to be retained for another two decades or longer, often serving in roles and in theaters very different from what was envisioned when they were originally designed.

Aging Aircraft has several connotations. Among them: (a) technological obsolescence, (b) the need for system upgrading, (c) changing mission requirements, (d) the specter of runaway maintenance costs, (e) concern about safety, (f) impairment of fleet readiness and (g) possible unavailability of home depot facilities. However, if there is one thread that runs through the above list, it is the adverse impact on sustainment of the fleet.

There are other considerations when dealing with the Aging Aircraft issue; for example, availability of spare parts, processes and tooling may no longer be available, logistic procedures may have changed and suppliers may be out of the business. Budgetary limitations and higher fleet utilization will increase the demand to cope with aging aspects for the structure and major subsystems like engines and avionics. Awareness in the user community about typical challenges and technical solutions can ameliorate some of the concerns. New technologies are now available for dealing with many of the aging aircraft concerns. They relate to inspection, repair and corrosion-resistant materials, structural modeling and more sophisticated maintenance scheduling. Thus a Lecture Series (LS) under the auspices of the NATO Partnership for Peace (PfP), is proposed, the main emphasis of which will be an in-depth discussion of these new technologies and methods. The LS will cover aspects of systems upgrades and structural airworthiness linked to fixed wing and helicopter fleets with emphasis on life enhancement strategies used by NATO nations.

The material in this publication was assembled to support Lecture Series 218 bis under the sponsorship of the Applied Vehicle Technology Panel (AVT) and the Consultant and Exchange Programme of RTO presented 13-16 November 2000 in Sofia, Bulgaria.

le Vieillissement des flottes d'avions militaires : aspects structures et autres sous-systèmes

(RTO EN-015 / AVT-053)

Synthèse

Le problème du vieillissement des aéronefs militaires s'est considérablement amplifié au cours de la dernière décennie. Le pourcentage d'aéronefs en exploitation au-delà de leur durée de vie théorique, tant du point de vue d'heures de vol que d'années de service, augmente régulièrement. Certains modèles, déjà en service depuis plus de 30 ans, devront être maintenus pendant encore deux décennies au moins, souvent pour des missions et des théâtres très différents de ceux qui étaient envisagés à l'origine.

Le terme "aéronefs vieillissants" a plusieurs connotations différentes, parmi lesquelles l'on peut distinguer : (a) l'obsolescence technologique, (b) la nécessité de procéder à la mise à niveau d'un système, (c) l'évolution de la mission, (d) le spectre des coûts de maintenance incontrôlés, (e) des considérations de sécurité, (f) l'atténuation de l'état de préparation de la flotte et (g) la non-disponibilité des dépôts de base. Mais tous ces aspects ont un facteur commun : l'impact négatif sur le maintien de la flotte.

Il y a aussi d'autres considérations à prendre en compte; par exemple la disponibilité de pièces de rechange, de processus et d'outillage, les procédures logistiques qui peuvent avoir changé et les fournisseurs qui peuvent avoir fait faillite. Les limitations budgétaires et l'utilisation accrue des flottes aériennes nécessiteront de porter plus d'attention aux aspects de vieillissement de la structure et des sous-systèmes principaux des aéronefs, tels que les moteurs et l'avionique. Une meilleure sensibilisation des utilisateurs aux défis et aux solutions techniques typiques pourrait pallier certains de ces problèmes. De nouvelles technologies, qui permettront de résoudre bon nombre de ces questions, sont désormais disponibles. Elles concernent l'inspection, la réparation, les matériaux résistants à la corrosion, la modélisation structurale et l'amélioration de la programmation de la maintenance.

Par conséquent, il est proposé d'organiser un Cycle de Conférences (LS) sous l'égide du programme OTAN de Partenariat pour la paix (PfP), dont l'objectif principal sera de permettre une discussion approfondie de ces nouvelles technologies et méthodes. Le Cycle de Conférences couvrira tous les aspects de la modernisation des systèmes et de l'aptitude au vol du point de vue structural des flottes d'avions à voilure fixe et d'hélicoptères, l'accent étant mis sur les stratégies d'extension de la durée de vie adoptées par les pays membres de l'OTAN.

Cette publication a été rédigée pour servir de support de cours pour le Cycle de conférences 218 bis, organisé par la Commission de AVT dans le cadre du programme des consultants et des échanges de la RTO du 13-16 novembre 2000 à Sofia, Bulgarie.

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Loads (forces)	Aircraft maintenance	Inspection	Aging aircraft
Aging (metallurgy)	Service life	Reliability	Transitions
Airframes	Equipment health monitoring	Airworthiness	Process technology

14. Abstract

Aging Aircraft concerns have dramatically escalated in the military community and commercial aviation during the past decade. Some models, which have already been in service for more than 40 years, will need to be retained for another two decades or longer, often serving in roles and in theatres very different from what was envisioned when they were originally designed. Aging Aircraft has several connotations. To name a few: technological obsolescence, the spectre of runaway maintenance costs, and safety. Moreover, spare parts, processes and tooling may no longer be available, logistic procedures may have changed and suppliers may be out of the business. Budgetary limitations and higher fleet utilisation will increase the demand to cope with aging structures and major subsystems like engines and avionics.

Specific topics covered by this Lecture Series are:

- Aircraft Loads
- Aging Systems and Sustainment Technology
- SNECMA ATAR Engines 1960-2020. Smarter Ideas and Less Money
- Repair Options for Airframes
- Risk Assessments of Aging Aircraft
- Occurrence of Corrosion in Airframes
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