



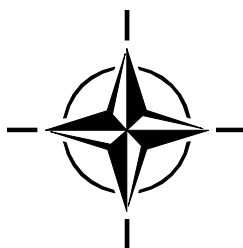
RTO EDUCATIONAL NOTES

EN-HFM-113

Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation

(Les aspects pathologiques et la biodynamique
associée dans les enquêtes sur les
accidents d'aéronefs)

The material in this publication was assembled to support a Lecture Series
under the sponsorship of the Human Factors and Medicine Panel (HFM)
presented on 28-29 October 2004 in Madrid, Spain.



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RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative 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 co-ordination 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 co-ordinates RTO's co-operation 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 co-operation.

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 co-operation 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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Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation (RTO-EN-HFM-113)

Executive Summary

The Human Factors and Medicine Panel of the RTO organized the LS-113 on “Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation”, to review the status and future directions related to effective crashworthiness design and design criteria of aircraft and how such new design interfaces with some critical aspects of the aircraft accident investigation preferably those related to forensic pathology, biodynamics of injury, injury mechanism, injury mitigation and their implications for flight safety in relation to any type air based platform.

These Lecture Series (LS) will be focused on determining what injury and injury mechanism data are required from accident investigations and will make recommendations on effective techniques and methodologies to use in the conduct of an accident investigation.

The purpose of this LS is to address the above mentioned critical aspects of the investigation and discuss specific issues such:

- 1) Determine service and country aircraft accident and ejection data requirements (injuries, equipment failure, etc...). Focus on determining what injury and injury mechanism data are required by service and by country and determine what data are not universally acquired, or not acquired at all, but deemed essential.
- 2) Acquire crash and survivability data on non aircraft accidents. Focus on general data, automobile crash data and correlation of measurements in anthropometric dummies to injury risk (predictive modelling of human tolerance levels), crashworthiness of vehicles and equipment and survivability of accidents, that may be useful in determination of injury mechanisms, survivability and development of crashworthiness design criteria.
- 3) Determine what appropriate injury criteria are available and how those criteria can be measured and analysed during testing of aircraft personnel.
- 4) Provide recommendations on effective accident investigation techniques and methodologies for obtaining accurate and sufficient injury data from aircraft crashes and ejection. Recommendations should enhance ability to determine injury mechanism from aircraft accidents and to prevent injuries.

This LS, sponsored by the Human Factor and Medicine Panel has been implemented by the Consultant and Exchange Programme. Thanks for the collaboration and magnificent support given for the Spanish authorities in providing the necessary facilities in Madrid to conduct this Lecture Series, and LS speakers for providing the related academic technical and scientific information.

Les aspects pathologiques et la biodynamique associée dans les enquêtes sur les accidents d'aéronefs (RTO-EN-HFM-113)

Synthèse

La Commission RTO sur les facteurs humains et la médecine a organisé le LS-113 sur « Les aspects pathologiques et la biodynamique associée dans les enquêtes sur les accidents d'aéronefs » pour faire le point sur l'état actuel des connaissances dans ce domaine, ainsi que pour trouver de futures voies de développement pour la conception d'aéronefs résistant à l'écrasement et pour l'élaboration de critères efficaces de conception. Il s'agissait de définir les interfaces entre ce nouveau type de conception et certains aspects décisifs des enquêtes sur les accidents d'aéronefs, en particulier en ce qui concerne la médecine légale, la biodynamique des lésions, les mécanismes et l'atténuation des lésions et les implications pour la sécurité en vol de n'importe quel type de plate-forme aérienne.

Ces cycles de conférences seront axés sur la détermination des données relatives aux blessures et aux mécanismes de blessure qui seraient à rechercher au cours des enquêtes sur les accidents d'aéronefs. Des recommandations seront faites sur les techniques et méthodologies efficaces à mettre en œuvre lors de ces enquêtes.

La conférence avait pour objectif d'examiner les aspects critiques exposés plus haut, afin de :

- 1) Déterminer les besoins en matière de données nationales et militaires sur les accidents et les éjections (blessures, défaillances de matériel, etc...). Déterminer quelles sont les données sur les blessures et sur les mécanismes de blessure demandées par chacune des forces armées et par chacun des pays membres. Définir quelles sont les données qui ne sont pas demandées unilatéralement. Identifier les données qui ne sont pas collectées du tout, mais qui sont considérées comme étant essentielles.
- 2) Acquérir des données sur les collisions et la capacité de survie dans le cas d'accidents autres que des accidents d'aéronefs. Mettre l'accent sur les données à caractère général, les données des accidents d'automobiles, la corrélation entre les résultats fournis par des mannequins anthropomorphiques et les risques de blessures (la modélisation prédictive des risques par rapport aux niveaux de tolérance humaine), la résistance à l'impact des véhicules et des équipements et la capacité de survie des personnes, puisque ces éléments pourraient permettre de déterminer les mécanismes de blessure et la capacité de survie, ainsi que de développer des critères de conception résistant à l'écrasement.
- 3) Vérifier l'existence de critères de blessure appropriés et proposer des méthodes pour le contrôle et l'analyse de ces critères dans le cadre d'essais effectués sur le personnel navigant.
- 4) Fournir des recommandations sur des techniques et des méthodologies efficaces pour les enquêtes sur les accidents d'aéronefs, permettant d'obtenir des données précises et en quantité suffisante sur les blessures subies en cas d'écrasement et d'évacuation d'un aéronef. Les recommandations devraient améliorer la capacité de déterminer les mécanismes de blessure en jeu lors d'accidents d'aéronefs et empêcher de telles blessures.

Ce cycle de conférences a été présenté dans le cadre du programme des consultants et des échanges, sous l'égide de la Commission sur les facteurs humains et la médecine. Nous tenons à remercier les autorités espagnoles pour leur collaboration, ainsi que pour la qualité des installations mises à notre disposition à Madrid. Nous remercions également les conférenciers pour les informations techniques et scientifiques de haut niveau qu'ils ont fournies.

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<p>The development of effective crashworthiness design and design criteria, personal protective equipment and in-flight escape systems depends on obtaining accurate injury data from aircraft crashes and ejection. The depth and quality of injury data collected by member nations is sporadic and usually lacking in the determination of the injury mechanism.</p> <p>In this LS, we have reviewed several aspects of the Aircraft Accident Investigation we think are key for the investigator. We have put especial attention to aspects related to the role of the FS and Investigator, how to behaviour in the crash site, what data should be collected and how to proceed in relation to the analysis of the injuries.</p> <p>In this perspective we put together the methodology that it should be apply and the structured procedures to identify and to evaluate the underlying causes in order to prevent new similar events.</p> <p>Also it has been presented a deep review of mechanism of injuries, how we analyse them and how they might be scored and be able to identify patterns of injury as a viable tool for accident reconstruction.</p> <p>In addition to that incapacitation events were presented and detailed information provided.</p> <p>Also toxicological and pathological findings related to the material to be investigated and the post-mortem diagnosis were explained and the appropriate interpretation used as a particularly remarkable evidence for further clarification of the correct sequence of events.</p> <p>Finally human tolerance and crash survivability has been explained and basic principles of crashworthiness and crashworthy design by using the CREEP model extensively discussed.</p>																								





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